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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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P.O. Box 1450
Alexandria, Virginia 22313-1450
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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/597,014	12/28/2021	11208878	047158.100048	4687

132858 7590 12/08/2021

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.

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

Jared Oehring, Houston, TX;
Brandon N. Hinderliter, Houston, TX;
Lon Robinson, Houston, TX;

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

U.S. Well Services, LLC, Houston, TX;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	16597014
Filing Date	2019-10-09
First Named Inventor	Jared Oehring
Art Unit	3746
Examiner Name	Christopher S. Bobish
Attorney Docket Number	047158.100048

	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	
Change(s) applied to document, /M.H.E./ 8/25/2021	24	20180363437		~~2019-12-28~~ 12/2018	Coli	
	25	20170030177		2017-02-02	Oehring	
	26	20080017369		2008-01-24	Sarada	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.S.B/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	16597014
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Art Unit	3746
Examiner Name	Christopher S. Bobish
Attorney Docket Number	047158.100048

Change(s) applied to document, /M.H.E./ 8/25/2021	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. /C.S.B/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16597014
	Filing Date	2019-10-09
	First Named Inventor	Jared Oehring
	Art Unit	3746
	Examiner Name	Christopher S. Bobish
	Attorney Docket Number	047158.100048

	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	
Change(s) applied to document, /M.H.E./ 8/25/2021	141	20170051732		2017-02-23	~~Baker Hughes Incorporated~~	Hemandez et al.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.S.B/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	16597014
Filing Date	2019-10-09
First Named Inventor	Jared Oehring
Art Unit	3746
Examiner Name	Christopher S. Bobish
Attorney Docket Number	047158.100048

	42	8899940		2014-12-02	Laugemors	
Change(s) applied to document, /M.H.E./ 8/25/2021	43	8905056		~~2004-12-09~~ 12/2014	Kendrick	
	44	4151575		1979-04-24	Hogue	
	45	5130628		1992-07-14	Owen	
	46	6315523		2001-11-13	Mills	
	47	7336514		2008-02-26	Amarillas	
	48	7525264		~~1999-04-28~~ 04/2009	Dodge	
	49	8096891		2012-01-17	Lochtefeld	
	50	9160168		2015-10-13	Chapel	
	51	8146665		2012-04-03	Neal	
	52	8474521		2013-07-02	Kajaria	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.S.B/

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United States Patent and Trademark Office
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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/597,014	10/09/2019	Jared Oehring	047158.100048

CONFIRMATION NO. 4687

132858
Hogan Lovells US LLP
609 Main Street
Suite 4200
Houston, TX 77002

POA ACCEPTANCE LETTER

OC00000129985717

Date Mailed: 11/24/2021

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 11/19/2021.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/zabraha/

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82A (07-13)
Approved for use through 03/31/2021. OMB 0651-0035
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 displays a valid OMB control number.

TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	16/597,014
Filing Date	2019-10-09
First Named Inventor	Jared Oehring
Title	MODULAR SWITCHGEAR SYSTEM AND POWER DISTRIBUTION FOR ELECTRIC OILFIELD EQUIPMENT
Art Unit	3746
Examiner Name	Bobish, Christopher S.
Attorney Docket Number	047158.100048

SIGNATURE of Applicant or Patent Practitioner

Signature	/Taylor P. Evans/	Date (Optional)	2021-11-19
Name	Taylor P. Evans	Registration Number	60506
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)	U.S. Well Services, LLC		

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ *Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. 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 3 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.

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82B (07-13)
Approved for use through 03/31/2021. OMB 0651-0035
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 displays a valid OMB control number

POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☑ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 132858

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

☑ The address associated with the above-mentioned Customer Number

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

U.S. Well Services, LLC

☐ Inventor or Joint Inventor (title not required below)

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

☑ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature	Lon Robinson	Date (Optional)	18 - Nov - 2020
Name	Lon Robinson		
Title	Chief Technology Officer		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. 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 3 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 Patent Application Fee Transmittal

Application Number:	16597014
Filing Date:	09-Oct-2019
Title of Invention:	MODULAR SWITCHGEAR SYSTEM AND POWER DISTRIBUTION FOR ELECTRIC OILFIELD EQUIPMENT
First Named Inventor/Applicant Name:	Jared Oehring
Filer:	Taylor P. Evans/Stephanie McDonough
Attorney Docket Number:	047158.100048

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:	44324136
Application Number:	16597014
International Application Number:	
Confirmation Number:	4687
Title of Invention:	MODULAR SWITCHGEAR SYSTEM AND POWER DISTRIBUTION FOR ELECTRIC OILFIELD EQUIPMENT
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:	047158.100048
Receipt Date:	19-NOV-2021
Filing Date:	09-OCT-2019
Time Stamp:	09:56:01
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	E2021AI056223700
Deposit Account	501349
Authorized User	Stephanie McDonough

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)	047158-100048_Issue_Fee.pdf	1232581 feaba3baf54ca7e567b944e94754a713ae745f82	no	1
Warnings:					
Information:					
2	Power of Attorney	047158-100048_POA-as-filed.pdf	629308 fb1cf7e550094a2b7e3d629a94d2d3db5681bedb	no	2
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	38236 7f8996bd42acfa366cd04e61f07e26477684490b	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	1900125		

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.

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 08/20/2021

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.
16/597,014	10/09/2019	Jared Oehring	047158.100048	4687

TITLE OF INVENTION: MODULAR SWITCHGEAR SYSTEM AND POWER DISTRIBUTION FOR ELECTRIC OILFIELD EQUIPMENT

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	11/22/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS
BOBISH, CHRISTOPHER S	3746	417-271000

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: U.S. Well Services, LLC

(B) RESIDENCE: (CITY and STATE OR COUNTRY): 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. 50-1349

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 /Taylor P. Evans/ Date 2021-11-19

Typed or printed name Taylor P. Evans Registration No. 60506

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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(Not for submission under 37 CFR 1.99)

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Filing Date	2019-10-09
First Named Inventor	Jared OEHRING
Art Unit	3746
Examiner Name	Christopher S. BOBISH
Attorney Docket Number	047158.100048

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	10648311	B2	2020-05-12	Oehring et al.	
	2	10415332	B2	2019-09-17	Morris et al.	
	3	10794165	B2	2020-10-06	Fischer et al.	
	4	7795830	B2	2010-09-14	Johnson	
	5	6788022	B2	2004-09-19	Sopko	
	6	6121705	A	2000-09-19	Hoong	
	7	6035265	A	2000-03-07	Dister et al.	
	8	5798596	A	1998-08-25	Lordo	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.S.B/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16597014
	Filing Date	2019-10-09
	First Named Inventor	Jared OEHRING
	Art Unit	3746
	Examiner Name	Christopher S. BOBISH
	Attorney Docket Number	047158.100048

	9	5334899	A	1994-08-02	Skybyk	

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	20180363640	A1	2018-12-20	Kajita et al.	
	2	20160006311	A1	2016-01-07	Li	
	3	20090072645	A1	2009-03-19	Quere	

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							

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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 Action issued in US Application No. 16/871,928 mailed August 25, 2021	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.S.B/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Art Unit	3746
	Examiner Name	Christopher S. BOBISH
	Attorney Docket Number	047158.100048

	2	Non-Final Office Action issued in US Application No. 16/943,727 mailed August 3, 2021	
	3	Non-Final Office Action issued in US Application No. 14/881,525 mailed July 21, 2021	
	4	Non-Final Office Action issued in US Application No. 16/404,283 mailed July 21 2021	
	5	Notice of Allowance and Notice of Allowability issued in US Application No. 15/829,419 mailed July 26, 2021	
	6	WOODBURY et al., "Electrical Design Considerations for Drilling Rigs," IEEE Transactions on Industry Applications, Vol. 1A-12, No. 4, July/August 1976, pp 421-431	

If you wish to add additional non-patent literature document citation information please click the Add button Add

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Examiner Signature	/CHRISTOPHER S BOBISH/	Date Considered	10/04/2021

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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.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.S.B/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16597014
Filing Date	2019-10-09
First Named Inventor	Jared OEHRING
Art Unit	3746
Examiner Name	Christopher S. BOBISH
Attorney Docket Number	047158.100048

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).

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)	2021-09-23
Name/Print	Taylor P. Evans	Registration Number	60506

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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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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	MODULAR SWITCHGEAR SYSTEM AND POWER DISTRIBUTION FOR ELECTRIC OILFIELD EQUIPMENT

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 16/597,014 filed on October 9, 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:

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LEGAL NAME OF INVENTOR

Inventor: Brandon N. Hinderliter Date (Optional): 9/27/21

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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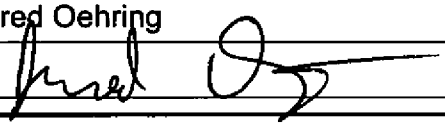
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LEGAL NAME OF INVENTOR

Inventor: Jared Oehring Date (Optional): 9/27/2021

Signature: 

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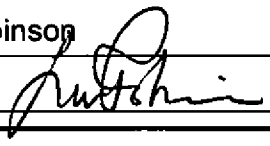
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LEGAL NAME OF INVENTOR

Inventor: Lon Robinson Date (Optional): 27-Sep-2021

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:	43896535
Application Number:	16597014
International Application Number:	
Confirmation Number:	4687
Title of Invention:	MODULAR SWITCHGEAR SYSTEM AND POWER DISTRIBUTION FOR ELECTRIC OILFIELD EQUIPMENT
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:	047158.100048
Receipt Date:	29-SEP-2021
Filing Date:	09-OCT-2019
Time Stamp:	10:46:26
Application Type:	Utility under 35 USC 111(a)

Payment information:

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Oath or Declaration filed	Modular-Switchgear-System-Declaration_BNH-as-filed.pdf	132271 3cd9dc968e7afefdfeb9e411f0da7fd7fcb7e788	no	1

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2	Oath or Declaration filed	Modular-Switchgear-System-Declaration_JO-as-filed.pdf	111716 428c81ae39ad43004ede6b66880a1145e7477e2b	no	1
Warnings:					
Information:					
3	Oath or Declaration filed	Modular-Switchgear-System-Declaration_LR-as-filed.pdf	111401 20092ed9fe6a857a9ffd9db317863332f951bbfd	no	1
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
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Application Number	16597014
Filing Date	2019-10-09
First Named Inventor	Jared OEHRING
Art Unit	3746
Examiner Name	Christopher S. BOBISH
Attorney Docket Number	047158.100048

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	10648311	B2	2020-05-12	Oehring et al.	
	2	10415332	B2	2019-09-17	Morris et al.	
	3	10794165	B2	2020-10-06	Fischer et al.	
	4	7795830	B2	2010-09-14	Johnson	
	5	6788022	B2	2004-09-19	Sopko	
	6	6121705	A	2000-09-19	Hoong	
	7	6035265	A	2000-03-07	Dister et al.	
	8	5798596	A	1998-08-25	Lordo	

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	9	5334899	A	1994-08-02	Skybyk	

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	1	20180363640	A1	2018-12-20	Kajita et al.	
	2	20160006311	A1	2016-01-07	Li	
	3	20090072645	A1	2009-03-19	Quere	

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	1	Non-Final Office Action issued in US Application No. 16/871,928 mailed August 25, 2021	

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	First Named Inventor	Jared OEHRING
	Art Unit	3746
	Examiner Name	Christopher S. BOBISH
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	2	Non-Final Office Action issued in US Application No. 16/943,727 mailed August 3, 2021
	3	Non-Final Office Action issued in US Application No. 14/881,525 mailed July 21, 2021
	4	Non-Final Office Action issued in US Application No. 16/404,283 mailed July 21 2021
	5	Notice of Allowance and Notice of Allowability issued in US Application No. 15/829,419 mailed July 26, 2021
	6	WOODBURY et al., "Electrical Design Considerations for Drilling Rigs," IEEE Transactions on Industry Applications, Vol. 1A-12, No. 4, July/August 1976, pp 421-431

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Examiner Signature		Date Considered	

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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.

Electronic Patent Application Fee Transmittal

Application Number:	16597014
Filing Date:	09-Oct-2019
Title of Invention:	MODULAR SWITCHGEAR SYSTEM AND POWER DISTRIBUTION FOR ELECTRIC OILFIELD EQUIPMENT
First Named Inventor/Applicant Name:	Jared Oehring
Filer:	Taylor P. Evans/Tina Fluharty
Attorney Docket Number:	047158.100048

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:	43849678
Application Number:	16597014
International Application Number:	
Confirmation Number:	4687
Title of Invention:	MODULAR SWITCHGEAR SYSTEM AND POWER DISTRIBUTION FOR ELECTRIC OILFIELD EQUIPMENT
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:	047158.100048
Receipt Date:	23-SEP-2021
Filing Date:	09-OCT-2019
Time Stamp:	16:37:20
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	E20219MG37444149
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 1.21 (Miscellaneous fees and charges)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.19 (Document supply fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

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

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)	047158-100048-IDS.pdf	1035187 1d9bd90971f1ed15ec49efb662ba81b4b60745ce	no	5
Warnings:					
Information:					
2	Non Patent Literature	047158-NOAllow.pdf	8603965 ce67b960432101d4f6ccd7521c7250aacafe6284	no	10
Warnings:					
Information:					
3	Non Patent Literature	047158-OA1.pdf	3773826 c7bd7bc4edf316fcb304b6049510ec7d0b963df9	no	6
Warnings:					
Information:					
4	Non Patent Literature	047158-OA2.pdf	5581085 31ef72a73318b75089d210480a144136b670fb6b	no	9
Warnings:					
Information:					
5	Non Patent Literature	047158-OA3.pdf	9262178 5729c835226e4108cf5dcae571878c3538589623	no	13
Warnings:					
Information:					
6	Non Patent Literature	047158-OA4.pdf	4845122 07ac294e7b973e6244cac95950537b5c994a8665	no	8
Warnings:					
Information:					

7	Non Patent Literature	Woodbury.pdf	1514903 5d7d029bdc016d8f60d0c5bd6b9911df3fe7c0c7	no	11
Warnings:					
Information:					
8	Fee Worksheet (SB06)	fee-info.pdf	38244 053ef9152f52802e7d03248d1c4f240795255659	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	34654510	

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.

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 08/20/2021

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

EXAMINER
BOBISH, CHRISTOPHER S

ART UNIT	PAPER NUMBER
3746	

DATE MAILED: 08/20/2021

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/597,014	10/09/2019	Jared Oehring	047158.100048	4687

TITLE OF INVENTION: MODULAR SWITCHGEAR SYSTEM AND POWER DISTRIBUTION FOR ELECTRIC OILFIELD EQUIPMENT

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	11/22/2021

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.

LIBERTY EXHIBIT 1002, Page 34

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 08/20/2021

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.
16/597,014	10/09/2019	Jared Oehring	047158.100048	4687

TITLE OF INVENTION: MODULAR SWITCHGEAR SYSTEM AND POWER DISTRIBUTION FOR ELECTRIC OILFIELD EQUIPMENT

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	11/22/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS
BOBISH, CHRISTOPHER S	3746	417-271000

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.
16/597,014	10/09/2019	Jared Oehring	047158.100048	4687

132858 7590 08/20/2021

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

EXAMINER	
BOBISH, CHRISTOPHER S	
ART UNIT	**PAPER NUMBER**
3746	

DATE MAILED: 08/20/2021

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 1002, Page 36

Notice Requiring Inventor's Oath or Declaration	Application No. 16/597,014	Applicant(s) Jared Oehring	
	Examiner BOBISH, CHRISTOPHER S	Art Unit 3746	

This notice is an attachment to the Notice of Allowability (PTOL-37), or the Notice of Allowability For A Design Application (PTOL-37D).

An inventor's oath or declaration in compliance with 37 CFR 1.63 or 1.64 executed by or with respect to each inventor has not yet been submitted.

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 (for any inventor for which a compliant oath, declaration, or substitute statement has not yet been submitted) 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.

A properly executed inventor's oath to declaration has not been received for the following inventor(s):

If applicant previously filed one or more oaths, declarations, or substitute statements, applicant may have received an informational notice regarding deficiencies therein.

The following deficiencies are noted:

INFORMAL ACTION PROBLEMS

- A properly executed inventor's oath or declaration has not been received for the following inventor(s): **Jared Oehring**, **Brandon N. Hinderliter**, and **Lon Robinson**.
  Applicant may submit the inventor's oath or declaration at any time before the Notice of Allowance and Fee(s) Due, PTOL-85, is mailed.

Questions relating to this Notice should be directed to the Application Assistance Unit at 571-272-4200.

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. 16/597,014	Applicant(s) Oehring et al.	
	Examiner CHRISTOPHER S BOBISH	Art Unit 3746	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 response filed 08/03/2021.
   ☐ 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 17-20 and 22-27 . 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 _____.

/CHRISTOPHER S BOBISH/
Examiner, Art Unit 3746

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/597,014	Oehring et al.
	Examiner	**Art Unit**
	CHRISTOPHER S BOBISH	3746

CPC						
Symbol					**Type**	**Version**
E21B	/	43	/	26	F	2013-01-01
F04B	/	1	/	00	I	2013-01-01
F04B	/	15	/	02	I	2013-01-01
F04B	/	17	/	03	I	2013-01-01
H02B	/	13	/	00	I	2013-01-01
H01F	/	27	/	02	I	2013-01-01
H02G	/	3	/	0437	I	2013-01-01
H02B	/	1	/	20	I	2013-01-01
H01F	/	38	/	14	I	2013-01-01
F04B	/	17	/	06	I	2013-01-01
F02B	/	63	/	047	I	2013-01-01
F02B	/	63	/	06	I	2013-01-01

CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	10	
/CHRISTOPHER S BOBISH/ Examiner, Art Unit 3746	14 August 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	4

U.S. Patent and Trademark Office

Part of Paper No.: 20210814

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/597,014	Oehring et al.
	Examiner	**Art Unit**
	CHRISTOPHER S BOBISH	3746

INTERNATIONAL CLASSIFICATION					
CLAIMED					
E21B43/26	/	43	/	26	
F04B17/03	/	17	/	03	
F04B17/06	/	17	/	06	

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	10	
/CHRISTOPHER S BOBISH/ Examiner, Art Unit 3746	14 August 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	4

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	16/597,014	Oehring et al.
	Examiner	**Art Unit**
	CHRISTOPHER S BOBISH	3746

☐ 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		10	3	19										
	2		11	4	20										
	3		12		21										
	4		13	5	22										
	5		14	6	23										
	6		15	7	24										
	7		16	8	25										
	8	1	17	9	26										
	9	2	18	10	27										

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	10	
/CHRISTOPHER S BOBISH/ Examiner, Art Unit 3746	14 August 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	4

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/597,014	Oehring et al.
	Examiner	Art Unit
	CHRISTOPHER S BOBISH	3746

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	12/20/2019	07/19/2020	01/28/2021						
	1	✓	✓	✓						
	2	✓	✓	✓						
	3	✓	✓	✓						
	4	✓	✓	✓						
	5	✓	✓	✓						
	6	✓	✓	✓						
	7	✓	✓	✓						
	8	✓	✓	✓						
	9	✓	✓	✓						
	10	✓	✓	✓						
	11	✓	✓	✓						
	12	✓	✓	✓						
	13	✓	✓	✓						
	14	✓	✓	✓						
	15	✓	✓	-						
	16	✓	✓	✓						
1	17	✓	✓	=						
2	18	✓	✓	=						
3	19	✓	✓	=						
4	20	✓	✓	=						
	21			-						
5	22			=						
6	23			=						
7	24			=						
8	25			=						
9	26			=						
10	27			=						

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/597,014	Oehring et al.
	Examiner	Art Unit
	CHRISTOPHER S BOBISH	3746

CPC - Searched*		
Symbol	**Date**	**Examiner**
F04B17/06, 03	12/10/2019	CSB
F02B63/047, 06	12/10/2019	CSB
E21B43/26	08/14/2021	CSB

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**
Inventor Name Search	12/10/2019	CSB
EAST Search	12/10/2019	CSB
Updated Search	07/08/2020	CSB
Updated Search	01/27/2021	CSB

/CHRISTOPHER S BOBISH/ Examiner, Art Unit 3746	

LIBERTY EXHIBIT 1003, Page 44

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/597,014	Oehring et al.
	Examiner	Art Unit
	CHRISTOPHER S BOBISH	3746

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
ALL	See attached	08/14/2021	CSB

/CHRISTOPHER S BOBISH/ Examiner, Art Unit 3746	

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	0	pump same motor same ((variable adj frequency adj drive) or VFD) same transformer same generator same switchgear same bus same cable.clm.	US-PGPUB; USPAT; USOCR; FPRS	OR	ON	2021/08/14 21:38

8/14/2021 9:38:25 PM
C:\Users\cbobish\Documents\EAST\Workspaces\ReciprocatingCompressor(IntegralValveDamper).wsp

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

PTO/SB/08a (02-18)
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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	16597014
Filing Date	2019-10-09
First Named Inventor	Jared OEHRING
Art Unit	3746
Examiner Name	Christopher S. BOBISH
Attorney Docket Number	047158.100048

U.S.PATENTS

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	5950726	A	1999-09-14	Roberts	
	2	6097310	A	2000-08-01	Harrell et al.	
	3	5114239	A	1992-05-19	Allen	

If you wish to add additional U.S. Patent citation information please click the Add button.

U.S.PATENT APPLICATION PUBLICATIONS

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	20190040727	A1	2019-02-07	Oehring et al.	
	2	20110110793	A1	2011-05-12	Leugemores et al.	
	3	20170096889	A1	2017-04-06	Blanckaert et al.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.S.B/

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Attorney Docket Number	047158.100048

	4	20120150455	A1	2012-06-14	Franklin et al.	
	5	20180313677	A1	2018-11-01	Warren et al.	
	6	20080257449	A1	2008-10-23	Weinstein et al.	
	7	20150147194	A1	2015-05-28	Foote	
	8	20180181830	A1	2018-06-28	Luharuka et al.	
	9	20120063936	A1	2012-03-15	Baxter et al.	
	10	20170204852	A1	2017-07-20	Barnett	
	11	20190145251	A1	2019-05-16	Johnson	
	12	20190128104	A1	2019-05-02	Graham et al.	
	13	20190257462	A1	2019-08-22	Rogers	
	14	20060109141	A1	2006-05-25	Huang	

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	15	20150233530	A1	2015-08-20	Sandidge	
	16	20110081268	A1	2011-04-07	Ochoa et al.	
	17	20080164023	A1	2008-07-10	Dykstra et al.	
	18	20050201197	A1	2005-09-15	Duell et al.	
	19	20010000996	A1	2001-05-10	Grimland et al.	

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FOREIGN PATENT DOCUMENTS

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	112196508	CN	A	2021-01-08	China Nat. Petroleum Corp.	English-language abstract	☐
	2	104117308	CN	A	2014-10-29	Danyan Hisense Paint Chemical Plant	English-language abstract	☐

If you wish to add additional Foreign Patent Document citation information please click the Add button

NON-PATENT LITERATURE DOCUMENTS

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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	Art Unit	3746
	Examiner Name	Christopher S. BOBISH
	Attorney Docket Number	047158.100048

	1	International Search Report and Written Opinion mailed in PCT/US20/67526 mailed May 6, 2021	☐
	2	International Search Report and Written Opinion mailed in PCT/US20/67608 mailed March 30, 2021	☐
	3	International Search Report and Written Opinion mailed in PCT/US20/67528 mailed March 19, 2021	☐
	4	International Search Report and Written Opinion mailed in PCT/US20/67146 mailed March 29, 2021	☐
	5	International Search Report and Written Opinion mailed in PCT/US20/67523 mailed March 22, 2021	☐
	6	International Search Report and Written Opinion mailed in PCT/US2020/066543 mailed May 11, 2021	☐

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EXAMINER SIGNATURE

Examiner Signature	/CHRISTOPHER S BOBISH/	Date Considered	08/14/2021

*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. /C.S.B/

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First Named Inventor	Jared OEHRING
Art Unit	3746
Examiner Name	Christopher S. BOBISH
Attorney Docket Number	047158.100048

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)	2021-06-08
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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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.

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

PTO/SB/08a (02-18)
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First Named Inventor	Jared OEHRING
Art Unit	3746
Examiner Name	Christopher S. BOBISH
Attorney Docket Number	047158.100048

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	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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	Attorney Docket Number	047158.100048

	9	10740730	B2	2020-08-11	Altamirano 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	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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	Attorney Docket Number	047158.100048

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

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.S.B/

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	Attorney Docket Number	047158.100048

	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	

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.	T5
	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	047158.100048

	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

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/CHRISTOPHER S BOBISH/	Date Considered	08/14/2021

*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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☒ 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)	2021-03-08
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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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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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L2	21,201	E21B43/26.cpc.	US-PGPUB; USPAT; USOCR; FPRS	OR	ON	2021/08/14 22:02
L3	479	L2 and (fracking or fracturing) with trailer	US-PGPUB; USPAT; USOCR; FPRS	OR	ON	2021/08/14 22:02
L4	183	L3 and ((variable adj frequency adj drive) or VFD)	US-PGPUB; USPAT; USOCR; FPRS	OR	ON	2021/08/14 22:02
L5	47	L3 and ((variable adj frequency adj drive) or VFD) and switchgear	US-PGPUB; USPAT; USOCR; FPRS	OR	ON	2021/08/14 22:03
L6	2,555	H02B1/20.cpc.	US-PGPUB; USPAT; USOCR; FPRS	OR	ON	2021/08/14 22:03
L7	1	L6 and (fracking or fracturing) with trailer	US-PGPUB; USPAT; USOCR; FPRS	OR	ON	2021/08/14 22:04
L8	9	L6 and (fracking or fracturing)	US-PGPUB; USPAT; USOCR; FPRS	OR	ON	2021/08/14 22:04
L9	4,670	F04B15/02.cpc.	US-PGPUB; USPAT; USOCR; FPRS	OR	ON	2021/08/14 22:04
L10	205	L9 and (fracking or fracturing)	US-PGPUB; USPAT; USOCR; FPRS	OR	ON	2021/08/14 22:04
L11	88	L9 and (fracking or fracturing) and (trailer or flatbed or skid)	US-PGPUB; USPAT; USOCR; FPRS	OR	ON	2021/08/14 22:05

8/14/2021 10:05:23 PM
C:\Users\cbobish\Documents\EAST\Workspaces\ReciprocatingCompressor(IntegralValveDamper).wsp

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	16598014
Filing Date	2019-10-09
First Named Inventor	Jared OEHRING
Art Unit	3746
Examiner Name	Christopher S. BOBISH
Attorney Docket Number	047158.100048

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	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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	Examiner Name	Christopher S. BOBISH
	Attorney Docket Number	047158.100048

	9	10740730	B2	2020-08-11	Altamirano 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	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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	Attorney Docket Number	047158.100048

	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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FOREIGN PATENT DOCUMENTS Remove

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

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	Application Number	16598014
	Filing Date	2019-10-09
	First Named Inventor	Jared OEHRING
	Art Unit	3746
	Examiner Name	Christopher S. BOBISH
	Attorney Docket Number	047158.100048

	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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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	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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	Filing Date	2019-10-09
	First Named Inventor	Jared OEHRING
	Art Unit	3746
	Examiner Name	Christopher S. BOBISH
	Attorney Docket Number	047158.100048

	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

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/CHRISTOPHER S BOBISH/	Date Considered	08/14/2021

*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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Filing Date	2019-10-09
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Art Unit	3746
Examiner Name	Christopher S. BOBISH
Attorney Docket Number	047158.100048

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)	2021-03-08
Name/Print	Taylor P. Evans	Registration Number	60506

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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL
(Submitted Only via EFS-Web)

Application Number	16597014	Filing Date	2019-10-09	Docket Number (if applicable)	047158.100048	Art Unit	3746
First Named Inventor	Jared Oehring			Examiner Name	Bobish, Christopher S.		

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

- ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____
- ☐ Other _____

☒ Enclosed

- ☒ Amendment/Reply
- ☐ Information Disclosure Statement (IDS)
- ☐ Affidavit(s)/ Declaration(s)
- ☒ Other Three Month Extension of Time

MISCELLANEOUS

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months _____ (Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other _____

FEES

☒ **The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.**
The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No 501349

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

☒ Patent Practitioner Signature

Applicant Signature

PTO/SB/30EFS (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.

Signature of Registered U.S. Patent Practitioner			
Signature	/Joe Grdinovac/	Date (YYYY-MM-DD)	2021-08-03
Name	Joe Grdinovac	Registration Number	72224

This collection of information is required by 37 CFR 1.114. 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 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.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	§	
Oehring	§	Attorney Docket No.: 047158.100048
	§	
Serial No.: 16/597,014	§	Confirmation No. : 4687
	§	
Filed: October 9, 2019	§	Art Unit: 3746
	§	
MODULAR SWITCHGEAR SYSTEM AND POWER DISTRIBUTION FOR ELECTRIC OILFIELD EQUIPMENT	§	Examiner: Bobish, Christopher S.

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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT

Dear Sir/Madam:

In response to the Final Office Action mailed February 4, 2021, Applicant hereby requests reconsideration of the above-referenced Application for patent, and reconsideration of the rejections in view of the amendments and the following arguments. Applicant hereby authorizes the Commissioner to charge any fees necessary for continued prosecution of this Application to **Hogan Lovells US LLP's Deposit Account Number 501349**.

AMENDMENTS TO THE CLAIMS

The following listing of claims replaces all prior versions and listing of claims in the application.

Listing of claims:

1.-16. (Cancelled)

17. (Currently Amended) A hydraulic fracturing system for fracturing a subterranean formation, comprising:

an electric powered pump 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 variable frequency drive (VFD) connected to the at least one electric motor to control the speed of the at least one electric motor;

a transformer for conditioning power to the electric powered pump, the power being received from at least one generator at a voltage higher than an operating voltage of the electric pump; and

a switchgear, receiving power from at least one generator, configured to distribute power to a plurality of pieces of wellsite equipment, the switchgear having a common load sharing bus and front aligned, shielded cable connections, the switchgear being positioned within an enclosure;

wherein the electric powered pump, the VFD, the switchgear, and the transformer are mounted on a common support structure and a single cable couples the switchgear to the transformer.

18. (Currently Amended) The system of claim 17, wherein the common load sharing bus is configured to synchronize three-phase power of a similar voltage and frequency from

different sources, the switchgear evenly distributing an electrical load between the electric powered pump ~~plurality of electric pumps~~ and the at least one generator.

19. (Previously Presented) The system of claim 17, wherein the common load sharing bus is configured to isolate the electric powered pump, the at least one generator, and the switchgear.

20. (Currently Amended) The system of claim 17, wherein the electric powered pump, the VFD, and the transformer are mounted on [[a]] the common support structure and a second single cable couples the switchgear to the common support structure.

21. (Cancelled)

22. (New) The system of claim 17, further comprising:

a cooling system providing a cooling fluid to the VFD via one or more headers.

23. (New) The system of claim 17, wherein the switchgear comprises:

integrated core units configured to operate in a connected position, an open position, or a grounded position.

24. (New) The system of claim 23, wherein the switchgear further comprises:

an isolating ground switch, enclosed within a tank arranged proximate the common load sharing bus; and

cable connections for coupling to the switchgear.

25. (New) The system of claim 17, wherein the common support structure is at least one of a trailer, a skid, a pad, a truck bed, or a combination thereof.

26. (New) The system of claim 17, further comprising:

cable trays positioned below a walking surface of the common support structure, the cable trays being covered by a hinged cover that pivots to provide access to one or more cable trays.

27. (New) The system of claim 17, further comprising:

a human machine interface, positioned proximate the VFD; and

a platform cover at least partially covering the humane machine interface and VFD.

REMARKS

This amendment is in response to the Final Office Action mailed February 4, 2021. Claims 1-14 and 16-21 were pending with claims 1, 9, and 17 being independent. Claims 1-14 and 16-20 stand rejected. Claim 18 is rejected under 35 U.S.C. § 112(b) as allegedly indefinite. Specifically, claims 1, 2, 5, 6, 9, 12, 13, and 16 are rejected under 35 U.S.C. § 103 as allegedly unpatentable over Morris et al. (U.S. Patent Publication No. 2019/0203572; hereinafter "Morris") and Broussard et al. (U.S. Patent Publication No. 2016/0032703; hereinafter "Broussard"). Claims 3, 4, 10 and 11 stand rejected under 35 U.S.C. § 103 as allegedly unpatentable over Morris, Broussard, and Mori et al. (U.S. Patent No. 7,835,140; hereinafter "Mori"). Claims 8 and 15 stand rejected under 35 U.S.C. § 103 as allegedly unpatentable over Morris, Broussard, and Symchuk (U.S. Patent No. 9,932,799; hereinafter "Symchuk"). Claims 7 and 14 stand rejected under 35 U.S.C. § 103 as allegedly unpatentable over Morris, Broussard, and Oehring et al. (U.S. Patent Publication No. 2016/0105022; hereinafter "Oehring"). Claims 17, 18, and 20 stand rejected under 35 U.S.C. § 103 as allegedly unpatentable over Morris, Benussi et al. (U.S. Patent Publication No. 2020/0194976; hereinafter "Benussi"), and Johnson et al. (U.S. Patent Publication No. 2018/0090914; hereinafter "Johnson"). Claim 19 stands rejected under 35 U.S.C. § 103 as allegedly unpatentable over Morris, Broussard, Benussi, and Mori. Applicant respectfully disagrees and traverses these rejections.

Claim 21 is indicated as including allowable subject matter.

By the present response, claims 17, 18, and 20 are amended, without prejudice, claim 21 is cancelled, and claims 22-27 are new. No new matter is added and support may be found in the specification. Upon entry of the amendments, Claims 17-20 and 22-27 will remain pending. Applicant respectfully requests reconsideration and allowance of the pending claims.

I. Allowable Subject Matter

Claim 21 is indicated as including allowable subject matter. Applicant thanks the Examiner for the indication of allowable subject matter.

II. Claim 18 is Definite

The Office Action rejects claim 18 under 35 U.S.C. § 112(b) as allegedly indefinite. While Applicant does not necessarily agree with the rejection, in order to advance prosecution,

Applicant has amended claim 18 as presented above. Applicant respectfully requests entry of the amendments and withdrawal of the rejection.

III. Claims 1, 2, 5, 6, 9, 12, 13, and 16 are Patentable over Morris and Broussard

The Office Action rejects claims 1, 2, 5, 6, 9, 12, 13, and 16 under 35 U.S.C. § 103 as allegedly unpatentable over Morris and Broussard. While Applicant disagrees with the rejection, in order to advance prosecution, claims 1, 2, 5, 6, 9, 12, 13, and 16 have been cancelled, as presented above. Accordingly, Applicant respectfully requests withdrawal of the rejection as moot.

IV. Claims 3, 4, 10, and 11 are Patentable over Morris, Broussard, and Mori

The Office Action rejects claims 3, 4, 10, and 11 as allegedly unpatentable over Morris, Broussard, and Mori. While Applicant disagrees with the rejection, in order to advance prosecution, claims 3, 4, 10, and 11 have been cancelled, as presented above. Accordingly, Applicant respectfully requests withdrawal of the rejection as moot..

V. Claims 8 and 15 are Patentable over Morris, Broussard, and Symchuk

The Office Action rejects claims 8 and 15 as allegedly unpatentable over Morris, Broussard, and Symchuk. While Applicant disagrees with the rejection, in order to advance prosecution, claims 8 and 15 have been cancelled, as presented above. Accordingly, Applicant respectfully requests withdrawal of the rejection as moot..

VI. Claims 7 and 14 are Patentable over Morris, Broussard, and Oehring

The Office Action rejects claims 7 and 14 as allegedly unpatentable over Morris, Broussard, and Oehring. While Applicant disagrees with the rejection, in order to advance prosecution, claims 7 and 14 have been cancelled, as presented above. Accordingly, Applicant respectfully requests withdrawal of the rejection as moot..

VII. Claims 17, 18, and 20 are Patentable over Morris, Benussi, and Johnson

The Office Action rejects claims 17, 18, and 20 under 35 U.S.C. § 103 as allegedly unpatentable over Morris, Broussard, and Benussi. Applicant respectfully disagrees and traverses this rejection.

As presented above, Applicant has incorporated the features of claim 21, which has been indicated as including allowable subject matter. Accordingly, Applicant respectfully asserts that

claim 17 is allowable in view of the cited references and respectfully requests withdrawal of the rejections. Moreover, Applicant requests withdrawal of the rejections of claims 18 and 20 as being dependent from an allowable base claim.

VIII. Claim 19 is Patentable over Morris, Broussard, Benussi, and Mori

The Office Action rejects claim 19 as allegedly unpatentable over Morris, Broussard, Benuissi, and Mori. Applicant respectfully disagrees and traverses this rejection.

Claim 19 depends from independent claim 17. Accordingly, Applicant respectfully asserts the claim is allowable at least due to its dependence from an allowable base claim. Accordingly, Applicant respectfully requests withdrawal of the rejection of claim 19.

IX. Conclusion

The foregoing response is full, complete, and timely filed. Amendments to the claims are made without prejudice, including under the doctrine of equivalents. In addition, the comments made herein are without prejudice. Applicant respectfully requests reconsideration of the instant application in light of the foregoing response and amendments. Should the Examiner have any questions, comments or suggestions in furtherance of the prosecution of the application, the Examiner is invited to contact the Applicant's representative by telephone or fax.

Respectfully submitted,

Date: August 3, 2021

/Joe Grdinovac/
Joe Grdinovac
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Electronic Patent Application Fee Transmittal

Application Number:	16597014
Filing Date:	09-Oct-2019
Title of Invention:	MODULAR SWITCHGEAR SYSTEM AND POWER DISTRIBUTION FOR ELECTRIC OILFIELD EQUIPMENT
First Named Inventor/Applicant Name:	Jared Oehring
Filer:	Joe Grdinovac/Stephanie McDonough
Attorney Docket Number:	047158.100048

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($)
Extension - 3 months with $0 paid	1253	1	1480	1480
Miscellaneous:				
RCE- 1ST REQUEST	1801	1	1360	1360
		Total in USD ($)		**2840**

Electronic Acknowledgement Receipt

EFS ID:	43418329
Application Number:	16597014
International Application Number:	
Confirmation Number:	4687
Title of Invention:	MODULAR SWITCHGEAR SYSTEM AND POWER DISTRIBUTION FOR ELECTRIC OILFIELD EQUIPMENT
First Named Inventor/Applicant Name:	Jared Oehring
Customer Number:	132858
Filer:	Joe Grdinovac/Stephanie McDonough
Filer Authorized By:	Joe Grdinovac
Attorney Docket Number:	047158.100048
Receipt Date:	03-AUG-2021
Filing Date:	09-OCT-2019
Time Stamp:	17:34:16
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$2840
RAM confirmation Number	E202183H34390892
Deposit Account	501349
Authorized User	Stephanie McDonough

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	Request for Continued Examination (RCE)	047158-100048_RCE.pdf	1349966 7086ac42666f27022ef57090c28d50f022ede16b	no	3
Warnings:					
Information:					
2		047158-100048_Response.pdf	130776 b1ff4df59ea8d34e2b5cdc301f758bc2c75d10b6	yes	7

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment Submitted/Entered with Filing of CPA/RCE	1	1
	Claims	2	4
	Applicant Arguments/Remarks Made in an Amendment	5	7

Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	41182 f1ef422ac72ba3cc374f1b52acde767d608c0445	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	1521924		

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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 16/597,014	Filing Date 10/09/2019	☐ 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	08/03/2021	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 10	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 1	Minus	*** 3	= 0		x $480 =	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".	/ZETA T ADAMS/
*** 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.

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	16597014
Filing Date	2019-10-09
First Named Inventor	Jared OEHRING
Art Unit	3746
Examiner Name	Christopher S. BOBISH
Attorney Docket Number	047158.100048

U.S.PATENTS

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	5950726	A	1999-09-14	Roberts	
	2	6097310	A	2000-08-01	Harrell et al.	
	3	5114239	A	1992-05-19	Allen	

If you wish to add additional U.S. Patent citation information please click the Add button.

U.S.PATENT APPLICATION PUBLICATIONS

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	20190040727	A1	2019-02-07	Oehring et al.	
	2	20110110793	A1	2011-05-12	Leugemores et al.	
	3	20170096889	A1	2017-04-06	Blanckaert et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16597014
	Filing Date	2019-10-09
	First Named Inventor	Jared OEHRING
	Art Unit	3746
	Examiner Name	Christopher S. BOBISH
	Attorney Docket Number	047158.100048

	4	20120150455	A1	2012-06-14	Franklin et al.	
	5	20180313677	A1	2018-11-01	Warren et al.	
	6	20080257449	A1	2008-10-23	Weinstein et al.	
	7	20150147194	A1	2015-05-28	Foote	
	8	20180181830	A1	2018-06-28	Luharuka et al.	
	9	20120063936	A1	2012-03-15	Baxter et al.	
	10	20170204852	A1	2017-07-20	Barnett	
	11	20190145251	A1	2019-05-16	Johnson	
	12	20190128104	A1	2019-05-02	Graham et al.	
	13	20190257462	A1	2019-08-22	Rogers	
	14	20060109141	A1	2006-05-25	Huang	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16597014
	Filing Date	2019-10-09
	First Named Inventor	Jared OEHRING
	Art Unit	3746
	Examiner Name	Christopher S. BOBISH
	Attorney Docket Number	047158.100048

	15	20150233530	A1	2015-08-20	Sandidge	
	16	20110081268	A1	2011-04-07	Ochoa et al.	
	17	20080164023	A1	2008-07-10	Dykstra et al.	
	18	20050201197	A1	2005-09-15	Duell et al.	
	19	20010000996	A1	2001-05-10	Grimland et al.	

If you wish to add additional U.S. Published Application citation information please click the Add button.

FOREIGN PATENT DOCUMENTS

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	112196508	CN	A	2021-01-08	China Nat. Petroleum Corp.	English-language abstract	☐
	2	104117308	CN	A	2014-10-29	Danyan Hisense Paint Chemical Plant	English-language abstract	☐

If you wish to add additional Foreign Patent Document citation information please click the Add button

NON-PATENT LITERATURE DOCUMENTS

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]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16597014
	Filing Date	2019-10-09
	First Named Inventor	Jared OEHRING
	Art Unit	3746
	Examiner Name	Christopher S. BOBISH
	Attorney Docket Number	047158.100048

	1	International Search Report and Written Opinion mailed in PCT/US20/67526 mailed May 6, 2021	☐
	2	International Search Report and Written Opinion mailed in PCT/US20/67608 mailed March 30, 2021	☐
	3	International Search Report and Written Opinion mailed in PCT/US20/67528 mailed March 19, 2021	☐
	4	International Search Report and Written Opinion mailed in PCT/US20/67146 mailed March 29, 2021	☐
	5	International Search Report and Written Opinion mailed in PCT/US20/67523 mailed March 22, 2021	☐
	6	International Search Report and Written Opinion mailed in PCT/US2020/066543 mailed May 11, 2021	☐

If you wish to add additional non-patent literature document citation information please click the Add button

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	16597014
Filing Date	2019-10-09
First Named Inventor	Jared OEHRING
Art Unit	3746
Examiner Name	Christopher S. BOBISH
Attorney Docket Number	047158.100048

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)	2021-06-08
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)

Date of mailing *(day/month/year)*	MAY 06 2021
Applicant's or agent's file reference 047158.500074	**FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/US 20/67526	International filing date *(day/month/year)* 30 December 2020 (30.12.2020)
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
047158.500074		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 20/67526	30 December 2020 (30.12.2020)	31 December 2019 (31.12.2019)
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 4 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 20/67526

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of 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. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims 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. ☐ Claims 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:

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be searched, the appropriate additional search fees must be paid.

Group I: Claims 1-7, drawn to a pump control system.

Group II: Claims 8-15, drawn to a calibration system.

-- Please See Supplemental Box --

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 claims 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 claims Nos.:

1-7

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

International application No.
PCT/US 20/67526

A. CLASSIFICATION OF SUBJECT MATTER

IPC - B01F 5/12, C09K 8/03, C09K 8/62, E21B 43/26, F04B 1/04, F04B 13/02, G05B 19/401 (2021.01)

CPC - B01F 5/12, B01F 2215/0081, C09K 8/02, C09K 8/03, C09K 8/487, C09K 8/493, C09K 8/62, C09K 8/80, E21B 21/062, E21B 43/26, E21B 43/2607, F04B 1/04, F04B 9/08, F04B 9/109, F04B 13/02, F04B 2205/09, F04B 2205/50, F04B 2201/0807, C08K 13/02, C08K 2201/002, C08K 2201/008, G01F 1/78, G01F 3/36, G01F 13/006, G01F 25/0007, G01F 25/0092, G05B 19/401

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 2019/0112910 A1 (U.S. WELL SERVICES, LLC) 18 April 2019 (18.04.2019), Fig. 1; para [0018]-[0019], [0021], [0025]-[0026], [0028], [0033]-[0036]	1-7
Y	US 2018/0313677 A1 (HALLIBURTON ENERGY SERVICES, INC.) 01 November 2018 (01.11.2018), para [0020], [0022]-[0023], [0031], [0040]-[0041]	1-7
E/A	CN 112196508 A (CHINA NAT PETROLEUM CORP, et al.) 08 January 2021 (08.01.2021), English Abstract, Machine Translation	1-7
A	CN 104117308 A (DANYANG HISENSE PAINT CHEMICAL PLANT) 29 October 2014 (29.10.2014), English Abstract, Machine Translation	1-7
A	US 2008/0257449 A1 (WEINSTEIN et al.) 23 October 2008 (23.10.2008), para [0010]-[0074]	1-7

☐ 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 April 2021	MAY 06 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)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/US 20/67526

Continued from Box No. III, Observations where unity of invention is lacking,

The inventions listed as Groups I and II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Special Technical Features

Group II does not require a pump control system, comprising: an additive pump (204), the additive pump (204) being fluidly coupled to a component (202) of a hydraulic fracturing system; an additive container (206), the additive container (206) configured to provide an additive to the additive pump (204) via a flow path (210); a diversion system (208), arranged within the flow path (21) between the additive pump (204) and the component (202) of the hydraulic fracturing system, the diversion system (208) configured to redirected at least a portion of additive directed toward the component (202) of the hydraulic fracturing system; a calibration system configured to receive the redirected portion of the additive, the calibration system adapted to adjust one or more operational parameters of the additive pump (204) responsive to an evaluation of a flow parameter of the redirected portion of the additive, as required by Group I.

Group I does not require a calibration system, comprising: a flow diverter (218) positioned along a first flow path (210) between a conveyance system (204) and a component (202) of a hydraulic fracturing system, the flow diverter (216) configured to redirect at least a portion of a flow to a second flow path; a sensor (212) positioned along the second flow path, the sensor (212) configured to determine one or more properties of the flow; and a controller (216) communicatively coupled to the sensor (212), the controller (216) configured to output a control signal to the conveyance system (204) responsive to the one or more properties of the flow, as required by Group II.

Shared Common Features

The only feature shared by Groups I and II that would otherwise unify the groups is a flow path, flow diverter, component of a hydraulic fracturing system, controller, and calibration system. However, this shared technical feature does not represent a contribution over prior art, because the shared technical feature is anticipated by US 2003/0037926 A1 (Sask). Sask discloses a flow path (para [0077]), flow diverter (Fig. 1; para [0063], drill bit, 3, which directs drilling fluid, 4, into three channels, as shown.), component of a hydraulic fracturing system (para [0014], [0043], electrically driven valves for hydraulic fracturing operations.), controller (para [0078]), and calibration system (para [0085], engineering values obtained from calibration coefficients from a pressure transducer.)

As the technical features were known in the art at the time of the invention, this cannot be considered a special technical feature that would otherwise unify the groups.

Groups I and II therefore lack unity under PCT Rule 13 because they do not share a same or corresponding special technical feature.

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)* MAY 06 2021

Applicant's or agent's file reference
047158.500074

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US 20/67526	30 December 2020 (30.12.2020)	31 December 2019 (31.12.2019)

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

IPC - B01F 5/12, C09K 8/03, C09K 8/62, E21B 43/26, F04B 1/04, F04B 13/02, G05B 19/401 (2021.01)

CPC - B01F 5/12, B01F 2215/0081, C09K 8/02, C09K 8/03, C09K 8/487, C09K 8/493, C09K 8/62, C09K 8/80, E21B 21/062, E21B 43/26, E21B 43/2607, F04B 1/04, F04B 9/08, F04B 9/109, F04B 13/02, F04B 2205/09, F04B 2205/50, F04B 2201/0807, C08K 13/02, C08K 2201/002, C08K 2201/008, G01F 1/78, G01F 3/36, G01F 13/006, G01F 25/0007, G01F 25/0092, G05B 19/401

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 April 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 20/67526

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 20/67526

Box No. IV Lack of unity of invention

1. ☒ In response to the invitation (Form PCT/ISA/206) to pay additional fees the applicant has, within the applicable time limit:

   ☐ paid additional fees.

   ☐ paid additional fees under protest and, where applicable, the protest fee.

   ☐ paid additional fees under protest but the applicable protest fee was not paid.

   ☒ not paid additional fees.

2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose not to invite the applicant to pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rule 13.1, 13.2 and 13.3 is

   ☐ complied with.

   ☒ not complied with for the following reasons:

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be searched, the appropriate additional search fees must be paid.

Group I: Claims 1-7, drawn to a pump control system.

Group II: Claims 8-15, drawn to a calibration system.

The inventions listed as Groups I and II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Special Technical Features

Group II does not require a pump control system, comprising: an additive pump (204), the additive pump (204) being fluidly coupled to a component (202) of a hydraulic fracturing system; an additive container (206), the additive container (206) configured to provide an additive to the additive pump (204) via a flow path (210); a diversion system (208), arranged within the flow path (21) between the additive pump (204) and the component (202) of the hydraulic fracturing system, the diversion system (208) configured to redirected at least a portion of additive directed toward the component (202) of the hydraulic fracturing system; a calibration system configured to receive the redirected portion of the additive, the calibration system adapted to adjust one or more operational parameters of the additive pump (204) responsive to an evaluation of a flow parameter of the redirected portion of the additive, as required by Group I.

Group I does not require a calibration system, comprising: a flow diverter (218) positioned along a first flow path (210) between a conveyance system (204) and a component (202) of a hydraulic fracturing system, the flow diverter (218) configured to redirect at least a portion of a flow to a second flow path; a sensor (212) positioned along the second flow path, the sensor (212) configured to determine one or more properties of the flow; and a controller (216) communicatively coupled to the sensor (212), the controller (216) configured to output a control signal to the conveyance system (204) responsive to the one or more properties of the flow, as required by Group II.

Shared Common Features

The only feature shared by Groups I and II that would otherwise unify the groups is a flow path, flow diverter, component of a hydraulic fracturing system, controller, and calibration system. However, this shared technical feature does not represent a contribution over prior art, because the shared technical feature is anticipated by US 2003/0037926 A1 (Sask). Sask discloses a flow path (para [0077]), flow diverter (Fig. 1; para [0063], drill bit, 3, which directs drilling fluid, 4, into three channels, as shown.), component of a hydraulic fracturing system (para [0014], [0043], electrically driven valves for hydraulic fracturing operations.), controller (para [0078]), and calibration system (para [0085], engineering values obtained from calibration coefficients from a pressure transducer.)

As the technical features were known in the art at the time of the invention, this cannot be considered a special technical feature that would otherwise unify the groups.

Groups I and II therefore lack unity under PCT Rule 13 because they do not share a same or corresponding special technical feature.

4. Consequently, this opinion has been established in respect of the following parts of the international application:

   ☐ all parts.

   ☒ the parts relating to claims Nos. 1-7

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/67526

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	YES
	Claims	none	NO
Inventive step (IS)	Claims	none	YES
	Claims	1-7	NO
Industrial applicability (IA)	Claims	1-7	YES
	Claims	none	NO

2. Citations and explanations:

Claims 1-7 lack an inventive step under PCT Article 33(3) as being obvious over US 2019/0112910 A1 (U.S. Well Services, LLC), in view of US 2018/0313677 A1 (Halliburton Energy Services, Inc.).

Regarding Claim 1, U.S. Well Services, LLC discloses a pump control system, comprising: an additive pump (204), the additive pump (204) being fluidly coupled to a component (202) of a hydraulic fracturing system (Fig. 1; para [0019], pump system, 16, for pumping solution for hydraulic fracturing into wellhead.); an additive container (206), the additive container (206) configured to provide an additive to the additive pump (204) via a flow path (210) (Fig. 1; para [0018]-[0019], pump trucks receive additives from pump source, 24.); a diversion system (208), arranged within the flow path (21) between the additive pump (204) and the component (202) of the hydraulic fracturing system, the diversion system (208) configured to redirected at least a portion of additive directed toward the component (202) of the hydraulic fracturing system (Fig. 1; para [0018]-[0019], distribution system, 30, receives fracturing fluid solution from each of the pump trucks, 14.); a system configured to receive the redirected portion of the additive (Fig. 1; para [0018]-[0019], [0026], distribution system, 30, receives fluid from pump trucks, 24, which receive additives from additive source... additives can also be delivered to hydration unit or blender unit.), the system adapted to adjust one or more operational parameters of the additive pump (204) responsive to an evaluation of a flow parameter of the redirected portion of the additive (para [0035]-[0036], controller uses sensors to measure parameters... automatically adjust flow rate.); but does not specifically disclose that said system is a calibration system. However, Halliburton Energy Services, Inc. discloses a pump control system (para [0023], [0041]), comprising a calibration system (para [0020], control system monitors calibration factor.), the system adapted to adjust one or more operational parameters of the additive pump (204) responsive to an evaluation of a flow parameter of the redirected portion of the additive (para [0040]-[0041], control system connected to a pump that controls flow rate.). To a person of ordinary skill in the art, substituting a calibration system as taught by Halliburton Energy Services, Inc. would have been obvious for use in the pump control system as in U.S. Well Services, LLC in order to monitor the metering system to determine replacement (para [0020], [0022]), because U.S. Well Services, LLC and Halliburton Energy Services, Inc. are directed to pump control systems that adjust operational parameters.

Regarding Claim 2, U.S. Well Services, LLC further discloses the pump control system of claim 1, further comprising: a container (214) positioned to receive the redirected portion of the additive (para [0019], distribution system, 30, receives fracturing fluid solution for injection into the wellhead.).

Regarding Claim 3, U.S. Well Services, LLC further discloses the pump control system of claim 1, further comprising: a controller (216) of the system, the controller (216) being communicatively coupled to the additive pump (204) to regulate one or more operational parameters of the additive pump (204) (para [0035]-[0036], controller uses sensors to measure parameters... automatically control pump and adjust flow rate.); but does not specifically disclose that said system is a calibration system. However, Halliburton Energy Services, Inc. discloses a pump control system (para [0023], [0041]), comprising a calibration system (para [0020], control system monitors calibration factor.), the system adapted to adjust one or more operational parameters of the additive pump (204) responsive to an evaluation of a flow parameter of the redirected portion of the additive (para [0040]-[0041], control system connected to a pump that controls flow rate.). To a person of ordinary skill in the art, substituting a calibration system as taught by Halliburton Energy Services, Inc. would have been obvious for use in the pump control system as in U.S. Well Services, LLC in order to monitor the metering system to determine replacement (para [0020], [0022]), because U.S. Well Services, LLC and Halliburton Energy Services, Inc. are directed to pump control systems that adjust operational parameters

Regarding Claim 4, U.S. Well Services, LLC further discloses the pump control system of claim 3, wherein the controller (216) is further communicatively coupled to the diversion system (208) (para [0025], [0033]-[0034], control system controls additive sources, blender, and pump.).

Regarding Claim 5, U.S. Well Services, LLC further discloses the pump control system of claim 1, wherein the diversion system (208) includes one or more valves to redirect the portion of the additive from the component (202) of the hydraulic fracturing system to the system (Fig. 1; para [0018]-[0019], [0026], [0036], distribution system, 30, receives fluid from pump trucks, 24, which receive additives from additive source... additives can also be delivered to hydration unit or blender unit... the components of the system include valves.); but does not specifically disclose that said system is a calibration system. However, Halliburton Energy Services, Inc. discloses a pump control system (para [0023], [0041]), comprising a calibration system (para [0020], control system monitors calibration factor.), the system adapted to adjust one or more operational parameters of the additive pump (204) responsive to an evaluation of a flow parameter of the redirected portion of the additive (para [0040]-[0041], control system connected to a pump that controls flow rate.). ... (continued)

-- Please See Supplemental Box --

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/67526

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
Box V.2., Citations and explanations,

(Continued from Box V.2.) ... To a person of ordinary skill in the art, substituting a calibration system as taught by Halliburton Energy Services, Inc. would have been obvious for use in the pump control system as in U.S. Well Services, LLC in order to monitor the metering system to determine replacement (para [0020], [0022]), because U.S. Well Services, LLC and Halliburton Energy Services, Inc. are directed to pump control systems that adjust operational parameters.

Regarding Claim 6, U.S. Well Services, LLC further discloses the pump control system of claim 1, wherein the component (202) of the hydraulic fracturing system is a blender (para [0021], [0025]).

Regarding Claim 7, U.S. Well Services, LLC further discloses the pump control system of claim 1, wherein the system is initialized prior to a fracturing operation (para [0028], [0036]); but does not specifically disclose that said system is a calibration system. However, Halliburton Energy Services, Inc. discloses a pump control system (para [0023], [0041]), comprising a calibration system (para [0020], control system monitors calibration factor.), the system adapted to adjust one or more operational parameters of the additive pump (204) responsive to an evaluation of a flow parameter of the redirected portion of the additive (para [0040]-[0041], control system connected to a pump that controls flow rate.). To a person of ordinary skill in the art, substituting a calibration system as taught by Halliburton Energy Services, Inc. would have been obvious for use in the pump control system as in U.S. Well Services, LLC in order to monitor the metering system to determine replacement (para [0020], [0022]), because U.S. Well Services, LLC and Halliburton Energy Services, Inc. are directed to pump control systems that adjust operational parameters.

Claims 1-7 have industrial applicability as defined by PCT Article 33(4) because the subject matter could be made or used in 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)

Date of mailing *(day/month/year)*	MAR 30 2021
Applicant's or agent's file reference 047158.500077	**FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/US 20/67608	International filing date *(day/month/year)* 31 December 2020 (31.12.2020)
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
047158.500077		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 20/67608	31 December 2020 (31.12.2020)	31 December 2019 (31.12.2019)
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 20/67608

A. CLASSIFICATION OF SUBJECT MATTER
IPC - G05B 19/406, E21B 43/26 (2021.01)
CPC - E21B 47/008, F04B 53/001, E21B 43/26, E21B 43/121, E21B 43/25

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 2018/0181830 A1 (SCHLUMBERGER TECHNOLOGY CORPORATION) 28 June 2018 (28.06.2018), entire document, especially Abstract; para [0018]; [0026]; [0028]; [0030]; [0037]; [0041]; [0052]; [0059-0060]; [0064]; [0077-0078]	1-20
Y	US 2019/0120024 A1 (U.S. WELL SERVICES, LLC) 25 April 2019 (25.04.2019), entire document, especially para [0035-0036]; [0039]; [0045]; [0049]	1-20
A	US 2019/0145251 A1 (SHEAR FRAC INC) 16 May 2019 (16.05.2019), entire document	1-20

☐ 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
25 February 2021 (25.02.2021)	MAR 30 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)* MAR 30 2021

Applicant's or agent's file reference
047158.500077

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US 20/67608	31 December 2020 (31.12.2020)	31 December 2019 (31.12.2019)

International Patent Classification (IPC) or both national classification and IPC
IPC - G05B 19/406, E21B 43/26 (2021.01)
CPC - E21B 47/008, F04B 53/001, E21B 43/26, E21B 43/121, E21B 43/25

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	25 February 2021 (25.02.2021)	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 20/67608

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 20/67608

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	1-20	YES
	Claims	None	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 1-20 lack an inventive step under PCT Article 33(3) as being obvious over US 2018/0181630 A1 (SCHLUMBERGER TECHNOLOGY CORPORATION) 28 June 2018 (28.06.2018) (hereinafter "Schlumberger") in view of US 2019/0120024 A1 (U.S. WELL SERVICES, LLC) 25 April 2019 (25.04.2019) (hereinafter "US Well").

Regarding claim 1, Schlumberger discloses a method of monitoring hydraulic fracturing equipment (Abstract), comprising: training a machine learning model on training data obtained from a plurality of hydraulic fracturing operations, the training data including a corpus of operational data associated with the hydraulic fracturing operations and corresponding health conditions associated with one or more hydraulic pump fluid ends (para [0018] - "hydraulic fracturing well site"; para [0041] - "database of information corresponding to one or more equipment units at one or more wellsites"; para [0052] - "determine a health condition of one or more equipment units"; para [0028] - "mixture may then be discharged from the common manifold 142 into the wellbore 104 via one or more conduits"); receiving a set of operational data associated with an active hydraulic fracturing operation (para [0030] - "control center 170 may be operable to monitor... operational parameters"); determine, based on the trained machine learning model and the input set of operational data, one or more estimated health conditions of a hydraulic pump fluid end used in the active hydraulic fracturing operation (para [0052] - "determine a health condition of one or more equipment units"; para [0028] - "mixture may then be discharged from the common manifold 142 into the wellbore 104 via one or more conduits"; para [0064] - "classifier may be implemented (506) using the... training samples. The classifier can be a machine learning algorithm").

Schlumberger does not disclose wherein process the set of operational data using the trained machine learning model. US Well discloses wherein: process the set of operational data using the trained machine learning model (para [0049] - "data may be used as training data for a machine learning model"; para [0039] - "processors that analyze the data received from one or more of the other components"). It would have been obvious to one of ordinary skill in the art to have modified the method of Schlumberger by including wherein process the set of operational data using the trained machine learning model as taught by US Well because it can more efficiently implement a control system for recciving, analyzing, and storing information from the well site (US Well, para [0049]).

Regarding claim 2, Schlumberger and US Well disclose the method according to claim 1. Schlumberger further discloses wherein the set of operational data includes one or more of environmental conditions, equipment specifications, operating specifications, equipment hours, damage accumulation data, vibration parameters, temperature parameters, flow rate parameters, pressure parameters, speed, and motion counts associated with the active hydraulic fracturing operation (para [0059] - "equipment units for which health may be monitored... a heat exchanger").

Regarding claim 3, Schlumberger and US Well disclose the method according to claim 1. US Well further discloses wherein the one or more estimated health conditions of the hydraulic pump fluid end include an estimated time to failure (para [0045] - "determining that the one or more parameters are indicative of a potential failure condition... method 160 also includes logging operation data including... pumping hours... and determining a maintenance schedule based at least in part on the operation data").

Regarding claim 4, Schlumberger and US Well disclose the method according to claim 1. Schlumberger further discloses wherein the one or more estimated health conditions of the hydraulic pump fluid end include indications associated with a plurality of different failure modes (para [0077-0078] - "alert may be generated when the temperature indicated by the corresponding portion of the thermal image is above the operational temperature range... when the temperature indicated by the corresponding portion of the thermal image is below the operational temperature range").

Regarding claim 5, Schlumberger and US Well disclose the method according to claim 4. US Well further discloses further comprising: determining, from the trained machine learning model, which parameters of the set of operational data are correlated with certain failure modes (para [0045] - "determining that the one or more parameters are indicative of a potential failure condition").

CONTINUED IN SUPPLEMENTAL BOX

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/67608

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:

Claims 19 and 20 lack clarity as referencing a method, since claim 16 (from which they depend) discloses a system. Accordingly, claims 19 and 20 have been interpreted to read as though they reference "The system of claim 16" as opposed to a "method".

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/67608

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
Box V.2. CITATIONS AND EXPLANATIONS:

Regarding claim 6, Schlumberger and US Well disclose the method according to claim 1. US Well further discloses further comprising: receiving and processing the set of operational data through the machine learning model in real time (para [0035] - "data may be accessed in real-time... control operation based on live and continuous data readings"); and generating an alert indicating a predicted failure (para [0036] - "alerts that more specifically provides information regarding the potential causes of issues or current conditions").

Regarding claim 7, Schlumberger and US Well disclose the method according to claim 1. Schlumberger further discloses further comprising: obtaining actual health and failure conditions of the hydraulic pump fluid end (para [0060] - "alert can be output (410) to an operator"); and updating the trained machine learning model by correlating the set of operational data with the actual health and failure conditions (para [0060] - "warning... can be stored in a database for subsequent analysis of historical events for given equipment unit(s)").

Regarding claim 8, Schlumberger discloses a method of monitoring hydraulic fracturing equipment, comprising: training a machine learning model on training data obtained from a plurality of hydraulic fracturing operations, the training data including a corpus of operational data associated with the hydraulic fracturing operations and corresponding health conditions associated with one or more hydraulic fracturing equipment (para [0018] - "hydraulic fracturing well site"; para [0041] - "database of information corresponding to one or more equipment units at one or more wellsites"; para [0052] - "determine a health condition of one or more equipment units"); receiving a set of operational data associated with an active hydraulic fracturing operation (para [0030] - "control center 170 may be operable to monitor... operational parameters"); determining, based on the trained machine learning model and the input set of operational data, one or more estimated health conditions of a hydraulic fracturing equipment used in the active hydraulic fracturing operation (para [0052] - "determine a health condition of one or more equipment units"; para [0028] - "mixture may then be discharged from the common manifold 142 into the wellbore 104 via one or more conduits"; para [0064] - "classifier may be implemented (506) using the... training samples. The classifier can be a machine learning algorithm").

Schlumberger does not disclose wherein processing the set of operational data using the trained machine learning model. US Well discloses wherein: processing the set of operational data using the trained machine learning model (para [0049] - "data may be used as training data for a machine learning model"; para [0039] - "processors that analyze the data received from one or more of the other components"). It would have been obvious to one of ordinary skill in the art to have modified the method of Schlumberger by including wherein processing the set of operational data using the trained machine learning model as taught by US Well because it can more efficiently implement a control system for receiving, analyzing, and storing information from the well site (US Well, para [0049]).

Regarding claim 9, Schlumberger and US Well disclose the method according to claim 8. Schlumberger further discloses wherein the set of operational data includes one or more of environmental conditions, equipment specifications, operating specifications, equipment hours, damage accumulation data, vibration parameters, temperature parameters, flow rate parameters, pressure parameters, speed, and motion counts associated with the active hydraulic fracturing operation (para [0059] - "equipment units for which health may be monitored... a heat exchanger").

Regarding claim 10, Schlumberger and US Well disclose the method according to claim 8. US Well further discloses wherein the one or more estimated health conditions of the hydraulic fracturing equipment include an estimated time to failure (para [0045] - "determining that the one or more parameters are indicative of a potential failure condition... method 160 also includes logging operation data including... pumping hours... and determining a maintenance schedule based at least in part on the operation data").

Regarding claim 11, Schlumberger and US Well disclose the method according to claim 8. Schlumberger further discloses wherein the one or more estimated health conditions of the hydraulic fracturing equipment include indications associated with a plurality of different failure modes (para [0077-0078] - "alert may be generated when the temperature indicated by the corresponding portion of the thermal image is above the operational temperature range... when the temperature indicated by the corresponding portion of the thermal image is below the operational temperature range").

Regarding claim 12, Schlumberger and US Well disclose the method according to claim 11. US Well further discloses further comprising: determining, from the trained machine learning model, which parameters of the set of operational data are correlated with certain failure modes (para [0045] - "determining that the one or more parameters are indicative of a potential failure condition").

Regarding claim 13, Schlumberger and US Well disclose the method according to claim 8. US Well further discloses further comprising: receiving and processing the set of operational data through the machine learning model in real time (para [0035] - "data may be accessed in real-time... control operation based on live and continuous data readings"); and generating an alert indicating a predicted failure (para [0036] - "alerts that more specifically provides information regarding the potential causes of issues or current conditions").

Regarding claim 14, Schlumberger and US Well disclose the method according to claim 8. Schlumberger further discloses further comprising: obtaining actual health and failure conditions of the hydraulic fracturing equipment (para [0060] - "alert can be output (410) to an operator"); and updating the trained machine learning model by correlating the set of operational data with the actual health and failure conditions (para [0060] - "warning... can be stored in a database for subsequent analysis of historical events for given equipment unit(s)").

Regarding claim 15, Schlumberger and US Well disclose the method according to claim 8. Schlumberger further discloses wherein the hydraulic fracturing equipment includes at least one of a hydraulic pump, a fluid end, a power end, power generation equipment, pump iron, and manifold system (para [0026] - "common manifold").

CONTINUED IN SUPPLEMENTAL BOX

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/67608

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
Box V.2. CITATIONS AND EXPLANATIONS:

Regarding claim 16, Schlumberger discloses a hydraulic fracturing system (Abstract), comprising: a pump comprising a fluid end (para [0028] - "mixture may then be discharged from the common manifold 142 into the wellbore 104 via one or more conduits"; para [0030] - "control center 170 may be operable to monitor... the pump assemblies"); one or more additional hydraulic fracturing equipment (para [0041] - "database of information corresponding to one or more equipment units at one or more wellsites"); a plurality of sensors configured to measure a plurality of operational parameters of the hydraulic fracturing system during an active hydraulic fracturing operation (para [0060] - "sensors that are on-board the equipment unit"); and a control system (para [0037] - "health monitoring system 200 includes a control center"), the control system configured to: receive a set of operational data associated with the active hydraulic fracturing operation, the set of operational data including the plurality of operational parameters (para [0030] - "control center 170 may be operable to monitor... operational parameters"); determine, based on the trained machine learning model and the set of operational data, one or more estimated health conditions of the fluid end (para [0052] - "determine a health condition of one or more equipment units"; para [0028] - "mixture may then be discharged from the common manifold 142 into the wellbore 104 via one or more conduits"; para [0064] - "classifier may be implemented (506) using the... training samples. The classifier can be a machine learning algorithm"; para [0052] - "determine a health condition of one or more equipment units").

Schlumberger does not disclose wherein process the set of operational data using a trained machine learning model. US Well discloses wherein: process the set of operational data using a trained machine learning model (para [0049] - "data may be used as training data for a machine learning model"; para [0039] - "processors that analyze the data received from one or more of the other components"). It would have been obvious to one of ordinary skill in the art to have modified the system of Schlumberger by including wherein process the set of operational data using a trained machine learning model as taught by US Well because it can more efficiently implement a control system for receiving, analyzing, and storing information from the well site (US Well, para [0049]).

Regarding claim 17, Schlumberger and US Well disclose the system according to claim 16. Schlumberger further discloses wherein the set of operational data includes one or more of environmental conditions, equipment specifications, operating specifications, equipment hours, damage accumulation data, vibration parameters, temperature parameters, flow rate parameters, pressure parameters, speed, and motion counts associated with the active hydraulic fracturing operation (para [0059] - "equipment units for which health may be monitored... a heat exchanger").

Regarding claim 18, Schlumberger and US Well disclose the system according to claim 16. Schlumberger further discloses wherein the trained machine learning model utilizes training data, the training data including a corpus of historical operational data associated with historical hydraulic fracturing operations and corresponding health conditions associated with one or more hydraulic pump fluid ends used in the historical hydraulic fracturing operations, respectively (para [0018] - "hydraulic fracturing well site"; para [0041] - "database of information corresponding to one or more equipment units at one or more wellsites"; para [0052] - "determine a health condition of one or more equipment units"; para [0060] - "warning... can be stored in a database for subsequent analysis of historical events for given equipment unit(s)").

Regarding claim 19, Schlumberger and US Well disclose the method according to claim 16. US Well further discloses wherein the one or more estimated health conditions of the fluid end include an estimated time to failure (para [0045] - "determining that the one or more parameters are indicative of a potential failure condition... method 160 also includes logging operation data including... pumping hours... and determining a maintenance schedule based at least in part on the operation data").

Regarding claim 20, Schlumberger and US Well disclose the method according to claim 16. US Well further discloses wherein the one or more estimated health conditions of the hydraulic fracturing equipment include indications associated with a plurality of different failure modes, and wherein the trained machine learning model indicates which parameters of the set of operational data are correlated with certain failure modes (para [0045] - "determining that the one or more parameters are indicative of a potential failure condition").

Claims 1-20 have industrial applicability as defined by PCT Article 33(4) because the subject matter can be made or used in 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)

Date of mailing *(day/month/year)*	MAR 19 2021
Applicant's or agent's file reference: 047158.500078	**FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No.: PCT/US 20/67528	International filing date *(day/month/year)*: 30 December 2020 (30.12.2020)
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
047158.500078		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 20/67528	30 December 2020 (30.12.2020)	31 December 2019 (31.12.2019)
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 20/67528

A. CLASSIFICATION OF SUBJECT MATTER
IPC - E21B 43/26, F04B 47/02, F04B 53/22 (2021.01)
CPC - E21B 43/26, F04B 47/02, F04B 53/22

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 --- A	US 2019/0126104 A1 (CaterPillar Inc.) 2 May 2019 (02.05.2019) Entire document especially para [0007], [0018], [0025], [0034] and figs. 1-7	1-9, 11-12, 15 ----- 10
X --- A	US 2011/0081268 A1 (Ochoa et al.) 7 April 2011 (07.04.2011) Entire document especially para [0037], [0040]-[0041] and figs. 1-5	11, 13-14 ----- 10
A	US 2017/0204852 A1 (Barnett, JR.) 20 July 2017 (20.07.2017) Entire document	1-15
A	US 2012/0063936 A1 (Baxter et al.) 15 March 2012 (15.03.2012) Entire document	1-15
A	US 2015/0147194 A1 (Global Energy Services, Inc.) 28 May 2015 (28.05.2015) 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 February 2021	MAR 19 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)*	MAR 19 2021

Applicant's or agent's file reference	FOR FURTHER ACTION
047158.500078	See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US 20/67528	30 December 2020 (30.12.2020)	31 December 2019 (31.12.2019)

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

IPC - E21B 43/26, F04B 47/02, F04B 53/22 (2021.01)

CPC - E21B 43/26, F04B 47/02, F04B 53/22

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, Virginia 22313-1450 Facsimile No. 571-273-8300	22 February 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 20/67528

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 20/67528

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	1-10, 13-14	YES
	Claims	11-12, 15	NO
Inventive step (IS)	Claims	10	YES
	Claims	1-9, 11-15	NO
Industrial applicability (IA)	Claims	1-15	YES
	Claims	None	NO

2. Citations and explanations:

Claims 11-12 and 15 lack novelty under PCT Article 33(2) as being anticipated by US 2019/0128104 A1 to CaterPillar Inc. (hereinafter 'CaterPillar').

Regarding Claim 11, CaterPillar teaches a fluid end (168 - "fluid end block", figs. 6-7; para [0034]) for a fracturing pump (para [0007], [0018], [0034]), comprising:
a plurality of segments (See fig. 6; first segment is defined as segments 176 and 174; second segment is defined as segment 180 and the two unlabeled segments) coupled together along a discharge axis (See figs. 6-7; discharge axis extends through opening in the sides of segments), each segment of the plurality of segments having a plurality of suction bores (See fig. 6; see how first segment has two suction bores in the front surface of the segments 174 and 176 while the second segment has three suction bores in the front surface);
respective interfaces between segment pairs formed by adjacent segments of the plurality of segments, the interfaces coupling the segment pairs together (See fig. 6; see left side of segment 180 and right side of segment 174 that abut one another); and
respective access areas (See fig. 6; see semicircle cutout portions in left side of segment 180 and right side of segment 174 that are above the suction bores) proximate the respective interfaces (See fig. 6), the respective access areas configured to provide access for mechanical couplings (156 - "stitch pins", fig. 6) to join the segment pairs together (See fig. 6; para [0034]).

Regarding Claim 12, CaterPillar teaches the fluid end of claim 11, wherein the mechanical couplings are fasteners (156 - "stitch pins", fig. 6; para [0034]).

Regarding Claim 15, CaterPillar teaches the fluid end of claim 11, wherein the respective access areas (See fig. 6; see semicircle cutout portions in left side of segment 180 and right side of segment 174 that are above the suction bores) are at least one of axially higher than the plurality of suction bores (See fig. 6; see semicircle cutout portions in left side of segment 180 and right side of segment 174 that are above the suction bores) or axially lower than the plurality of suction bores.

Claims 1-9 lack an inventive step under PCT Article 33(3) as being obvious over CaterPillar.

Regarding Claim 1, CaterPillar teaches a fluid end (168 - "fluid end block", figs. 6-7; para [0034]) for a fracturing pump (para [0007], [0018], [0034]), comprising:
a first segment (collectively 176 - "segment", 174 - "replacement segment", fig. 6), the first segment having a plurality of first suction bores (See fig. 6; see bores on front of segments 176, 174) and a first discharge path (See figs. 6 and 7; see horizontal bore through segments 174, 176 that extend through the abutting surfaces of the segments 174, 176);
a second segment (See fig. 6; collectively segment 180 as well as the unlabeled segment immediately to the right of segment 180), the second segment having a plurality of second suction bores (See fig. 6; see bores on front of segment 180 and the segment to the right) and a second discharge path (See figs. 6 and 7; see horizontal bore through segment 180 and its adjacent segment that extend through the abutting surfaces of the segments 180); and
a third segment (See fig. 6; see segment on far end of fluid end block 168), the third segment having a third suction bore (See fig. 6; see bore on front of far-right segment) and a third discharge path (See figs. 6 and 7; see horizontal bore through far-right segment that extends through the abutting surfaces of the segment);
wherein the first segment is mechanically coupled to the second segment, the second segment is mechanically coupled to the third segment (See fig. 6), and each of the first discharge path, the second discharge path, and the third discharge path are aligned (See fig. 6-7; discharge paths must be aligned to allow the fluid to leave the fluid end block 168) but does not specifically teach wherein the third segment has a plurality of suction bores. However, the duplication of parts falls within the ordinary skill of in the art using routine experimentation and design principles. Accordingly, it would have been obvious to one of ordinary skill in the art to have the third segment be made of two fluid segments, like the first and second segment of CaterPillar, in order to increase the fluid capacity of the pump to reach greater downhole depths.

Regarding Claim 2, CaterPillar teaches the fluid end of claim 1, wherein the first segment (collectively 176 - "segment", 174 - "replacement segment", fig. 6) is coupled to the second segment (See fig. 6; collectively segment 180 as well as the unlabeled segment immediately to the right of segment 180) via one or more fasteners (156 - "stitch pins", fig. 6).

-*-Continued in Supplemental Box-*-

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/67528

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 3, CaterPillar teaches the fluid end of claim 1, wherein the second segment (See fig. 6; collectively segment 180 as well as the unlabeled segment immediately to the right of segment 180) comprises: a notch (See fig. 6; see semicircle cutout portions in left side of segment 180 that are above the suction bores) formed in the second segment (See figs. 6-7), the notch having a second aperture (See figs. 6-7; see aperture in top of segment 180 that receives pins 156) aligned with a first aperture of the first segment (See figs. 6-7; see aperture in top of segment 174 that receives pins 156 and is aligned with the aperture of segment 180).

Regarding Claim 4, CaterPillar teaches the fluid end of claim 3, wherein the notch (See fig. 6; see semicircle cutout portions in left side of segment 180 that are above the suction bores) is at least one of axially higher than the plurality of suction bores (See figs. 6-7) or axially lower than the plurality of suction bores.

Regarding Claim 5, CaterPillar teaches the fluid end of claim 3, wherein the notch (See fig. 6; see semicircle cutout portions in left side of segment 180 that are above the suction bores) is formed on at least one of a suction side of the second segment (See figs. 6-7; see how the first notch that is above the suction bore is located on the suction side of the fluid end block 168) or a back side of the second segment.

Regarding Claim 6, CaterPillar teaches the fluid end of claim 1, but does not specifically teach wherein the plurality of first suction bores includes three suction bores, four suction bores, or five suction bores. Further, design decisions regarding the number of suction bores fall within the ordinary skill in the art of one designing a hydraulic fracturing pump. Accordingly, it would have been obvious to one of ordinary skill in the art to have utilized routine experimentation and design choices to have chosen an appropriate number of suction bores as claimed thereby allowing for a high enough fluid capacity to fracture formations at great depths.

Regarding Claim 7, CaterPillar teaches the fluid end of claim 1, wherein each of the plurality of first suction bores, the plurality of second suction bores, and the plurality of third suction bores has an equal number of respective suction bores (See fig. 6 and claim 1 above; each plurality of suction bores has two suction bores).

Regarding Claim 8, CaterPillar teaches the fluid end of claim 1, but does not specifically teach the system further comprising: a sealing system arranged at an interface between the first segment and the second segment, the sealing system including at least one seal to control flow at the interface. However, in a further embodiment, CaterPillar teaches a hydraulic fracturing system (See fig. 3, para [0025]) comprising a first segment (130, 138 - "segments", fig. 3) and a second segment (140 - "segment", fig. 3), further comprising: a sealing system (153 - "seal", fig. 3) arranged at an interface between the first segment and the second segment (See fig. 3; seal 153 is between the discharge conduits 118 of segments 130 and 140), the sealing system including at least one seal to control flow at the interface (See fig. 3; para [0030]). Accordingly, it would have been obvious to one of ordinary skill in the art to use the sealing system of the second embodiment on the interfaces of the first embodiment in order to ensure there are no leaks between segments.

Regarding Claim 9, CaterPillar teaches the fluid end of claim 1, but does not specifically teach wherein the plurality of first suction bores, the plurality of second suction bores, and the plurality of third suction bores have a cumulative number of bores equal to at least one of nine bores, ten bores, twelve bores, or fifteen bores. Further, design decisions regarding the total number of suction bores fall within the ordinary skill in the art of one designing a hydraulic fracturing pump. Accordingly, it would have been obvious to one of ordinary skill in the art to have utilized routine experimentation and design choices to have chosen an appropriate number of total suction bores as claimed thereby allowing for a high enough fluid capacity to fracture formations at great depths.

Claims 11 and 13-14 lack an inventive step under PCT Article 33(3) as being obvious over US 2011/0081268 A1 to Ochoa et al. (hereinafter 'Ochoa').

Regarding Claim 11, Ochoa teaches a fluid end (See figs. 1-5; para [0037]) for a fracturing pump (See fig. 1; para [0037]), comprising:
a plurality of segments (See fig. 1; first segment is left two body portions 100; second segment is the right most portion 100) coupled together along a discharge axis (See fig. 3; see opening near top of end plate 118 that connects discharge paths of each portion 100 to one another; extends horizontally from end plate to end plate), the first segment having a plurality of suction bores (See fig. 1; see openings on front surface of portions 100);
respective interfaces (116 - "exterior surfaces", fig. 4) between segment pairs formed by adjacent segments of the plurality of segments, the interfaces coupling the segment pairs together (See figs. 1-4); and
respective access areas (See fig. 4; see opening in surface 116 for fastener 120) proximate the respective interfaces (See fig. 4), the respective access areas configured to provide access for mechanical couplings (120 - "fastener", fig. 4) to join the segment pairs together (See fig. 4; para [0040]-[0041]) but does not specifically teach wherein the second segment comprises a plurality of suction bores. However, the duplication of parts falls within the ordinary skill of in the art using routine experimentation and design principles. Accordingly, it would have been obvious to one of ordinary skill in the art to have the second segment be made of two fluid segments, like the first segment of Ochoa, in order to increase the fluid capacity of the pump to reach greater downhole depths.

Regarding Claim 13, Ochoa teaches the fluid end of claim 11, wherein each respective access area (See fig. 4; see opening in surface 116 for fastener 120) includes an aperture (See fig. 4; see opening in surface 116 for fastener 120) aligned along the discharge axis (See figs. 1-5; discharge axis and fastener 120 both extend horizontally from endplate 118 to end plate 118), the aperture aligning with an adjacent coupling aperture of the segment pairs (Se fig. 4; both segments have an opening to receive fastener 120).

Regarding Claim 14, Ochoa teaches the fluid end of claim 11, wherein a single access area is associated with a respective interface (See fig. 4; para [0040]-[0041]; only one of the fasteners 120 actually extends through the portions 100 so there is only a single access area per respective interface).

-*-Continued in next Supplemental Box-*-

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/67528

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 10 meets 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) CaterPillar and (2) Ochoa.

(1) CaterPillar teaches a fluid end (168 - "fluid end block", figs. 6-7; para [0034]) for a fracturing pump (para [0007], [0018], [0034]), comprising:
a first segment (collectively 176 - "segment", 174 - "replacement segment", fig. 6), the first segment having a plurality of first suction bores (See fig. 6; see bores on front of segments 176, 174) and a first discharge path (See figs. 6 and 7; see horizontal bore through segments 174, 176 that extend through the abutting surfaces of the segments 174, 176);
a second segment (See fig. 6; collectively segment 180 as well as the unlabeled segment immediately to the right of segment 180), the second segment having a plurality of second suction bores (See fig. 6; see bores on front of segment 180 and the segment to the right) and a second discharge path (See figs. 6 and 7; see horizontal bore through segment 180 and its adjacent segment that extend through the abutting surfaces of the segments 180); and
a third segment (See fig. 6; see segment on far end of fluid end block 168), the third segment having a third suction bore (See fig. 6; see bore on front of far-right segment) and a third discharge path (See figs. 6 and 7; see horizontal bore through far-right segment that extends through the abutting surfaces of the segment);
wherein the first segment is mechanically coupled to the second segment, the second segment is mechanically coupled to the third segment (See fig. 6), and each of the first discharge path, the second discharge path, and the third discharge path are aligned (See fig. 6-7; discharge paths must be aligned to allow the fluid to leave the fluid end block 168).

(2) Ochoa teaches a fluid end (See figs. 1-5; para [0037]) for a fracturing pump (See fig. 1; para [0037]), comprising: a plurality of segments (See fig. 1; first segment is left two body portions 100; second segment is the right most portion 100) coupled together along a discharge axis (See fig. 3; see opening near top of end plate 118 that connects discharge paths of each portion 100 to one another; extends horizontally from end plate to end plate), the first segment having a plurality of suction bores (See fig. 1; see openings on front surface of portions 100); wherein a second end of the first segment (See fig. 4; see right end of middle segment 100) is machined as a male end (114 - "raised surface", fig. 4).

Regarding Claim 10, CaterPillar teaches the fluid end of claim 1, but does not specifically teach wherein a first end of the first segment is machined as a female end and a second end of the first segment is machined as a male end. Further, Ochoa teaches a fluid end (See figs. 1-5; para [0037]) for a fracturing pump (See fig. 1; para [0037]), comprising: a plurality of segments (See fig. 1; first segment is left two body portions 100; second segment is the right most portion 100) coupled together along a discharge axis (See fig. 3; see opening near top of end plate 118 that connects discharge paths of each portion 100 to one another; extends horizontally from end plate to end plate), the first segment having a plurality of suction bores (See fig. 1; see openings on front surface of portions 100); wherein a second end of the first segment (See fig. 4; see right end of middle segment 100) is machined as a male end (114 - "raised surface", fig. 4). However, any combination of the above references fails to teach wherein a first end of the first segment is machined as a female end. Accordingly, the prior art does not specifically teach or fairly suggest individually or in combination the fluid end of a 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.

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 047158.500072	Date of mailing *(day/month/year)* MAR 29 2021 **FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/US 20/67146	International filing date *(day/month/year)* 28 December 2020 (28.12.2020)
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
047158.500072		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 20/67146	28 December 2020 (28.12.2020)	27 December 2019 (27.12.2019)
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 23 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 20/67146

A. CLASSIFICATION OF SUBJECT MATTER

IPC - E21B 21/08; E21B 47/06; E21B 47/008; E21B 47/017; F04D 15/00; G05B 19/042 (2021.01)

CPC - E21B 21/08; E21B 47/06; E21B 47/008; E21B 47/017; F04D 15/00; G05B 19/042; F04D 15/0088; G05B 2219/45004

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 2017/0292513 A1 (SCHLUMBERGER TECHNOLOGY CORPORATION) 12 October 2017 (12.10.2017) entire document, especially para [0019], [0035], [0056], [0059], [0069]	1-20
Y	US 2012/0150455 A1 (FRANKLIN ET AL.) 14 June 2012 (14.06.2012) entire document, especially para [0078], [0101], [0073], [0080]	1-20
Y	US 2017/0096889 A1 (SCHLUMBERGER TECHNOLOGY CORPORATION) 06 April 2017 (06.04.2017) entire document, especially para [0190], [0194]	6, 13

☐ 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
07 March 2021	MAR 29 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)* MAR 29 2021

Applicant's or agent's file reference
047158.500072

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US 20/67146	28 December 2020 (28.12.2020)	27 December 2019 (27.12.2019)

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

IPC - E21B 21/08; E21B 47/06; E21B 47/008; E21B 47/017; F04D 15/00; G05B 19/042 (2021.01)

CPC - E21B 21/08; E21B 47/06; E21B 47/008; E21B 47/017; F04D 15/00; G05B 19/042; F04D 15/0088; G05B 2219/45004

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, Virginia 22313-1450 Facsimile No. 571-273-8300	07 March 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 20/67146

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 20/67146

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	1-20	YES
	Claims	NONE	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 1-5, 7-12, and 14-20 lack an inventive step under PCT Article 33(3) as being obvious over US 2017/0292513 A1 to Schlumberger Technology Corporation (hereinafter Schlumberger 513) in view of US 2012/0150455 A1 to Franklin et al. (hereinafter Franklin).

Regarding claim 1, Schlumberger 513 discloses a method of hydraulic fracturing (abstract- Method and apparatus for assessing health of fracturing fluid pump assemblies and other wellsite equipment), comprising: providing a fracturing fluid to a pump (para [0019]- The manifold unit 140 is operable to receive the fluid via the one or more conduits 130 and distribute the fluid to the pump units 200 via corresponding conduits 136), the pump comprising a pressure sensor for measuring pressure at a fluid end (para [0035]- The pump assembly 200 may also or instead comprise one or more sensors 318 operable to generate real-time data related to fluid input (suction) pressure and/or flow rate, fluid output (discharge) pressure and/or flow rate, and/or other operational parameters of the fluid end 210); injecting the fracturing fluid from the pump into a wellhead via the fluid end (para [0019]- The pump units 200 pressurize the fluid received via the corresponding conduits 136 and return the high-pressure fluid to the manifold unit 140 via corresponding conduits 138. The high-pressure fluid may then be injected into the wellbore 104, such as via one or more conduits 131), determining a pressure differential (para [0056]- For example, continuing with the above-described examples of the first and second predictive models related to the transmission 205, a third predictive model related to the transmission 205 may predict the difference between the filter in-pressure of the transmission 205 and the filter out-pressure of the transmission, based on the other operational parameters in the real-time data). Schlumberger 513 fails to disclose, obtaining a first pressure measurement at the fluid end via the pressure sensor; obtaining a second pressure measurement at the fluid end via the pressure sensor; determining a pressure differential between the first pressure measurement and the second pressure measurement; and determining an operational condition of the fluid end based at least in part on the pressure differential and a known or estimated correlation between the pressure differential and the operational condition.

Franklin, drawn to oil and gas operations testing, discloses, obtaining a first pressure measurement at the fluid end via the pressure sensor (Fig. 2, element 20A, 12A; para [0018]- The computer system is further configured to receive pressure data from the pressure sensor... when pressurized by the source of pressurized fluid to a first test pressure; para [0078]- it will be understood that the software application can read the data and calculate the leak detection value (LDV) nearly simultaneously with the measurement of the pressure by the pressure sensor; para [0101]- one at the surface near the pumping unit 12a... The pressure sensors 20A and 20B are also in electrical communication with the computer system 22A, as is the graphical output 25A); obtaining a second pressure measurement at the fluid end via the pressure sensor (para [0018]- a second period of time when pressurized by the source of pressurized fluid to a second test pressure; para [0073]- which is a function of a variance of the first pressure at time t0 and the test pressure at time t1); determining a pressure differential between the first pressure measurement and the second pressure measurement (para [0073]- Embodiments of the software application as will be described in further detail below are configured to calculate a leak detection value, which is a function of a variance of the first pressure at time t0 and the test pressure at time t1; the test pressure at time t1 and the test pressure at time t2; and so on; para [0136]- The second pressure can be significantly different than the first pressure and, optionally, the second pressure can be orders of magnitude higher or lower than the first pressure); and determining an operational condition of the fluid end based at least in part on the pressure differential and a known or estimated correlation between the pressure differential and the operational condition (para [0080]- the software application for the computer system 22 (or operating program hardwired on a silicon chip in a specific computer), can measure the rate-of-change of the pressure within the pressure system, and then utilize this value to calculate the leak detection value (LDV); para [0130]- It should also be noted that for purposes of the validation, test 532 and leak detection value or curve 632 was selected as a benchmark as typically would be the case when conducting the test in real-time at a well site. The remaining tests show good correlation of the leak detection values; para [0127]- This reflects, in part, a change in temperature as discussed previously. As stated, it is important to differentiate between the normal decrease in pressure from a decrease in pressure relating to a problem such as a potentially harmful leak). It would have been obvious to one having ordinary skill in the art to combine the pressure analysis of Franklin with the method of Schlumberger 513 to improve the reliability and accuracy of detection (see Franklin, para [0012]- Thus, there exists a need for a system and methods for quickly and accurately performing a leak/pressure test for a pressure system; para [0127]- Regardless of the reason for adding the additional fluid, chart 600 of the calculated leak detection values will illustrate that the presently disclosed method and systems quickly and more easily allow the user of the present system to identify good tests (not leaking) from leaking pressure systems).

Regarding claim 2, Schlumberger 513 in view of Franklin disclose the method of claim 1. Franklin further discloses, wherein the first pressure measurement and second pressure measurement are derived from a pressure sample taken by the pressure sensor over a period of time (para [0073]- Embodiments of the software application as will be described in further detail below are configured to calculate a leak detection value, which is a function of a variance of the first pressure at time t0 and the test pressure at time t1; the test pressure at time t1 and the test pressure at time t2; and so on).

--see supplemental box

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/67146

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
----Continuation of Box No. V----

Regarding claim 3, Schlumberger 513 in view of Franklin disclose the method of claim 2. Franklin further discloses, wherein the first pressure measurement is the maximum value in the pressure sample and the second measurement is the minimum value in the pressure sample (para [0136]- The second pressure can be significantly different than the first pressure and, optionally, the second pressure can be orders of magnitude... lower than the first pressure).

Regarding claim 4, Schlumberger 513 in view of Franklin disclose the method of claim 2. Franklin further discloses, wherein the first pressure measurement and the second measurement represent a pressure fluctuation in the pressure sample (para [0113]- On the other hand, leak detection values 432 and 433 have a significantly different character when plotted on chart 400 as compared to the leak detection values 431, 434, and 435. Thus, whether establishing a threshold leak detection value of 0.1 for example, or comparing the leak detection values 432 and 433 against the other leak detection values 431, 434, and 435, which are good and usable as a benchmark, the slopes or graphs associated with leak detection values 432 and 433 indicate clearly that the pressure system tested in 332 and 333 differs dramatically from the others 431, 434 and 435).

Regarding claim 5, Schlumberger 513 in view of Franklin disclose the method of claim 1. Schlumberger 513 further discloses, wherein the operational condition includes an estimation of remaining life of the fluid end (para [0059]- wherein the first predetermined threshold corresponds to a first predetermined value related to operational failure of one or more of the other pump assemblies; para [0069]- The method (500) may also comprise generating (580) the predetermined thresholds utilized for comparison (530) with the generated (525) and/or abstracted (535) residual data. The generated (580) thresholds may correspond to particular amounts of operating time remaining before a failure occurs).

Regarding claim 7, Schlumberger 513 in view of Franklin disclose the method of claim 1. Franklin further discloses, wherein the first and second pressure measurements are taken at a discharge side, a suction side, or a plunger chamber of the fluid end (para [0166]- During testing the pressure sensors 1086, 1087 and flow sensor 1088 can be located anywhere on the pressure system that is in fluid communication with the fluid pathway being pressurized. As apparent to one of skill in the art, a convenient location for the sensors would be proximate the fluid pumping units 1080, 1081).

Regarding claim 8, Schlumberger 513 discloses a method of monitoring a fluid end of a hydraulic fracturing pump (abstract- Method and apparatus for assessing health of fracturing fluid pump assemblies and other wellsite equipment), determining a pressure differential (para [0056]- For example, continuing with the above-described examples of the first and second predictive models related to the transmission 205, a third predictive model related to the transmission 205 may predict the difference between the filter in-pressure of the transmission 205 and the filter out-pressure of the transmission, based on the other operational parameters in the real-time data). Schlumberger 513 fails to disclose, comprising: obtaining a first pressure measurement at the fluid end via a pressure sensor; obtaining a second pressure measurement at the fluid end via the pressure sensor, determining a pressure differential between the first pressure measurement and the second pressure measurement; and determining an operational condition of the fluid end based at least in part on the pressure differential and a known or estimated correlation between the pressure differential and the operational condition.

Franklin, drawn to oil and gas operations testing, discloses, comprising: obtaining a first pressure measurement at the fluid end via a pressure sensor (Fig. 2, element 20A, 12A; para [0018]- The computer system is further configured to receive pressure data from the pressure sensor... when pressurized by the source of pressurized fluid to a first test pressure; para [0078]- it will be understood that the software application can read the data and calculate the leak detection value (LDV) nearly simultaneously with the measurement of the pressure by the pressure sensor; para [0101]- one at the surface near the pumping unit 12a... The pressure sensors 20A and 20B are also in electrical communication with the computer system 22A, as is the graphical output 25A); obtaining a second pressure measurement at the fluid end via the pressure sensor (para [0018]- a second period of time when pressurized by the source of pressurized fluid to a second test pressure; para [0073]- which is a function of a variance of the first pressure at time t0 and the test pressure at time t1); determining a pressure differential between the first pressure measurement and the second pressure measurement (para [0073]- Embodiments of the software application as will be described in further detail below are configured to calculate a leak detection value, which is a function of a variance of the first pressure at time t0 and the test pressure at time t1; the test pressure at time t1 and the test pressure at time t2; and so on; para [0136]- The second pressure can be significantly different than the first pressure and, optionally, the second pressure can be orders of magnitude higher or lower than the first pressure); and determining an operational condition of the fluid end based at least in part on the pressure differential and a known or estimated correlation between the pressure differential and the operational condition (para [0080]- the software application for the computer system 22 (or operating program hardwired on a silicon chip in a specific computer), can measure the rate-of-change of the pressure within the pressure system, and then utilize this value to calculate the leak detection value (LDV); para [0130]- It should also be noted that for purposes of the validation, test 532 and leak detection value or curve 632 was selected as a benchmark as typically would be the case when conducting the test in real-time at a well site. The remaining tests show good correlation of the leak detection values; para [0127]- This reflects, in part, a change in temperature as discussed previously. As stated, it is important to differentiate between the normal decrease in pressure from a decrease in pressure relating to a problem such as a potentially harmful leak). It would have been obvious to one having ordinary skill in the art to combine the pressure analysis of Franklin with the method of Schlumberger 513 to improve the reliability and accuracy of detection (see Franklin, para [0012]- Thus, there exists a need for a system and methods for quickly and accurately performing a leak/pressure test for a pressure system; para [0127]- Regardless of the reason for adding the additional fluid, chart 600 of the calculated leak detection values will illustrate that the presently disclosed method and systems quickly and more easily allow the user of the present system to identify good tests (not leaking) from leaking pressure systems).

Regarding claim 9, Schlumberger 513 in view of Franklin disclose the method of claim 8. Franklin further discloses, wherein the first pressure measurement and second pressure measurement are derived from a pressure sample taken by the pressure sensor over a period of time (para [0073]- Embodiments of the software application as will be described in further detail below are configured to calculate a leak detection value, which is a function of a variance of the first pressure at time t0 and the test pressure at time t1; the test pressure at time t1 and the test pressure at time t2; and so on).
--see next page

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/67146

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
----Continuation of box No. V-----

Regarding claim 10, Schlumberger 513 in view of Franklin disclose the method of claim 9. Franklin further discloses, wherein the first pressure measurement is the maximum value in the pressure sample and the second measurement is the minimum value in the pressure sample (para [0136]- The second pressure can be significantly different than the first pressure and, optionally, the second pressure can be orders of magnitude... lower than the first pressure).

Regarding claim 11, Schlumberger 513 in view of Franklin disclose the method of claim 9. Franklin further discloses, wherein the first pressure measurement and the second measurement represent a pressure fluctuation in the pressure sample (para [0113]- On the other hand, leak detection values 432 and 433 have a significantly different character when plotted on chart 400 as compared to the leak detection values 431, 434, and 435. Thus, whether establishing a threshold leak detection value of 0.1 for example, or comparing the leak detection values 432 and 433 against the other leak detection values 431, 434, and 435, which are good and usable as a benchmark, the slopes or graphs associated with leak detection values 432 and 433 indicate clearly that the pressure system tested in 332 and 333 differs dramatically from the others 431, 434 and 435).

Regarding claim 12, Schlumberger 513 in view of Franklin disclose the method of claim 8. Schlumberger 513 further discloses, wherein the operational condition includes an estimation of remaining life of the fluid end (para [0059]- wherein the first predetermined threshold corresponds to a first predetermined value related to operational failure of one or more of the other pump assemblies; para [0069]- The method (500) may also comprise generating (580) the predetermined thresholds utilized for comparison (530) with the generated (525) and/or abstracted (535) residual data. The generated (580) thresholds may correspond to particular amounts of operating time remaining before a failure occurs).

Regarding claim 14, Schlumberger 513 in view of Franklin disclose the method of claim 8. Franklin further discloses, wherein the operational condition is determined based on one or more control system data in addition to the pressure differential (para [0166]- During testing the pressure sensors 1086, 1087 and flow sensor 1088 can be located anywhere on the pressure system that is in fluid communication with the fluid pathway being pressurized. As apparent to one of skill in the art, a convenient location for the sensors would be proximate the fluid pumping units 1080, 1081).

Regarding claim 15, Schlumberger 513 discloses a hydraulic fracturing system (abstract- Method and apparatus for assessing health of fracturing fluid pump assemblies and other wellsite equipment), comprising: a pump comprising a fluid end (Fig. 3, element 210); a pressure sensor positioned to measure pressure at the fluid end (para [0035]- The pump assembly 200 may also or instead comprise one or more sensors 316 operable to generate real-time data related to fluid input (suction) pressure and/or flow rate, fluid output (discharge) pressure and/or flow rate, and/or other operational parameters of the fluid end 210); and a control system (para [0021]- The control/power center 133 may be operable to monitor and control at least a portion of the wellsite system 100 during pumping operations), a pressure differential (para [0056]- For example, continuing with the above-described examples of the first and second predictive models related to the transmission 205, a third predictive model related to the transmission 205 may predict the difference between the filter in-pressure of the transmission 205 and the filter out-pressure of the transmission, based on the other operational parameters in the real-time data). Schlumberger 513 fails to disclose, the control system configured to: obtain a first pressure measurement at the fluid end via the pressure sensor; obtain a second pressure measurement at the fluid end via the pressure sensor; determine a pressure differential between the first pressure measurement and the second pressure measurement; and determine an operational condition of the fluid end based at least in part on the pressure differential and a known or estimated correlation between the pressure differential and the operational condition.

Franklin, drawn to oil and gas operations testing, discloses, the control system configured to (para [0018]- The computer system is further configured to receive pressure data from the pressure sensor, to store the pressure data from a first fluid pathway for a first period of time): obtain a first pressure measurement at the fluid end via the pressure sensor (Fig. 2, element 20A, 12A; para [0018]- The computer system is further configured to receive pressure data from the pressure sensor... when pressurized by the source of pressurized fluid to a first test pressure; para [0078]- it will be understood that the software application can read the data and calculate the leak detection value (LDV) nearly simultaneously with the measurement of the pressure by the pressure sensor; para [0101]- one at the surface near the pumping unit 12a... The pressure sensors 20A and 20B are also in electrical communication with the computer system 22A, as is the graphical output 25A); obtain a second pressure measurement at the fluid end via the pressure sensor (para [0018]- a second period of time when pressurized by the source of pressurized fluid to a second test pressure; para [0073]- which is a function of a variance of the first pressure at time t0 and the test pressure at time t1); determine a pressure differential between the first pressure measurement and the second pressure measurement (para [0073]- Embodiments of the software application as will be described in further detail below are configured to calculate a leak detection value, which is a function of a variance of the first pressure at time t0 and the test pressure at time t1; the test pressure at time t1 and the test pressure at time t2; and so on; para [0136]- The second pressure can be significantly different than the first pressure and, optionally, the second pressure can be orders of magnitude higher or lower than the first pressure); and determine an operational condition of the fluid end based at least in part on the pressure differential and a known or estimated correlation between the pressure differential and the operational condition (para [0080]- the software application for the computer system 22 (or operating program hardwired on a silicon chip in a specific computer), can measure the rate-of-change of the pressure within the pressure system, and then utilize this value to calculate the leak detection value (LDV); para [0130]- It should also be noted that for purposes of the validation, test 532 and leak detection value or curve 632 was selected as a benchmark as typically would be the case when conducting the test in real-time at a well site. The remaining tests show good correlation of the leak detection values; para [0127]- This reflects, in part, a change in temperature as discussed previously. As stated, it is important to differentiate between the normal decrease in pressure from a decrease in pressure relating to a problem such as a potentially harmful leak). It would have been obvious to one having ordinary skill in the art to combine the pressure analysis of Franklin with the system of Schlumberger 513 to improve the reliability and accuracy of detection (see Franklin, para [0012]- Thus, there exists a need for a system and methods for quickly and accurately performing a leak/pressure test for a pressure system; para [0127]- Regardless of the reason for adding the additional fluid, chart 600 of the calculated leak detection values will illustrate that the presently disclosed method and systems quickly and more easily allow the user of the present system to identify good tests (not leaking) from leaking pressure systems).

--see next page

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/67146

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
----Continuation of Box No. V----

Regarding claim 16, Schlumberger 513 in view of Frankilin disclose the system of claim 15. Franklin further discloses, wherein the pressure sensor is a high speed, high pressure transducer (para [0137]- FIG. 9 provides component numbers and a discussion of a series of low pressure tests that preceded each of the high pressure tests; para [0069]- such a pressure sensor 20 include the Models 509, 709, and 809 Pressure Transducers; para [0079]- The time interval at which the test pressure is sensed or measured typically occurs over a relatively short period of time, such as every 3 seconds).

Regarding claim 17, Schlumberger 513 in view of Franklin disclose the system of claim 15. Franklin further discloses, wherein the first pressure measurement and second pressure measurement are derived from a pressure sample taken by the pressure sensor over a period of time (para [0073]- Embodiments of the software application as will be described in further detail below are configured to calculate a leak detection value, which is a function of a variance of the first pressure at time t0 and the test pressure at time t1; the test pressure at time t1 and the test pressure at time t2; and so on).

Regarding claim 18, Schlumberger 513 in view of Franklin disclose the system of claim 17. Franklin further discloses, wherein the first pressure measurement is the maximum value in the pressure sample and the second measurement is the minimum value in the pressure sample (para [0136]- The second pressure can be significantly different than the first pressure and, optionally, the second pressure can be orders of magnitude... lower than the first pressure).

Regarding claim 19, Schlumberger 513 in view of Franklin disclose the system of claim 17. Franklin wherein the first pressure measurement and the second measurement represent a pressure fluctuation in the pressure sample (para [0113]- On the other hand, leak detection values 432 and 433 have a significantly different character when plotted on chart 400 as compared to the leak detection values 431, 434, and 435. Thus, whether establishing a threshold leak detection value of 0.1 for example, or comparing the leak detection values 432 and 433 against the other leak detection values 431, 434, and 435, which are good and usable as a benchmark, the slopes or graphs associated with leak detection values 432 and 433 indicate clearly that the pressure system tested in 332 and 333 differs dramatically from the others 431, 434 and 435).

Regarding claim 20, Schlumberger 513 in view of Franklin disclose the method of claim 15. Schlumberger 513 further discloses, wherein the operational condition includes an estimation of remaining life of the fluid end (para [0059]- wherein the first predetermined threshold corresponds to a first predetermined value related to operational failure of one or more of the other pump assemblies; para [0069]- The method (500) may also comprise generating (580) the predetermined thresholds utilized for comparison (530) with the generated (525) and/or abstracted (535) residual data. The generated (580) thresholds may correspond to particular amounts of operating time remaining before a failure occurs).

Claims 6 and 13 lack an inventive step under PCT Article 33(3) as being obvious over Schlumberger 513 in view of Franklin and further in view of US 2017/0096889 A1 to Schlumberger Technology Corporation (hereinafter Schlumberger 889).

Regarding claim 6, Schlumberger 513 in view of Franklin disclose the method of claim 5. Neither Schlumberger 513 nor Franklin disclose, wherein the pressure differential is negatively correlated with the estimation of remaining life.
Schlumberger 889, drawn to hydrocarbon extraction, discloses, wherein the pressure differential is negatively correlated with the estimation of remaining life (para [0190]- By removing early stages of stress patterns, a failure may be prevented, thus increasing the life expectancy of the pump and avoiding other costly operation delays. Some stress patterns are low flow, deadhead, and gas ingestion; para [0194]- Zone A reflects the deadhead event with a sudden increase in discharge pressure 321 and intake pressure 323 as well as the difference in pressures (delta pressure)). It would have been obvious to one having ordinary skill in the art to combine the negative correlation of Schlumberger 889 with the method of Schlumberger 513 to improve the reliability (see Schlumberger 889, para [0190]- By removing early stages of stress patterns, a failure may be prevented, thus increasing the life expectancy of the pump and avoiding other costly operation delays. Some stress patterns are low flow, deadhead, and gas ingestion).

Regarding claim 13, Schlumberger 513 in view of Franklin disclose the method of claim 12. Neither Schlumberger 513 nor Franklin disclose, wherein the pressure differential is negatively correlated with the estimation of remaining life.
Schlumberger 889, drawn to hydrocarbon extraction, discloses, wherein the pressure differential is negatively correlated with the estimation of remaining life (para [0190]- By removing early stages of stress patterns, a failure may be prevented, thus increasing the life expectancy of the pump and avoiding other costly operation delays. Some stress patterns are low flow, deadhead, and gas ingestion; para [0194]- Zone A reflects the deadhead event with a sudden increase in discharge pressure 321 and intake pressure 323 as well as the difference in pressures (delta pressure)). It would have been obvious to one having ordinary skill in the art to combine the negative correlation of Schlumberger 889 with the method of Schlumberger 513 to improve the reliability (see Schlumberger 889, para [0190]- By removing early stages of stress patterns, a failure may be prevented, thus increasing the life expectancy of the pump and avoiding other costly operation delays. Some stress patterns are low flow, deadhead, and gas ingestion).

Claims 1-20 have industrial applicability as defined by PCT Article 33(4) 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 047158.500073	Date of mailing *(day/month/year)* MAR 22 2021 **FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/US 20/67523	International filing date *(day/month/year)* 30 December 2020 (30.12.2020)
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
047158.500073		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 20/67523	30 December 2020 (30.12.2020)	31 December 2019 (31.12.2019)
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/US 20/67523

A. CLASSIFICATION OF SUBJECT MATTER
IPC - E21B 43/26 (2021.01)
CPC - E21B 43/26, E21B 43/267

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 2011/0110793 A1 (Leugemors et al.) 12 May 2011 (12.05.2011) Entire document especially para [0034], [0044], [0047] and figs. 2-8	1-4, 10, 12-14 ----- 5-6, 8-9, 11, 15 ----- 7
Y	US 2019/0040727 A1 (U.S. Well Services, LLC) 7 February 2019 (07.02.2019) Entire document especially para [0020]-[0022] anf figs. 1-2	5-6, 8-9, 11
Y	US 5,950,726 A (Roberts) 14 September 1999 (14.09.1999) Entire document especially col 3, ln 20-47; col 6, ln 56-64 and fig. 1	15
A	US 2019/0257462 A1 (Performance Pulsation Control, Inc.) 22 August 2019 (22.08.2019) Entire document especially para [0043] and fig. 3	7
A	US 2006/0109141 A1 (Huang et al.) 25 May 2006 (25.05.2006) Entire document	1-15
A	US 6,097,310 A (Harrell et al.) 1 August 2000 (01.08.2000) Entire document	1-15
A	US 2015/0233530 A1 (PCS Ferguson, Inc.) 20 August 2015 (20.08.2015) 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 February 2021	MAR 22 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)*	MAR 22 2021
Applicant's or agent's file reference: 047158.500073	FOR FURTHER ACTION: See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US 20/67523	30 December 2020 (30.12.2020)	31 December 2019 (31.12.2019)

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

IPC - E21B 43/26 (2021.01)

CPC - E21B 43/26, E21B 43/267

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, Virginia 22313-1450 Facsimile No. 571-273-8300	19 February 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 20/67523

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 20/67523

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	5-15	YES
	Claims	1-4	NO
Inventive step (IS)	Claims	7	YES
	Claims	1-6, 8-15	NO
Industrial applicability (IA)	Claims	1-15	YES
	Claims	None	NO

2. Citations and explanations:

Claims 1-4 lack novelty under PCT Article 33(2) as being anticipated by US 2011/0110793 A1 to Leugemors et al. (hereinafter 'Leugemors')

Regarding Claim 1, Leugemors teaches a hydraulic fracturing pump system (see figs. 2-8; para [0034], [0044]), comprising:
an electric powered hydraulic fracturing pump (102 - "pump", fig. 2; not shown clearly in figs. 3-6 but is located on top of pump fluid end inlets 224 in fig. 8; para [0034]);
a suction stabilizer/dampener (200 - "inlet stabilizer", fig. 8) coupled to a suction end of the pump (See fig. 2; see suction manifold 106; see figs. 3-8; see inlet manifold 204);
a compressed gas supply (238 - "source", fig. 8; para [0047]), fluidly coupled to the suction stabilizer/dampener (See fig. 8; para [0047]); and
a control system (collectively 234 - "valve", 236 - "regulator", 231 - "gauge", fig. 8; para [0047]) positioned along a flow path between the suction stabilizer/dampener and the compressed gas supply (See fig. 8; see flow path between source 238 and stabilizer 200), the control system comprising:
a valve (234 - "valve", fig. 8); a regulator (236 - "pressure regulator", fig. 8); and a sensor (231 - "pressure gauge", fig. 8).

Regarding Claim 2, Leugemors teaches the hydraulic fracturing pump system of claim 1, wherein the regulator (236 - "pressure regulator", fig. 8) is configured at a set pressure, the set pressure corresponding to an operating pressure for the suction stabilizer/dampener (intended use; see fig. 8; para [0047]; regulator 236 is capable of setting pressure for stabilizer to operating pressure).

Regarding Claim 3, Leugemors teaches the hydraulic fracturing pump system of claim 1, wherein the sensor is a pressure gauge (231 - "pressure gauge", fig. 8; para [0047]).

Regarding Claim 4, Leugemors teaches the hydraulic fracturing pump system of claim 1, wherein the sensor is a pressure sensor (231 - "pressure gauge", fig. 8; para [0047]) configured to transmit a signal, to the valve (234 - "valve", fig. 8), to regulate an open position or a closed position of the valve based, at least in part, on a pressure within the flow path (intended use: See fig. 8; para [0047]).

Claims 10 and 12-14 lack an inventive step under PCT Article 33(3) as being obvious over Leugemors

Regarding Claim 10, Leugemors teaches a method for controlling a pumping operation (see figs. 2-8; para [0034], [0044]), comprising:
charging a suction stabilizer/dampener (200 - "inlet stabilizer", fig. 8) via a compressed gas supply (238 - "source", fig. 8; para [0047]);
determining a charge pressure of the suction stabilizer/dampener is within a threshold of a target pressure (231 - "pressure gauge", fig. 8; para [0047]);
setting a pressure control device (collectively 234 - "valve", 236 - "regulator", 231 - "gauge", fig. 8; para [0047]), along a flow path between the suction stabilizer/dampener and the compressed gas supply (See fig. 8; see flow path between source 238 and stabilizer 200); and
operating a hydraulic fracturing pump (102 - "pump", fig. 2; not shown clearly in figs. 3-8 but is located on top of pump fluid end inlets 224 in fig. 8) coupled to the suction stabilizer/dampener (See fig. 8; para [0047]).
While Leugemors does not explicitly disclose the positive recitation of a method, the device taught by Leugemors is implicitly used to perform the claimed method. Accordingly, it would have been obvious to a person having ordinary skill in the art to have utilized the system and teachings of Leugemors, as a whole, effectively providing a method of use through enabling a user to install and use a hydraulic fracturing pump system.

Regarding Claim 12, Leugemors teaches the method of claim 10, further comprising:
determining the charge pressure is outside of the threshold (231 - "pressure gauge", fig. 8; para [0047]);
operating a valve to permit flow along the flow path (234 - "valve", fig. 8); and
increasing the charge pressure (See fig. 8; para [0047]; pressure is supplied from source 238).
While Leugemors does not explicitly disclose the positive recitation of a method, the device taught by Leugemors is implicitly used to perform the claimed method. Accordingly, it would have been obvious to a person having ordinary skill in the art to have utilized the system and teachings of Leugemors, as a whole, effectively providing a method of use through enabling a user to install and use a hydraulic fracturing pump system.

-*-Continued in Supplemental Box-*-

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/67523

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 13, Leugemors teaches the method of claim 12, wherein the determining and the operating are conducted remotely (para [0047] - in an embodiment, transmitter 232 is remote, resulting in remote control and operation). While Leugemors does not explicitly disclose the positive recitation of a method, the device taught by Leugemors is implicitly used to perform the claimed method. Accordingly, it would have been obvious to a person having ordinary skill in the art to have utilized the system and teachings of Leugemors, as a whole, effectively providing a method of use through enabling a user to install and use a hydraulic fracturing pump system.

Regarding Claim 14, Leugemors teaches the method of claim 12, wherein the determining is performed by a pressure sensor (231 - "pressure gauge", fig. 8; para [0047]) configured to transmit a signal to the valve (See fig. 8; para [0047]). While Leugemors does not explicitly disclose the positive recitation of a method, the device taught by Leugemors is implicitly used to perform the claimed method. Accordingly, it would have been obvious to a person having ordinary skill in the art to have utilized the system and teachings of Leugemors, as a whole, effectively providing a method of use through enabling a user to install and use a hydraulic fracturing pump system.

Claims 5-6, 8-9 and 11 lack an inventive step under PCT Article 33(3) as being obvious over Leugemors in view of US 2019/0040727 A1 to U.S. Well Services, LLC (hereinafter 'US').

Regarding Claim 5, Leugemors teaches the hydraulic fracturing pump system of claim 1, but does not specifically teach wherein the pump, the suction stabilizer/dampener, and the compressed gas supply are positioned on a common support structure. Further, US teaches a hydraulic fracturing pump system (See figs. 1-2; para [0020]-[0022]) comprising a pump (36 - "pump", fig. 2) and a suction stabilizer/dampener (82 - "pulsation dampener", fig. 2) positioned on a common support structure (81 - "support platform", fig. 2). Accordingly, it would have been obvious to one of ordinary skill in the art to use the support structure of US for the pump, supply and stabilizer of Leugemors in order to allow the assembly to be easily transported together.

Regarding Claim 6, the modified Leugemors teaches the hydraulic fracturing pump system of claim 5, wherein the common support structure is one of a trailer, a skid, a platform, or a truck bed (US: para [0022]).

Regarding Claim 8, the modified Leugemors teaches the hydraulic fracturing pump system of claim 1, but does not specifically teach the system further comprising: a blender positioned upstream of the electric powered hydraulic fracturing pump, wherein the suction stabilizer/dampener is positioned in at least one of a downstream position or an upstream position with respect to the blender. Further, US teaches a hydraulic fracturing pump system (See figs. 1-2; para [0020]-[0022]) comprising a pump (36 - "pump", fig. 1) and a blender (28 - "blender", fig. 1), wherein the blender is positioned upstream of the electric powered hydraulic fracturing pump (See fig. 1) and upstream of a stabilizer/dampener (82 - "pulsation dampener", fig. 2). Accordingly, it would have been obvious to one of ordinary skill in the art to use the blender of US upstream of the pump of Leugemors in order to better treat the fluid entering the well.

Regarding Claim 9, the modified Leugemors teaches the hydraulic fracturing pump system of claim 5, further comprising: an electric motor (Leugemors: para [0034] - "electric motor") configured to drive operation of the pump (Leugemors: para [0034]), the electric motor positioned on the support structure (US: 81 - "support platform", fig. 2).

Regarding Claim 11, Leugemors teaches the method of claim 10, but does not specifically teach the method further comprising: positioning the compressed gas supply on a support structure, the support structure including the hydraulic fracturing pump. Further, US teaches a hydraulic fracturing pump system (See figs. 1-2; para [0020]-[0022]) comprising a pump (36 - "pump", fig. 2) and a suction stabilizer/dampener (82 - "pulsation dampener", fig. 2) positioned on a common support structure (81 - "support platform", fig. 2). Accordingly, it would have been obvious to one of ordinary skill in the art to use the support structure of US for the pump, supply and stabilizer of Leugemors in order to allow the assembly to be easily transported together. While the modified Leugemors does not explicitly disclose the positive recitation of a method, the device taught by the modified Leugemors is implicitly used to perform the claimed method. Accordingly, it would have been obvious to a person having ordinary skill in the art to have utilized the system and teachings of the modified Leugemors, as a whole, effectively providing a method of use through enabling a user to install and use a hydraulic fracturing pump system.

Claim 15 lacks an inventive step under PCT Article 33(3) as being obvious over Leugemors in view of US 5,950,726 A to Roberts (hereinafter 'Roberts').

Regarding Claim 15, Leugemors teaches the method of claim 12, wherein the valve is a valve (234 - "valve", fig. 8) with an actuator (not shown but valve 234 must be actuated somehow) that, responsive to the determining, moves the valve between an open position and a closed position (See fig. 8; para [0047]) but does not specifically teach wherein the valve is a ball valve. Further, Roberts teaches a hydraulic fracturing pump system (See fig. 1; col 3, ln 20-47) comprising a pressure sensor (60 - "pressure gauge", fig 1) and a valve (61 - "ball valve", fig. 1; col 6, ln 56-64). Accordingly it would have been obvious to one of ordinary skill in the art to use the ball valve of Roberts on the valve of Leugemors in order to allow for easy transitioning between open and closed positions. While the modified Leugemors does not explicitly disclose the positive recitation of a method, the device taught by the modified Leugemors is implicitly used to perform the claimed method. Accordingly, it would have been obvious to a person having ordinary skill in the art to have utilized the system and teachings of the modified Leugemors, as a whole, effectively providing a method of use through enabling a user to install and use a hydraulic fracturing pump system.

-*-Continued in next Supplemental Box-*-

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 20/67523

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 7 meets 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) Leugemors and (2) US 2019/0257462 A1 to Performance Pulsation Control, Inc. (hereinafter 'Pulsation')

(1) Leugemors teaches a hydraulic fracturing pump system (see figs. 2-8; para [0034], [0044]), comprising:
an electric powered hydraulic fracturing pump (102 - "pump", fig. 2; not shown clearly in figs. 3-8 but is located on top of pump fluid end inlets 224 in fig. 6);
a suction stabilizer/dampener (200 - "inlet stabilizer", fig. 8) coupled to a suction end of the pump (See fig. 2; see suction manifold 106; see figs. 3-8; see inlet manifold 204);
a compressed gas supply (238 - "source", fig. 8; para [0047]), fluidly coupled to the suction stabilizer/dampener (See fig. 8; para [0047]); and
a control system (collectively 234 - "valve", 236 - "regulator", 231 - "gauge", fig. 8; para [0047]) positioned along a flow path between the suction stabilizer/dampener and the compressed gas supply (See fig. 8; see flow path between source 238 and stabilizer 200), the control system comprising:
a valve (234 - "valve", fig. 8); a regulator (236 - "pressure regulator", fig. 8); and a sensor (231 - "pressure gauge", fig. 8).

(2) Pulsation teaches a pump system (See fig. 3; para [0043]) comprising a pump (top 304 - "pump", fig. 3), a stabilizer/dampener (302 - "dampener device", fig. 3) and a second pump (bottom 304 - "pump", fig. 3) being coupled to the stabilizer/dampener (See fig. 3).

Regarding Claim 7, Leugemors teaches the hydraulic fracturing pump system of claim 1, but does not specifically teach the system further comprising: a second electric powered hydraulic fracturing pump, the second electric powered hydraulic fracturing pump being coupled, at a second suction end, to the suction stabilizer/dampener. Further, Pulsation teaches a pump system (See fig. 3; para [0043]) comprising a pump (top 304 - "pump", fig. 3), a stabilizer/dampener (302 - "dampener device", fig. 3) and a second pump (bottom 304 - "pump", fig. 3) being coupled to the stabilizer/dampener (See fig. 3). However, the system of Pulsation is a drilling system, not a hydraulic fracturing system. Additionally, the stabilizer/dampener of Pulsation that couples to two pumps is on the suction side of the pump, but rather on the outlet side. Accordingly, the prior art does not specifically teach or fairly suggest individually or in combination the 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.

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)* MAR 11 2021
Applicant's or agent's file reference 047158.500076	**FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/US2020/066543	International filing date *(day/month/year)* 22 December 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
047158.500076		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/US2020/066543	22 December 2020	30 December 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/US2020/066543

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - E21B 43/26; B01F 3/00; B01F 7/16; B01F 13/10; B01F 15/00; E21B 21/06; E21B 43/17 (2021.01)
CPC - E21B 43/26; B01F 5/10; B01F 7/16; B01F 13/00; B01F 15/00; E21B 21/06; E21B 43/267 (2021.02)

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 2010/0172202 A1 (BORGSTADT) 08 July 2010 (08.07.2010) entire document	1-15
A	US 2008/0164023 A1 (DYKSTRA et al) 10 July 2008 (10.07.2008) entire document	1-15
A	US 2005/0201197 A1 (DUELL et al) 15 September 2005 (15.09.2005) entire document	1-15
A	US 2001/0000996 A1 (GRIMLAND et al) 10 May 2001 (10.05.2001) entire document	1-15
A	US 5,114,239 A (ALLEN) 19 May 1992 (19.05.1992) 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
09 February 2021	MAR 11 2021
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)* MAR 11 2021

Applicant's or agent's file reference
047158.500076

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2020/066543	22 December 2020	30 December 2019

International Patent Classification (IPC) or both national classification and IPC
IPC(8) - E21B 43/26; B01F 3/00; B01F 7/16; B01F 13/10; B01F 15/00; E21B 21/06; E21B 43/17 (2021.01)
CPC - E21B 43/26; B01F 5/10; B01F 7/16; B01F 13/00; B01F 15/00; E21B 21/06; E21B 43/267 (2021.02)

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	09 February 2021	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/US2020/066543

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/US2020/066543

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 out in PCT Article 33(2)-(3), because the prior art does not teach or fairly suggest:

Regarding claim 1, the prior art of record, individually or in combination, does not teach or fairly suggest a system characterized by: a first tub and a second tub to be associated with a fracturing fluid blender, the second tub adapted to circumvent an outside diameter of the first tub and adapted with a height that is determined based in part on at least one overflow constraint of an application of the fracturing fluid blender; and one or more valves and routing pipes associated with the second tub to direct an overflow fluid received in the second tub, from the first tub, to be returned to the first tub upon a determination that the first tub has a capacity to handle the overflow fluid.

The following prior art is made of record to support and further define the reasons that claim 1 meets the criteria set out in PCT Article 33 (2)-(3):

Borgstadt discloses a system (mixer system 100, fig. 1) characterized by: a first tub (first mixing tub 102, fig. 1) and a second tub (second mixing tub 104, fig. 1) to be associated with a fracturing fluid blender ("a formation fracturing operation during well completion and/or production enhancement operations. The first mixer system 100 may also be suitable to other continuous mixing operations", para. [0023]), the second tub adapted with a height that is determined based in part on at least one overflow constraint of an application of the fracturing fluid blender ("The first mixing tub 102 may be positioned and/or configured to flow the mixture into the second mixing tub 104. In an embodiment, the first mixing tub 102 comprises a weir over which the mixture overflows the first mixing tub 102 into the second mixing tub 104", para. [0025]); and one or more valves ("The first actuator 106 and the second actuator 108 may be any of valves", para. [0028]).
However Borgstadt fails to disclose the second tub adapted to circumvent an outside diameter of the first tub, and routing pipes associated with the second tub to direct an overflow fluid received in the second tub, from the first tub, to be returned to the first tub upon a determination that the first tub has a capacity to handle the overflow fluid.

Dykstra et al. (hereinafter Dykstra) discloses a system (physical plant 10, fig. 1) characterized by: a first tub (first tank 12, fig. 1) and a second tub (second tank 16, fig. 1) to be associated with a fracturing fluid blender ("proppants and a carrier fluid may be dispensed through the first and second actuators 18, 20 into the first tank 10 to form a portion of a fracturing fluid", para. [0030]), the second tub adapted with a height that is determined based in part on at least one overflow constraint of an application of the fracturing fluid blender ("When the first mixture 13 fills the first tank 12 to the height of the weir 14, the first mixture 13 overflows into the second tank 16", para. [0029]); and one or more valves ("In this embodiment, the first and second actuators 18, 20 may be valves", para. [0030]).
However Dykstra fails to disclose the second tub adapted to circumvent an outside diameter of the first tub, and routing pipes associated with the second tub to direct an overflow fluid received in the second tub, from the first tub, to be returned to the first tub upon a determination that the first tub has a capacity to handle the overflow fluid.

Duell et al. (hereinafter Duell) discloses a system (system 10, fig. 1) characterized by: a first tub (compartment 16, fig. 1) and a second tub (compartment 18, fig. 1) to be associated with a fracturing fluid blender ("Other applications include, but are not limited to, the mixing of drilling fluids, fracturing fluids, and emulsions of water and non-aqueous liquids", para. [0030]), the second tub adapted with a height that is determined based in part on at least one overflow constraint of an application of the fracturing fluid blender (fig. 1 shows the compartment 18 adapted with a height that is determined based on part on at least one overflow constraint of fracture fluid from the compartment 16); and one or more valves (valve 44, fig. 1) and routing pipes (flow line 45, fig. 1) associated with the second tub (fig. 1 shows valve 44 and flow line 45 associated with the compartment 18) to direct an overflow fluid received in the second tub (fig. 1 shows the overflow from the compartment 16 is being directed by the valve 44 and the flow line 45).
However Duell fails to disclose the second tub adapted to circumvent an outside diameter of the first tub, from the first tub, to be returned to the first tub upon a determination that the first tub has a capacity to handle the overflow fluid.

None of the cited prior art references taken alone or in combination disclose or suggest the second tub adapted to circumvent an outside diameter of the first tub; direct an overflow fluid received in the second tub, from the first tub, to be returned to the first tub upon a determination that the first tub has a capacity to handle the overflow fluid as recited above, and none of the cited references cure the deficiencies of Borgstadt, Dykstra and Duell discussed in this written opinion.

Claims 2-10 depend from claim 1, and therefore meet the criteria set out in PCT Article 33(2)-(3) for at least the same reasons as claim 1.

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2020/066543

Supplemental Box

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

Regarding claim 11, the prior art of record, individually or in combination, does not teach or fairly suggest a method characterized by: associating a first tub and a second tub with a fracturing fluid blender; enabling the second tub to circumvent an outside diameter of the first tub and to include a height that is a determined based in part on at least one overflow constraint of an application of the fracturing fluid blender; and associating one or more valves and routing pipes with the second tub to direct an overflow fluid received in the second tub, from the first tub, to be returned to the first tub upon a determination that the first tub has a capacity to handle the overflow fluid.

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):

Borgstadt discloses a method (mixer system 100, fig. 1; the device is disclosed, therefore the method is disclosed) characterized by: associating a first tub (first mixing tub 102, fig. 1) and a second tub (second mixing tub 104, fig. 1) with a fracturing fluid blender ("a formation fracturing operation during well completion and/or production enhancement operations. The first mixer system 100 may also be suitable to other continuous mixing operations", para. [0023]); enabling the second tub to include a height that is a determined based in part on at least one overflow constraint of an application of the fracturing fluid blender ("The first mixing tub 102 may be positioned and/or configured to flow the mixture into the second mixing tub 104. In an embodiment, the first mixing tub 102 comprises a weir over which the mixture overflows the first mixing tub 102 into the second mixing tub 104", para. [0025]); and associating one or more valves ("The first actuator 106 and the second actuator 108 may be any of valves", para. [0028]).
However Borgstadt fails to disclose enabling the second tub to circumvent an outside diameter of the first tub, routing pipes with the second tub to direct an overflow fluid received in the second tub, from the first tub, to be returned to the first tub upon a determination that the first tub has a capacity to handle the overflow fluid.

Dykstra discloses a method (physical plant 10, fig. 1; the device is disclosed, therefore the method is disclosed) characterized by: associating a first tub (first tank 12, fig. 1) and a second tub (second tank 16, fig. 1) with a fracturing fluid blender ("proppants and a carrier fluid may be dispensed through the first and second actuators 18, 20 into the first tank 10 to form a portion of a fracturing fluid", para. [0030]); enabling the second tub to include a height that is a determined based in part on at least one overflow constraint of an application of the fracturing fluid blender ("When the first mixture 13 fills the first tank 12 to the height of the weir 14, the first mixture 13 overflows into the second tank 16", para. [0029]); and associating one or more valves ("In this embodiment, the first and second actuators 18, 20 may be valves", para. [0030]).
However Dykstra fails to disclose enabling the second tub to circumvent an outside diameter of the first tub, routing pipes with the second tub to direct an overflow fluid received in the second tub, from the first tub, to be returned to the first tub upon a determination that the first tub has a capacity to handle the overflow fluid.

Duell discloses a method (system 10, fig. 1; the device is disclosed, therefore the method is disclosed) characterized by: associating a first tub (compartment 16, fig. 1) and a second tub (compartment 18, fig. 1) with a fracturing fluid blender ("Other applications include, but are not limited to, the mixing of drilling fluids, fracturing fluids, and emulsions of water and non-aqueous liquids", para. [0030]); enabling the second tub to include a height that is a determined based in part on at least one overflow constraint of an application of the fracturing fluid blender (fig. 1 shows the compartment 18 adapted with a height that is determined based on part on at least one overflow constraint of fracture fluid from the compartment 16); and associating one or more valves (valve 44, fig. 1) and routing pipes (flow line 45, fig. 1) with the second tub to direct an overflow fluid received in the second tub, from the first tub (fig. 1 shows the overflow from the compartment 16 is being directed by the valve 44 and the flow line 45).
However Duell fails to disclose enabling the second tub to circumvent an outside diameter of the first tub, to be returned to the first tub upon a determination that the first tub has a capacity to handle the overflow fluid.

None of the cited prior art references taken alone or in combination disclose or suggest enabling the second tub to circumvent an outside diameter of the first tub, to be returned to the first tub upon a determination that the first tub has a capacity to handle the overflow fluid as recited above, and none of the cited references cure the deficiencies of Borgstadt, Dykstra and Duell discussed in this written opinion.

Claims 12-15 depend from claim 11, and therefore meet the criteria set out in PCT Article 33(2)-(3) for at least the same reasons as claim 11.

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.

Electronic Patent Application Fee Transmittal

Application Number:	16597014
Filing Date:	09-Oct-2019
Title of Invention:	MODULAR SWITCHGEAR SYSTEM AND POWER DISTRIBUTION FOR ELECTRIC OILFIELD EQUIPMENT
First Named Inventor/Applicant Name:	Jared Oehring
Filer:	Taylor P. Evans/Tina Fluharty
Attorney Docket Number:	047158.100048

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:	42929209
Application Number:	16597014
International Application Number:	
Confirmation Number:	4687
Title of Invention:	MODULAR SWITCHGEAR SYSTEM AND POWER DISTRIBUTION FOR ELECTRIC OILFIELD EQUIPMENT
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:	047158.100048
Receipt Date:	08-JUN-2021
Filing Date:	09-OCT-2019
Time Stamp:	14:53:19
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	E202168E53400430
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)	047158-100048-IDS.pdf	69992 d35eac39680eaa88e920b8a4e85a482319bbbb57	no	6
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
2	Foreign Reference	CN104117308A.pdf	343198 bf39ac44913e2e686e5355c8296ae27ef8a03527	no	5
Warnings:					
Information:					
3	Foreign Reference	CN104117308-abstract1.pdf	64331 14f0909adf7049d132a89ab533c7a8bc88d73122	no	1
Warnings:					
Information:					
4	Foreign Reference	CN112196508A.pdf	732379 30ced7f991ed4365ce2b0a1e1e77524e1d420fdb	no	10
Warnings:					
Information:					
5	Foreign Reference	CN112196508-abstract1.pdf	100282 62c5b27dd7462b71d3b35da6a23d6c9ed98d12de	no	2
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6	Non Patent Literature	ISR-1.pdf	1674393 3801f59777062bd2c70317c77eb0237479296172	no	10
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Information:					
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Warnings:					
Information:					
			Total Files Size (in bytes):	10139308	

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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.

Espacenet

Bibliographic data: CN104117308 (A) — 2014-10-29

Device for mixing and preparing coating

Inventor(s): HUANG XINLIANG ± (HUANG XINLIANG)

Applicant(s): DANYANG HISENSE PAINT CHEMICAL PLANT ± (DANYANG HISENSE PAINT CHEMICAL PLANT)

Classification: **- international:** ***B01F7/18***
- cooperative:

Application number: CN201410362107 20140728 Global Dossier

Priority number(s): CN201410362107 20140728

Abstract of CN104117308 (A)

The invention provides a device for mixing and preparing a coating. The device comprises a blending bucket, a stirring bucket and a storage bucket, wherein the storage bucket is connected with the blending bucket through a pipeline; the blending bucket is connected with the stirring bucket through another pipeline; both the blending bucket and the stirring bucket are connected with air exhausters; an additive feeding box is arranged on the blending bucket; a discharge tube is arranged at the right end of the stirring bucket; a filling machine is connected with the tail end of the discharge tube. The device is used for preparing the coating by adopting the blending bucket and the stirring bucket, the blending bucket and the stirring bucket are vacuumed through the air exhausters, and the coating is pressed to a next procedure through barometric pressure, so that a water pump does not need to participate in conveying, the preparation efficiency is improved, and the situation that the coating is left in the water pump and is hard to clean because of large viscosity is avoided.

(19)中华人民共和国国家知识产权局

(12)发明专利申请

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代理人 沈志海

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B01F 7/18(2006.01)

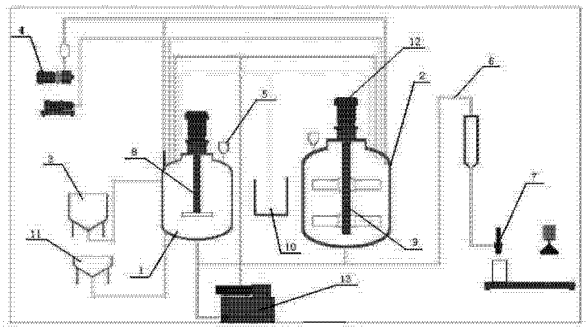
权利要求书1页 说明书2页 附图1页

(54)发明名称

涂料混合制备装置

(57)摘要

本发明提供一种涂料混合制备装置，包括配料桶、搅拌桶和储料桶，所述储料桶与配料桶通过管道连接，所述配料桶与搅拌桶通过管道连接，所述配料桶和搅拌桶上都连接有抽气机，所述配料桶上设置有辅助剂加装盒，所述搅拌桶右端设置有卸料管，所述卸料管末端连接有灌装机。通过配料桶和搅拌桶对涂料进行配置，并且通过抽气机对配料桶及搅拌桶进行抽真空处理，通过大气压将涂料压入下一道工序，避免水泵参与运输，提高制作效率，且防止由于涂料粘度过大残留在水泵中无法清理。



CN 104117308 A

1. 一种涂料混合制备装置，其特征在于：包括配料桶（1）、搅拌桶（2）和储料桶（3），所述储料桶（3）与配料桶（1）通过管道连接，所述配料桶（1）与搅拌桶（2）通过管道连接，所述配料桶（1）和搅拌桶（2）上都连接有抽气机（4），所述配料桶（1）上设置有辅助剂加装盒（5），所述搅拌桶（2）右端设置有卸料管（6），所述卸料管（6）末端连接有灌装机（7）。

2. 如权利要求 1 所述的涂料混合制备装置，其特征在于：所述配料桶（1）中设置有高速分散装置（8），所述搅拌桶（2）中设置有搅拌装置（9）。

3. 如权利要求 1 所述的涂料混合制备装置，其特征在于：所述搅拌桶（2）左侧设置有乳液添加桶（10），所述乳液添加桶（10）通过管道连接在搅拌桶（2）上。

4. 如权利要求 1 所述的涂料混合制备装置，其特征在于：所述储料桶（3）旁边设置有辅助储料桶（11），方便不间断工作。

5. 如权利要求 2 所述的涂料混合制备装置，其特征在于：所述配料桶（1）和搅拌桶（2）上设置有转动电机（12），所述转动电机（12）连接在高速分散装置（8）和搅拌装置（9）上。

6. 如权利要求 1-3 任意一项所述的涂料混合制备装置，其特征在于：所述配料桶（1）和搅拌桶（2）之间的管道上设置有流量记录机（13）。

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涂料混合制备装置

技术领域

[0001] 本发明涉及涂料制造设备领域，更具体的说是涉及一种自动混合制备涂料的涂料混合制备装置。

背景技术

[0002] 在涂料制备时，需要将不同的原料加水混合成为涂料，而目前在制备涂料时，需要人工进行一步一步的监控，并且不时需要参与配置，工作繁琐且容易出现人工失误，而在现有的制备装置还需要通过水泵进行料筒之间的运输，容易污染涂料，且由于涂料粘度较大，水泵中的残留物质无法完全清洗。因此，解决涂料制备时工作复杂且转移不便的问题就显得尤为重要了。

发明内容

[0003] 本发明的目的是提供一种自动混合制备涂料的涂料混合制备装置，通过一系列装置的配合，自动对涂料进行配置，并且通过抽气机，通过抽真空的方式进行涂料的运输，避免了水泵参与，解决了涂料制备时工作复杂且转移不便的问题。

[0004] 本发明提供一种涂料混合制备装置，包括配料桶、搅拌桶和储料桶，所述储料桶与配料桶通过管道连接，所述配料桶与搅拌桶通过管道连接，所述配料桶和搅拌桶上都连接有抽气机，所述配料桶上设置有辅助剂加装盒，所述搅拌桶右端设置有卸料管，所述卸料管末端连接有灌装机。

[0005] 进一步改进在于：所述配料桶中设置有高速分散装置，所述搅拌桶中设置有搅拌装置，所述搅拌装置上设置有两个搅拌叶。

[0006] 进一步改进在于：所述搅拌桶左侧设置有乳液添加桶，所述乳液添加桶通过管道连接在搅拌桶上。

[0007] 进一步改进在于：所述储料桶旁边设置有辅助储料桶，方便不间断工作。

[0008] 进一步改进在于：所述配料桶和搅拌桶上设置有转动电机，所述转动电机连接在高速分散装置和搅拌装置上。

[0009] 进一步改进在于：所述配料桶和搅拌桶之间的管道上设置有流量记录机。

[0010] 本发明的有益效果：通过配料桶和搅拌桶对涂料进行配置，并且通过抽气机对配料桶及搅拌桶进行抽真空处理，通过大气压将涂料压入下一道工序，避免水泵参与运输，提高制作效率，且防止由于涂料粘度过大残留在水泵中无法清理。

附图说明

[0011] 图 1 是本发明的结构示意图。

[0012] 其中：1- 配料桶，2- 搅拌桶，3- 储料桶，4- 抽气机，5- 辅助剂加装盒，6- 卸料管，7- 灌装机，8- 高速分散装置，9- 搅拌装置，10- 乳液添加桶，11- 辅助储料桶，12- 转动电机，13- 流量记录机。

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具体实施方式

[0013] 为了加深对本发明的理解，下面将结合实施例对本发明作进一步详述，该实施例仅用于解释本发明，并不构成对本发明保护范围的限定。

[0014] 如图 1 所示，本实施例提供了一种涂料混合制备装置，包括配料桶 1、搅拌桶 2 和储料桶 3，所述储料桶 3 与配料桶 1 通过管道连接，所述配料桶 1 与搅拌桶 2 通过管道连接，所述配料桶 1 和搅拌桶 2 上都连接有抽气机 4，所述配料桶 1 上设置有辅助剂加装盒 5，所述搅拌桶 2 右端设置有卸料管 6，所述卸料管 6 末端连接有灌装机 7。所述配料桶 1 中设置有高速分散装置 8，所述搅拌桶 2 中设置有搅拌装置 9。所述搅拌桶 2 左侧设置有乳液添加桶 10，所述乳液添加桶 10 通过管道连接在搅拌桶 2 上。所述储料桶 3 旁边设置有辅助储料桶 11，方便不间断工作。所述配料桶 1 和搅拌桶 2 上设置有转动电机 12，所述转动电机 12 连接在高速分散装置 8 和搅拌装置 9 上。所述配料桶 1 和搅拌桶 2 之间的管道上设置有流量记录机 13。通过配料桶 1 和搅拌桶 2 对涂料进行配置，并且通过抽气机 4 对配料桶 1 及搅拌桶 2 进行抽真空处理，通过大气压将涂料压入下一道工序，避免水泵参与运输，提高制作效率，且防止由于涂料粘度过大残留在水泵中无法清理。

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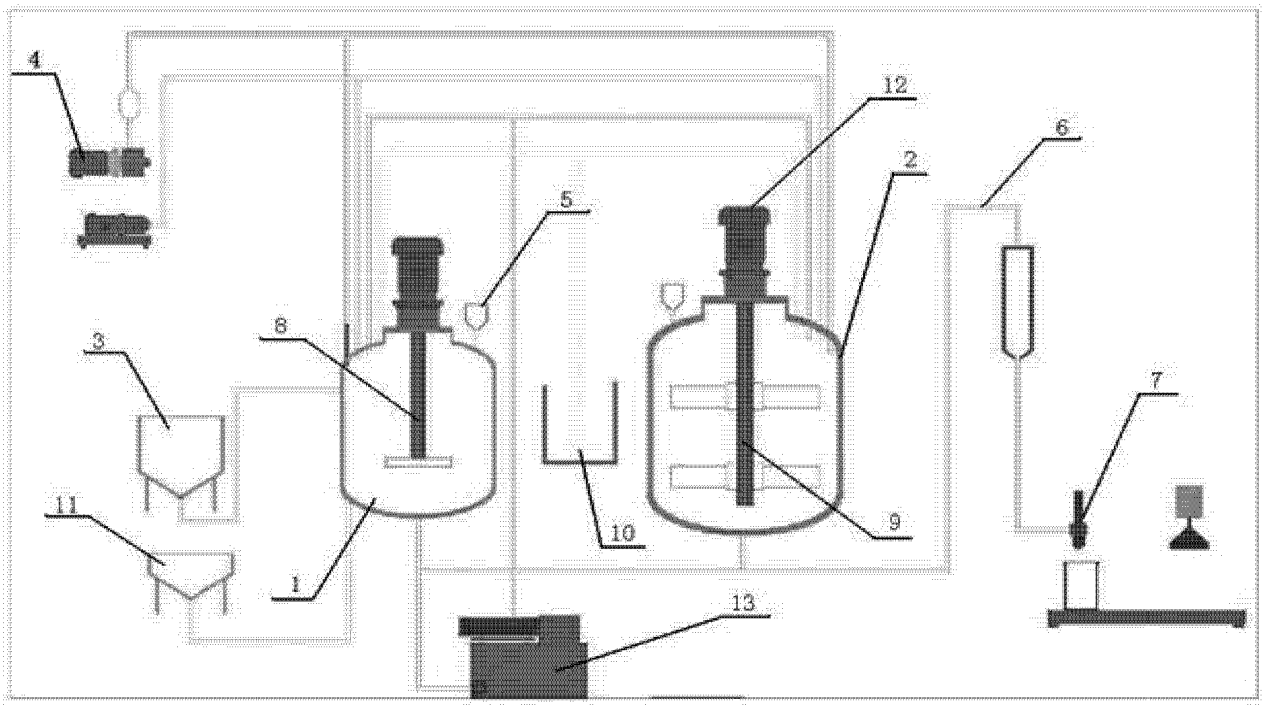


图 1

LIBERTY EXHIBIT 1002, Page 152

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Bibliographic data: CN112196508 (A) — 2021-01-08

Full-automatic liquid adding device for fracturing construction and adding calibration method

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Applicant(s): CHINA NAT PETROLEUM CORP; CNPC CHUANQING DRILLING ENG CO ± (中国石油天然气集团有限公司, ; 中国石油集团川庆钻探工程有限公司)

Classification: - international: ***B01F15/04; E21B43/26; G01F1/76; G01F25/00***
- cooperative: **B01F15/04 (CN); E21B43/26 (CN); G01F1/76 (CN); G01F25/0007 (CN)**

Application number: CN20201165942 20200930 Global Dossier

Priority number(s): CN20201165942 20200930

Abstract of CN112196508 (A)

The invention belongs to the technical field of fracturing construction mechanization, and particularly provides a full-automatic liquid adding device for fracturing construction and an adding calibration method. The full-automatic liquid adding device comprises a prying frame, an engine, a transfer case, a hydraulic device, a liquid adding pump, a metering calibration tank, a liquid additive tank, a liquid supply pump and a control unit, wherein the input ends of the engine, the transfer case and the hydraulic device are sequentially connected; the output end of the hydraulic device is connected with the liquid supply pump and the liquid adding pump; the liquid supply pump is connected with an inlet of the liquid additive tank; an outlet of the liquid additive tank is sequentially connected with inlets of the metering calibration tank, the liquid adding pump and the liquid additive tank; the control unit is electrically connected with the engine, the transfer case, the hydraulic device, the liquid adding pump, the metering calibration tank, the liquid supply pump and the liquid additive tank; and the current situation that in the fracturing construction process, the liquid additive adding precision

is large in adding difficulty and discontinuous is avoided, the mechanization and automation degree of fracturing construction is improved, meanwhile, the construction quality and potential safety hazards are effectively eliminated, and the construction success rate is increased.

(19)中华人民共和国国家知识产权局

(12)发明专利申请

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代理人 鲍燕平

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B01F 15/04(2006.01)
G01F 1/76(2006.01)
G01F 25/00(2006.01)

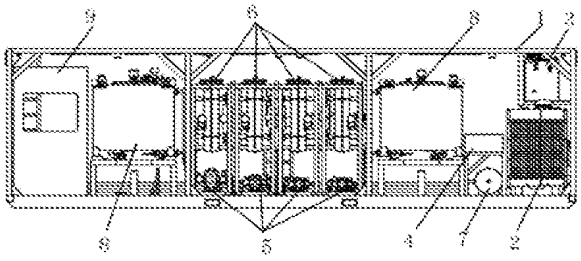
权利要求书2页 说明书6页 附图1页

(54)发明名称

一种压裂施工全自动液体添加装置及添加校准方法

(57)摘要

本发明属于压裂施工机械化技术领域，具体提供了压裂施工全自动液体添加装置及添加校准方法，包括撬架、发动机、分动箱、液压装置、液体添加泵、计量标校罐、液体添加剂罐、供液泵和控制单元，发动机、分动箱和液压装置的输入端依次连接，液压装置的输出端分别连接供液泵和液体添加泵，供液泵连接液体添加剂罐的入口，液体添加剂罐的出口依次连接计量标校罐、液体添加泵和液体添加剂罐的入口；控制单元分别电连接发动机、分动箱、液压装置、液体添加泵、计量标校罐、供液泵、液体添加剂罐，解决了压裂施工过程中入液体添加剂精确加入难度大且不连续的现状，提高压裂施工机械化、自动化程度，同时有效消除施工质量和安全隐患，提高施工成功率。



CN 112196508 A

1.一种压裂施工全自动液体添加装置，其特征在于：包括撬架(1)、发动机(2)、分动箱(3)、液压装置(4)、液添单元、供液泵(7)和控制单元(9)，液添单元的数量为多个，每个液添单元包括液体添加泵(5)、计量标校罐(6)、液体添加剂罐(8)；发动机(2)、分动箱(3)、液压装置(4)、液添单元、供液泵(7)和控制单元(9)均连接在撬架(1)上；发动机(2)、分动箱(3)和液压装置(4)的输入端依次连接，液压装置(4)的输出端分别连接供液泵(7)和每个液添单元的液体添加泵(5)，供液泵(7)连接每个液添单元的液体添加剂罐(8)的入口，每个液体添加剂罐(8)的出口依次连接该液添单元的计量标校罐(6)、液体添加泵(5)和液体添加剂罐(8)的入口；控制单元(9)分别电连接发动机(2)、分动箱(3)、液压装置(4)、液体添加泵(5)、计量标校罐(6)、供液泵(7)、液体添加剂罐(8)。

2.如权利要求1所述的压裂施工全自动液体添加装置，其特征在于：所述发动机(2)、分动箱(3)、液压装置(4)、控制单元(9)的数量均为1个，液体添加泵(5)、计量标校罐(6)、液体添加剂罐(8)的数量均为4个，供液泵(7)的数量为3个，发动机(2)、分动箱(3)、液压装置(4)、液添单元、供液泵(7)和控制单元(9)均连于撬架(1)内部，控制单元(9)位于撬架(1)左部内侧，控制单元(9)右侧自前向后分布2个液体添加剂罐(8)，2个液体添加剂罐(8)的右侧上部自左向右依次分布4个计量标校罐(6)，2个供液泵(7)的右侧下部自左向右依次分布4个液体添加泵(5)，计量标校罐(6)和液体添加泵(5)的右侧自前向后依次分布另2个液体添加剂罐(8)，另2个液体添加剂罐(8)的右侧中部分布液压装置(4)，另2个液体添加剂罐(8)的右侧下部自前向后依次分布3个供液泵(7)，液压装置(4)和供液泵(7)的右侧自上向下依次分布分动箱(3)和发动机(2)。

3.如权利要求1所述的压裂施工全自动液体添加装置，其特征在于：所述液体添加剂罐(8)的罐顶设有人孔、呼吸帽和下罐人梯。

4.如权利要求1所述的压裂施工全自动液体添加装置，其特征在于：所述液体添加剂罐(8)的底部开设有排残液口。

5.如权利要求1所述的压裂施工全自动液体添加装置，其特征在于：所述液体添加剂罐(8)内设有搅拌器。

6.如权利要求2所述的压裂施工全自动液体添加装置，其特征在于：所述4个液添单元的液体添加泵(5)均为转子泵，压力≥0.5MPa，排量分别为：5-50L/M、5-50L/M、15-150L/M、35-350L/M。

7.如权利要求1所述的压裂施工全自动液体添加装置，其特征在于：液添单元还包括质量流量计，液体添加泵(5)的出口通过质量流量计连接液体添加剂罐(8)的入口。

8.如权利要求1所述的压裂施工全自动液体添加装置，其特征在于：所述计量标校罐(6)设有容积刻度。

9.一种压裂施工全自动液体添加校准方法，其特征在于：包括如下步骤：发动机(2)为分动箱(3)提供动力，分动箱(3)驱动液压装置(4)，液压装置(4)为供液泵(7)和液体添加泵(5)提供压力，供液泵(7)为液体添加剂罐(8)供应施工液体；当对施工液体的输出排量进行校准时，液体添加泵(5)从液体添加剂罐(8)内抽吸施工液体进入计量标校罐(6)内，并标定计量标校罐(6)内施工液体的体积，然后液体添加泵(5)将计量标校罐(6)内的施工液体经质量流量计计量后泵送排入液体添加剂罐(8)内，再将标定计量标校罐(6)内施工液体的体积与质量流量计的计量值进行对比，对质量流量计进行校准，实现施工液体的输出排量的

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校准；控制单元(9)对发动机(2)、分动箱(3)、液压装置(4)、液体添加泵(5)、计量标校罐(6)、供液泵(7)和液体添加剂罐(8)进行监控。

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一种压裂施工全自动液体添加装置及添加校准方法

技术领域

[0001] 本发明属于压裂施工机械化、自动化技术领域，具体涉及一种压裂施工全自动液体添加装置及添加校准方法。

背景技术

[0002] 水基压裂液是目前国内油气田增产改造压裂液的主题，压裂液主要作用是携砂和造缝，不仅是决定压裂施工成败的关键因素之一，也是压裂增产有效性的保障。目前致密气区域连续混配配液时，将各种水剂料按照设计配比混合倒入水剂料池内，由混配车液添泵按照总配比进行泵注，该添加方式因传统计量方式缺陷，导致单位体积内胍胶基液与水剂料的配比不均，达不到设计配比要求，从而影响液体性能；加之现场甲方及监督对配液过程的要求日益严格，因此必须改变常规添加方式；同时传统配液方式，在添加水剂料的过程中，需要吊车一台，操作人员3名配合，该过程中存在吊装风险，车辆移动、液体飞溅、人员摔伤等风险。

[0003] 针对传统配液方式存在的问题，进行全流程优化设计，将液体添加剂按照设计要求配比单独泵注，开发一台自带动力源，可满足液体独立存储、单独泵注，自动化控制，且泵注排量可随时校准的全自动高精度液添装置，确保配液过程中精细质量控制，达到严格按照配比添加的要求，同时实现机械化“五省”目标，对提高压裂液性能和施工成功率具有重要意义。

发明内容

[0004] 本发明提供的一种压裂施工全自动液体添加装置及添加校准方法目的一是克服现有技术中压裂施工过程中入液体添加剂精确加入难度大且不连续的现状问题；目的二是克服现有技术中压裂施工过程中存在吊装风险，车辆移动、液体飞溅、人员摔伤的问题。

[0005] 为此，本发明提供了一种压裂施工全自动高精度液体添加装置，包括撬架、发动机、分动箱、液压装置、液添单元、供液泵和控制单元，液添单元的数量为多个，每个液添单元包括液体添加泵、计量标校罐、液体添加剂罐；发动机、分动箱、液压装置、液添单元、供液泵和控制单元均连接在撬架上；发动机、分动箱和液压装置的输入端依次连接，液压装置的输出端分别连接供液泵和每个液添单元的液体添加泵，供液泵连接每个液添单元的液体添加剂罐的入口，每个液体添加剂罐的出口依次连接该液添单元的计量标校罐、液体添加泵和液体添加剂罐的入口；控制单元分别电连接发动机、分动箱、液压装置、液体添加泵、计量标校罐、供液泵、液体添加剂罐。

[0006] 进一步的，所述发动机、分动箱、液压装置、控制单元的数量均为1个，液体添加泵、计量标校罐、液体添加剂罐的数量均为4个，供液泵的数量为3个，发动机、分动箱、液压装置、液添单元、供液泵和控制单元均连于撬架内部，控制单元位于撬架左部内侧，控制单元右侧自前向后分布2个液体添加剂罐，2个液体添加剂罐的右侧上部自左向右依次分布4个计量标校罐，2个供液泵的右侧下部自左向右依次分布4个液体添加泵，计量标校罐和液体

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添加泵的右侧自前向后依次分布另2个液体添加剂罐，另2个液体添加剂罐的右侧中部分布液压装置，另2个液体添加剂罐的右侧下部自前向后依次分布3个供液泵，液压装置和供液泵的右侧自上向下依次分布分动箱和发动机。

[0007] 进一步的，所述液体添加剂罐的罐顶设有人孔、呼吸帽和下罐人梯。

[0008] 进一步的，所述液体添加剂罐的底部开设有排残液口。

[0009] 进一步的，所述液体添加剂罐内设有搅拌器。

[0010] 进一步的，所述4个液添单元的液体添加泵均为转子泵，压力≥0.5MPa，排量分别为：5-50L/M、5-50L/M、15-150L/M、35-350L/M。

[0011] 进一步的，液添单元还包括质量流量计，液体添加泵的出口通过质量流量计连接液体添加剂罐的入口。

[0012] 进一步的，所述计量标校罐设有容积刻度。

[0013] 一种压裂施工全自动高精度液体添加校准方法，包括如下步骤：发动机为分动箱提供动力，分动箱驱动液压装置，液压装置为供液泵和液体添加泵提供压力，供液泵为液体添加剂罐供应施工液体；当对施工液体的输出排量进行校准时，液体添加泵从液体添加剂罐内抽吸施工液体进入计量标校罐内，并标定计量标校罐内施工液体的体积，然后液体添加泵将计量标校罐内的施工液体经质量流量计计量后泵送排入液体添加剂罐内，再将标定计量标校罐内施工液体的体积与质量流量计的计量值进行对比，对质量流量计进行校准，实现施工液体的输出排量的校准；控制单元对发动机、分动箱、液压装置、液体添加泵、计量标校罐、供液泵和液体添加剂罐进行监控。

[0014] 本发明的有益效果：

[0015] 1、本发明提供的这种压裂施工全自动液体添加装置及添加校准方法，发动机、分动箱、液压装置、液添单元、供液泵和控制单元均连接在撬架上，撬架为固定式结构，安装紧凑，结构稳定，体积小，效率高，占地面积少，安装使用方便，容易搬迁；

[0016] 2、本发明提供的这种压裂施工全自动液体添加装置及添加校准方法，液体添加剂罐可满足液体独立存储；液体添加泵和供液泵可单独泵注；液添单元可实现泵注排量随时校准；

[0017] 3、本发明提供的这种压裂施工全自动液体添加装置及添加校准方法，控制单元对发动机、分动箱、液压装置、液体添加泵、计量标校罐、供液泵和液体添加剂罐进行监控，控制单元内的控制系统可进行作业参数设置和施工监控，包含动力系统、泵调速控制、液面检测、外部流量(瞬时，累计)及添加剂流量(瞬时，累计)及采集和显示；控制系统根据预设的配比和采集的外部流量计的流量，控制液体添加泵的转速，实时监测液添排量，按照预设的配比将液体添加剂加入到管汇中；控制系统读取液体添加剂罐液位信号，当罐内液位低于下限设定值时自动给液体添加剂罐上液，当液位到达设定上限值时自动停止上液，实现装置全自动控制功能；有效克服现有技术中压裂施工过程中入液体添加剂精确加入难度大且不连续的现状问题，提高压裂施工机械化、自动化程度，有效消除施工质量和安全隐患，提高施工成功率；

[0018] 4、本发明提供的这种压裂施工全自动液体添加装置及添加校准方法，控制单元对发动机、分动箱、液压装置、液体添加泵、计量标校罐、供液泵和液体添加剂罐进行监控，控制单元内的控制系统可进行作业参数设置和施工监控，包含动力系统、泵调速控制、液面检

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测、外部流量(瞬时,累计)及添加剂流量(瞬时,累计)及采集和显示;当对施工液体的输出排量进行校准时,控制系统控制液体添加泵从液体添加剂罐内抽吸施工液体进入计量标校罐内,并标定计量标校罐内施工液体的体积,然后液体添加泵将计量标校罐内的施工液体经质量流量计计量后泵送排入液体添加剂罐内,控制系统再将标定计量标校罐内施工液体的体积与质量流量计的计量值进行对比,通过相同时间内流量计的监控数据和标校罐内液体实际添加量相对比,通过对比实现质量流量计校准,解决压裂施工过程中入液体添加剂精确加入难度大的问题,确保配液过程中精细质量控制,达到严格按照配比添加的要求;

[0019] 5、本发明提供的这种压裂施工全自动液体添加装置及添加校准方法,发动机、分动箱、液压装置、液添单元、供液泵和控制单元均安装连接在撬架上,该结构为一体化集成设计,实现一体化吊装,有效避免施工过程中吊装、车辆移动、液体飞溅、人员摔伤等安全问题,安全环保施工水平显著提升。

附图说明

[0020] 以下将结合附图对本发明做进一步详细说明。

[0021] 图1是压裂施工全自动高精度液体添加装置的结构主视图;

[0022] 图2是压裂施工全自动高精度液体添加装置的结构俯视图。

[0023] 附图标记说明:1、撬架;2、发动机;3、分动箱;4、液压装置;5、液体添加泵;6、计量标校罐;7、供液泵;8、液体添加剂罐;9、控制单元。

具体实施方式

[0024] 实施例1:

[0025] 如图1和图2所示,一种压裂施工全自动高精度液体添加装置,包括撬架1、发动机2、分动箱3、液压装置4、液添单元、供液泵7和控制单元9,液添单元的数量为多个,每个液添单元包括液体添加泵5、计量标校罐6、液体添加剂罐8;发动机2、分动箱3、液压装置4、液添单元、供液泵7和控制单元9均连接在撬架1上;发动机2、分动箱3和液压装置4的输入端依次连接,液压装置4的输出端分别连接供液泵7和每个液添单元的液体添加泵5,供液泵7连接每个液添单元的液体添加剂罐8的入口,每个液体添加剂罐8的出口依次连接该液添单元的计量标校罐6、液体添加泵5和液体添加剂罐8的入口;控制单元9分别电连接发动机2、分动箱3、液压装置4、液体添加泵5、计量标校罐6、供液泵7、液体添加剂罐8。

[0026] 本发明发动机、分动箱、液压装置、液添单元、供液泵和控制单元均安装连接在撬架上,该结构为一体化集成设计,实现一体化吊装,有效避免施工过程中吊装、车辆移动、液体飞溅、人员摔伤等安全问题,安全环保施工水平显著提升。

[0027] 本发明液体添加剂罐8可满足液体独立存储;液体添加泵5和供液泵7可单独泵注;液添单元可实现泵注排量随时校准;控制单元9对发动机2、分动箱3、液压装置4、液体添加泵5、计量标校罐6、供液泵7和液体添加剂罐8进行监控,控制单元9可进行作业参数设置和施工监控,控制单元根据预设的配比和采集的外部流量计的流量,控制液体添加泵5的转速,实时监测液添排量,按照预设的配比将液体添加剂加入到管汇中;控制单元读取液体添加剂罐8液位信号,当罐内液位低于下限设定值时自动给液体添加剂罐8上液,当液位到达设定上限值时自动停止上液,实现装置全自动控制功能;

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[0028] 当对施工液体的输出排量进行校准时，控制单元控制液体添加泵5从液体添加剂罐8内抽吸施工液体进入计量标校罐6内，并标定计量标校罐6内施工液体的体积，然后液体添加泵5将计量标校罐6内的施工液体经质量流量计计量后泵送排入液体添加剂罐8内，控制单元再将标定计量标校罐6内施工液体的体积与质量流量计的计量值进行对比，通过相同时间内流量计的监控数据和标校罐内液体实际添加量相对比，通过对比实现质量流量计校准，解决压裂施工过程中入液体添加剂精确加入难度大的问题，确保配液过程中精细质量控制，达到严格按照配比添加的要求。

[0029] 实施例2：

[0030] 在实施例1的基础上，进一步的，所述发动机2、分动箱3、液压装置4、控制单元9的数量均为1个，液体添加泵5、计量标校罐6、液体添加剂罐8的数量均为4个，供液泵7的数量为3个，发动机2、分动箱3、液压装置4、液添单元、供液泵7和控制单元9均连于撬架1内部，控制单元9位于撬架1左部内侧，控制单元9右侧自前向后分布2个液体添加剂罐8，2个液体添加剂罐8的右侧上部自左向右依次分布4个计量标校罐6，2个供液泵7的右侧下部自左向右依次分布4个液体添加泵5，计量标校罐6和液体添加泵5的右侧自前向后依次分布另2个液体添加剂罐8，另2个液体添加剂罐8的右侧中部分布液压装置4，另2个液体添加剂罐8的右侧下部自前向后依次分布3个供液泵7，液压装置4和供液泵7的右侧自上向下依次分布分动箱3和发动机2；总重8T，外形尺寸8.5m(长)×2.30m(宽)×2.6m(高)，每个液体添加剂罐8容积均为350GAL(1.35m3)，材质为316材质不锈钢；结构简单紧凑，该结构为一体化集成设计，实现一体化吊装，有效避免施工过程中吊装、车辆移动、液体飞溅、人员摔伤等安全问题，安全环保施工水平显著提升。

[0031] 所述发动机为柴油机；柴油机配套设备结构紧凑、安装地点灵活、发电机热效率高，燃油消耗低、起动迅速、并能很快达到安全功率只需几秒，应急1分钟内带到全负荷，停机过程短，可以频繁起停、发电机维护操作简单，人少，备用期间保养容易、建设与发电的综合成本最低。

[0032] 进一步的，所述液体添加剂罐8的罐顶设有人孔、呼吸帽和下罐人梯。人孔和呼吸帽可避免因意外原因造成罐内急剧超压或真空时，损坏液体添加剂罐8而发生事故，又能起到安全防火作用，是保护液体添加剂罐8的安全装置，具有定压排放、定压吸入、开闭灵活、安全阻火、结构紧凑、密封性能好、安全可靠等优点；下罐人梯方便人员上下罐检查液体添加剂罐8的情况。

[0033] 进一步的，所述液体添加剂罐8的底部开设有排残液口。方便排残液，保证零罐余。

[0034] 进一步的，所述液体添加剂罐8内设有搅拌器。可以起到防止添加剂沉淀的作用。所述搅拌器为叶片式搅拌器，搅拌器由液压马达驱动进行搅拌，提高搅拌效率。

[0035] 进一步的，所述4个液添单元的液体添加泵5均为转子泵，压力≥0.5MPa，排量分别为：5-50L/M、5-50L/M、15-150L/M、35-350L/M。转子泵不会对被输送物质造成污染，经其输送的物料保持原有的品质部变，不起任何理化反应，可直接水冲洗，耐高压，不易磨损，无泄漏，体积小，流量大，扬程压力高，低噪音，可靠性好，使用寿命长，节能降耗，结构紧凑，维护方便，运行的成本低。

[0036] 进一步的，所述3个供液泵7均为齿轮泵，排量为100升/分或400升/分，排出压力为0.3MPa，很好的保证4个液体添加剂罐8的施工液量，结构简单，操作方便。齿轮泵结构简单

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紧凑、体积小、质量轻、工艺性好、价格便宜、自吸力强、对油液污染不敏感、转速范围大、能耐冲击性负载，维护方便、工作可靠。

[0037] 进一步的，液添单元还包括质量流量计，液体添加泵5的出口通过质量流量计连接液体添加剂罐8的入口。质量流量计便于计量液体添加剂罐8的输出液量，方便进行液量的校准，结构简单，提高测量精度。

[0038] 进一步的，所述计量标校罐6设有容积刻度。结构简单，用于质量流量计的校准，提高测量精度。计量标校罐6为细长型，计量标校罐6通过阀门分别与液体添加剂罐8和液体添加泵5连通；连接简单方便，操作可控，可以将液体添加剂罐8内的液体引入到计量标校罐6中去。当对质量流量计进行校准时，先将计量标校罐6引入液体，再关闭液体添加剂罐8出口阀门，液体通过计量标校罐6的出口进入液体添加泵5，被泵送后通过质量流量计计量后排入液体添加剂罐8；泵送计量标校罐6内定量容积的液体与质量流量计的计量值进行对比，对质量流量计进行初步校准。

[0039] 进一步的，所述控制单元9对发动机2、分动箱3、液压装置4、液体添加泵5、计量标校罐6、供液泵7和液体添加剂罐8进行监控。控制单元9包括动力控制系统、泵调速控制系统、液面检测控制系统和流量检测控制系统；控制单元9可进行作业参数设置和施工监控，动力控制系统对发动机2进行控制，泵调速控制系统对液体添加泵5和供液泵7进行控制，液面检测控制系统对液体添加剂罐8内液体进行检测，流量检测控制系统对液压装置4、液体添加泵5、计量标校罐6、供液泵7、液体添加剂罐8和质量流量计的液体流量(瞬时，累计)进行采集和显示检测；控制单元9能够根据预设的配比和采集的流量计的流量，控制液体添加泵5的转速，实时监测液添排量，按照预设的配比将液体添加剂加入到管汇中；控制单元9可通过手动设置基准流量实现自动控制，控制单元9也可以全部实现手动控制与数据采集；提高压裂施工机械化、自动化程度，提高施工成功率。动力控制系统、泵调速控制系统、液面检测控制系统和流量检测控制系统均为现有技术，在此不对其结构及原理做详细介绍。

[0040] 实施例3：

[0041] 在实施例2的基础上，一种压裂施工全自动高精度液体添加校准方法，包括如下步骤：发动机2为分动箱3提供动力，分动箱3驱动液压装置4，液压装置4为供液泵7和液体添加泵5提供压力，供液泵7为液体添加剂罐8供应施工液体；当对施工液体的输出排量进行校准时，液体添加泵5从液体添加剂罐8内抽吸施工液体进入计量标校罐6内，并标定计量标校罐6内施工液体的体积，然后液体添加泵5将计量标校罐6内的施工液体经质量流量计计量后泵送排入液体添加剂罐8内，再将标定计量标校罐6内施工液体的体积与质量流量计的计量值进行对比，对质量流量计进行校准，实现施工液体的输出排量的校准；控制单元9对发动机2、分动箱3、液压装置4、液体添加泵5、计量标校罐6、供液泵7和液体添加剂罐8进行监控。

[0042] 针对现场作业时，不同地层参数、不同井深等因素对压裂液的性能要求各不相同现状，可以存储适量液体添加剂，将液体添加剂自动按设定的配比加入压裂液中，连续调配出满足井况的压裂液；确保配液过程中精细质量控制，达到严格按照配比添加的要求，确保施工质量，提高HSE的管控能力及生产效率，解决压裂施工过程中入液体添加剂精确加入难度大且不连续的现状，提高压裂施工机械化、自动化程度，同时有效消除施工质量和安全隐患，提高施工成功率。

[0043] 本发明的描述中，需要理解的是，若有术语指示的方位或位置关系为基于附图所

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示的方位或位置关系，而不是指示或暗示所指的装置或元件必须具有特定的方位、以特定的方位构造和操作，因此附图中描述位置关系的用语仅用于示例性说明，不能理解为对本专利的限制。

[0044] 以上例举仅仅是对本发明的举例说明，并不构成对本发明的保护范围的限制，凡是与本发明相同或相似的设计均属于本发明的保护范围之内。

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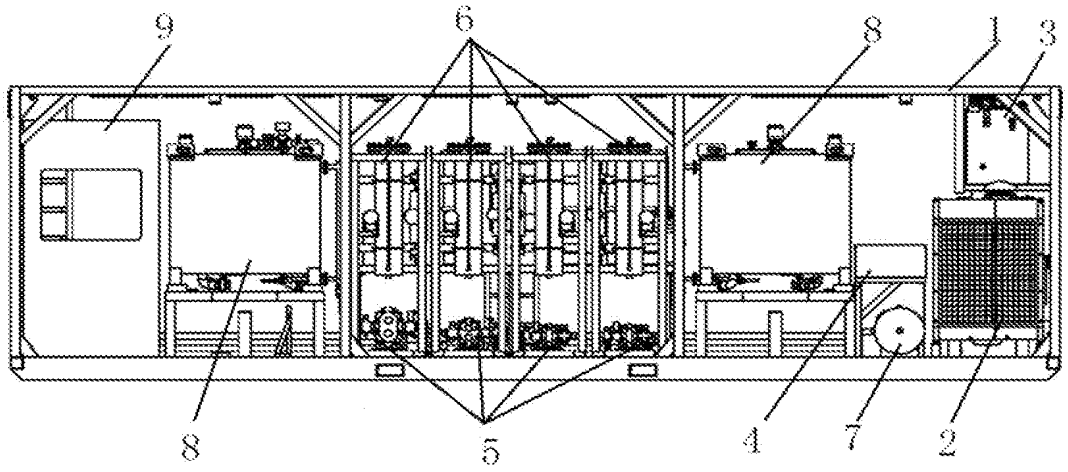


图1

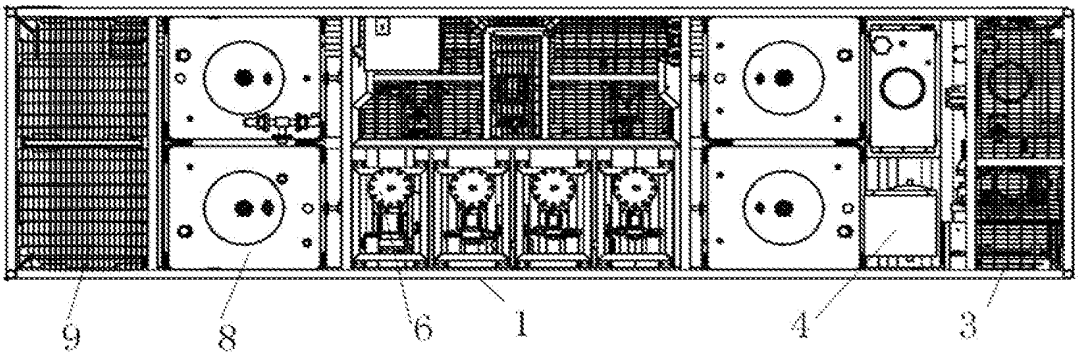


图2

LIBERTY EXHIBIT 1002, Page 164

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16598014
Filing Date	2019-10-09
First Named Inventor	Jared OEHRING
Art Unit	3746
Examiner Name	Christopher S. BOBISH
Attorney Docket Number	047158.100048

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	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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	Examiner Name	Christopher S. BOBISH
	Attorney Docket Number	047158.100048

	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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	Art Unit	3746
	Examiner Name	Christopher S. BOBISH
	Attorney Docket Number	047158.100048

	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		

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16598014
	Filing Date	2019-10-09
	First Named Inventor	Jared OEHRING
	Art Unit	3746
	Examiner Name	Christopher S. BOBISH
	Attorney Docket Number	047158.100048

	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	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16598014
	Filing Date	2019-10-09
	First Named Inventor	Jared OEHRING
	Art Unit	3746
	Examiner Name	Christopher S. BOBISH
	Attorney Docket Number	047158.100048

	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

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	16598014
Filing Date	2019-10-09
First Named Inventor	Jared OEHRING
Art Unit	3746
Examiner Name	Christopher S. BOBISH
Attorney Docket Number	047158.100048

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)	2021-03-08
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.

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)

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.

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)

	Date of mailing *(day/month/year)* 14DEC 2020
Applicant's or agent's file reference 047158.500065	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 43.6*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/US2020/053980

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 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, 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 (VFD's) [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 [0078]).

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 (VFD's) [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 [0078]) 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 [0078]).

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 quintuplex pumps (each of the pumps 702A and 702B may be quintiplex pumps; see [0078]).

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 (VFD's) [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 (VFD's) [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)

Applicant's or agent's file reference 047158.500067	Date of mailing *(day/month/year)* 03 FEB 2021 **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)

	Date of mailing *(day/month/year)* 02 FEB 2021
Applicant's or agent's file reference 047158-500068	**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 --- Y --- A	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 ----- 1-4, 6-9, 11, 13 ----- 5, 12
Y --- A	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 ----- 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.
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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

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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-*-

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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

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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.

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(54) Title: MOBILE FRACTURING PUMP TRANSPORT FOR HYDRAULIC FRACTURING OF SUBSURFACE GEOLOGICAL FORMATIONS

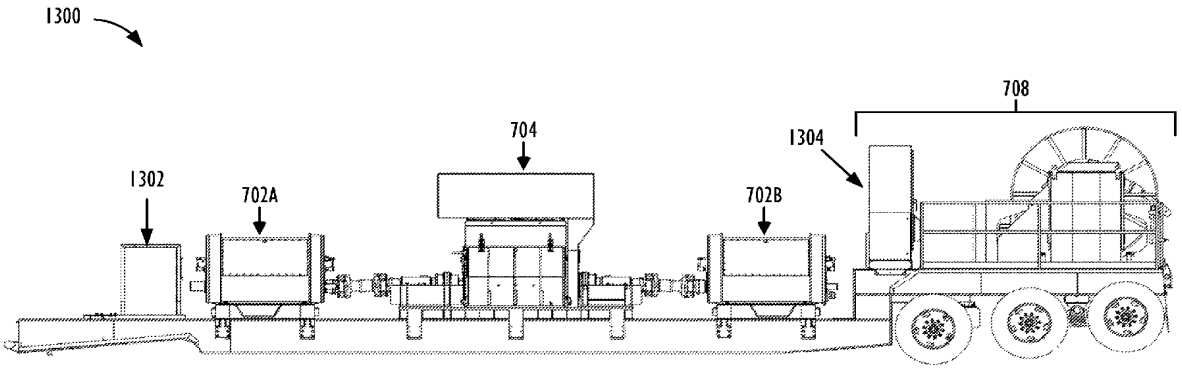


FIG. 13

(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.

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

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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.

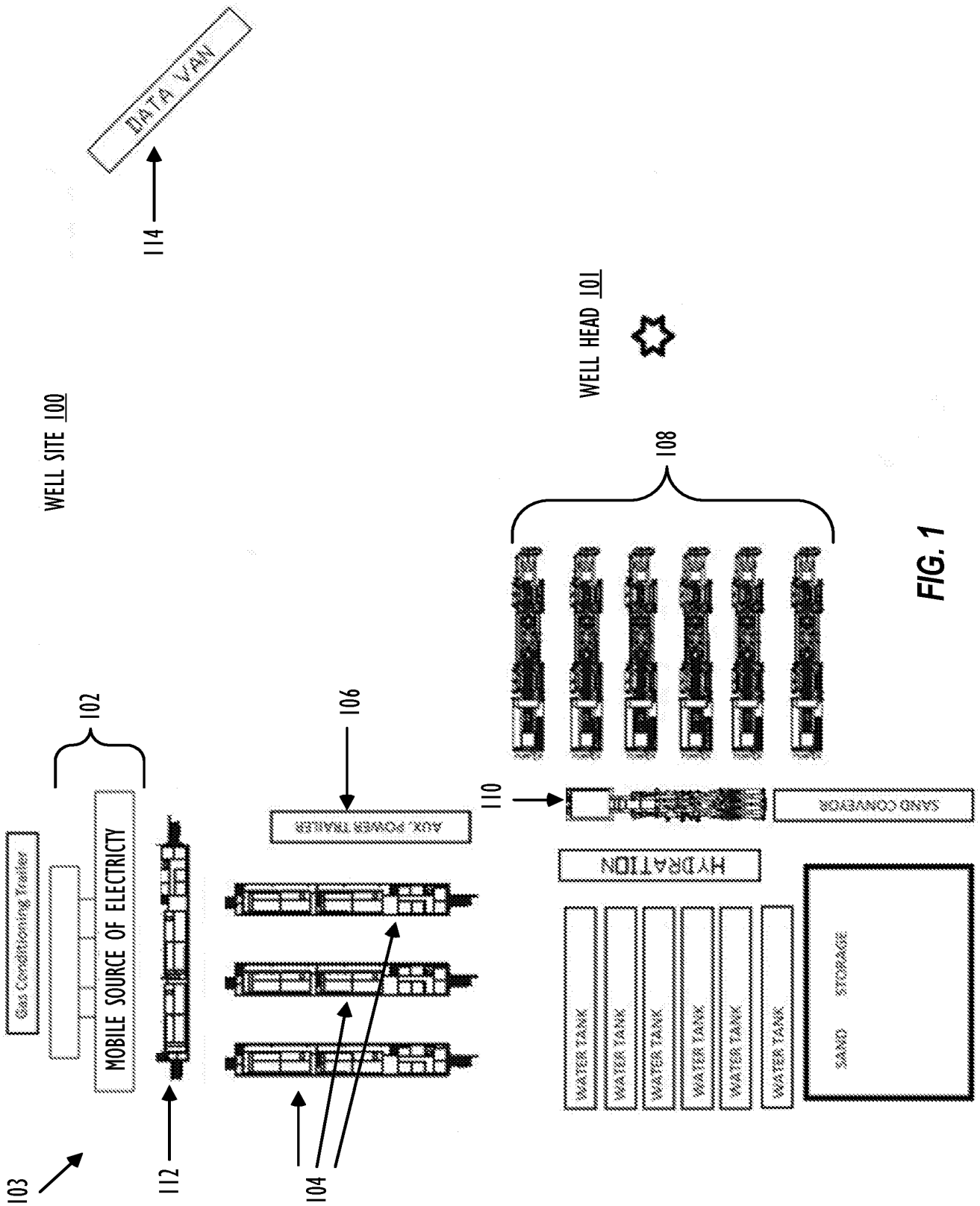


FIG. 1

LIBERTY EXHIBIT 1002, Page 244

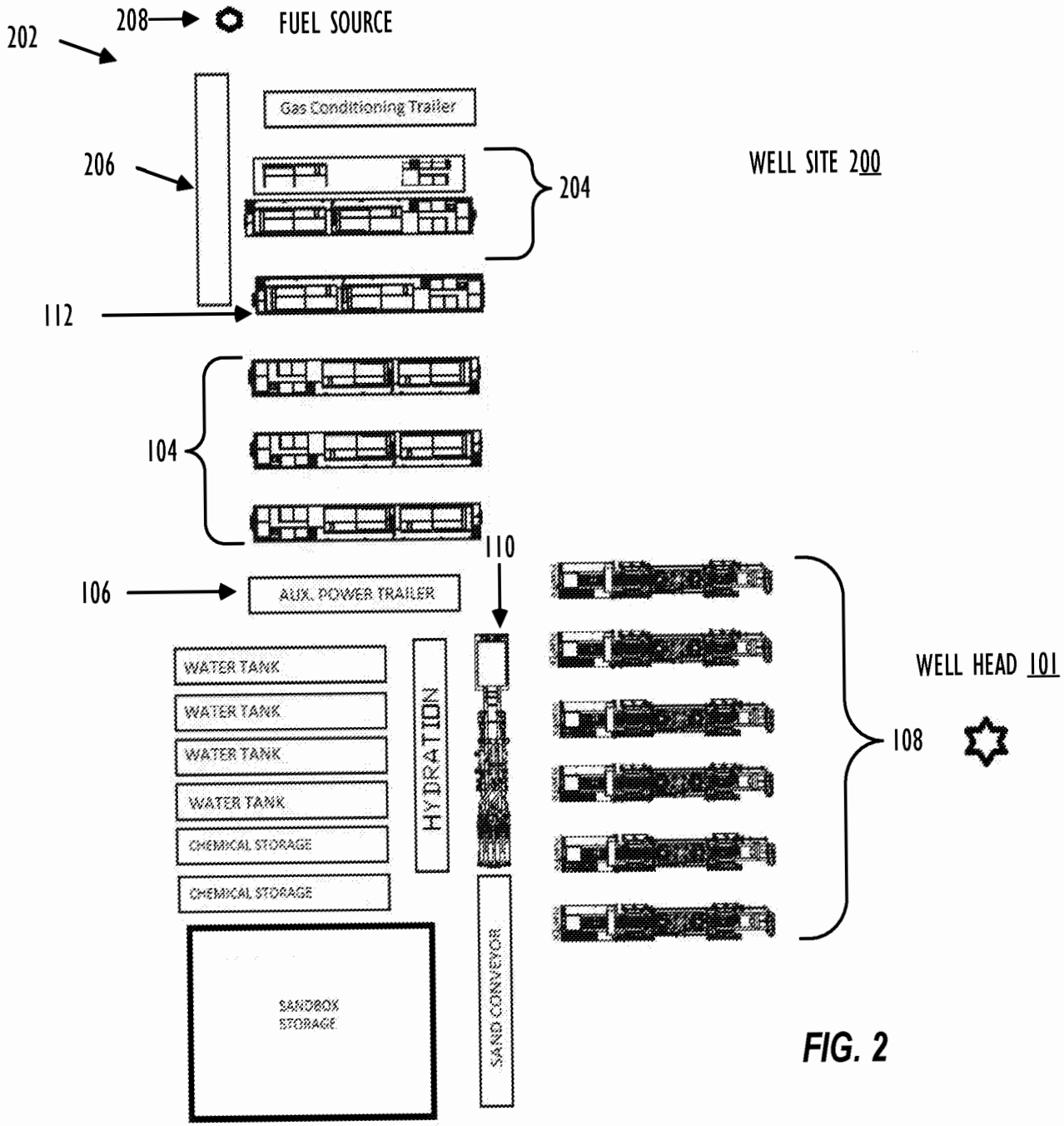

202
208
FUEL SOURCE
Gas Conditioning Trailer
206
204
WELL SITE 200
114
DATA VAN
112
104
110
106
AUX. POWER TRAILER
WATER TANK
WATER TANK
WATER TANK
WATER TANK
CHEMICAL STORAGE
CHEMICAL STORAGE
HYDRATION
WELL HEAD 101
108
SAND CONVEYOR
SANDBOX STORAGE

FIG. 2

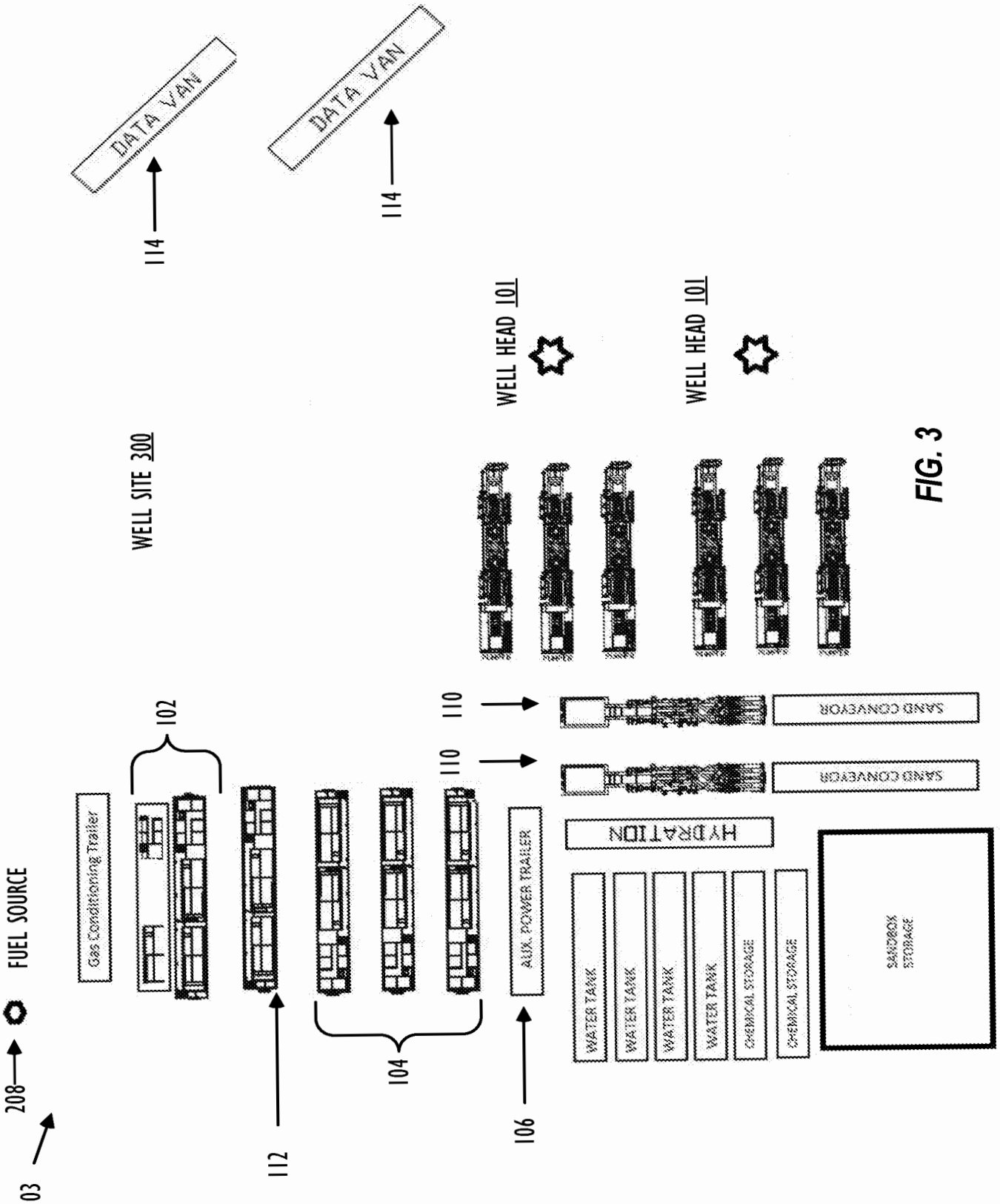


FIG. 3

LIBERTY EXHIBIT 1002, Page 246

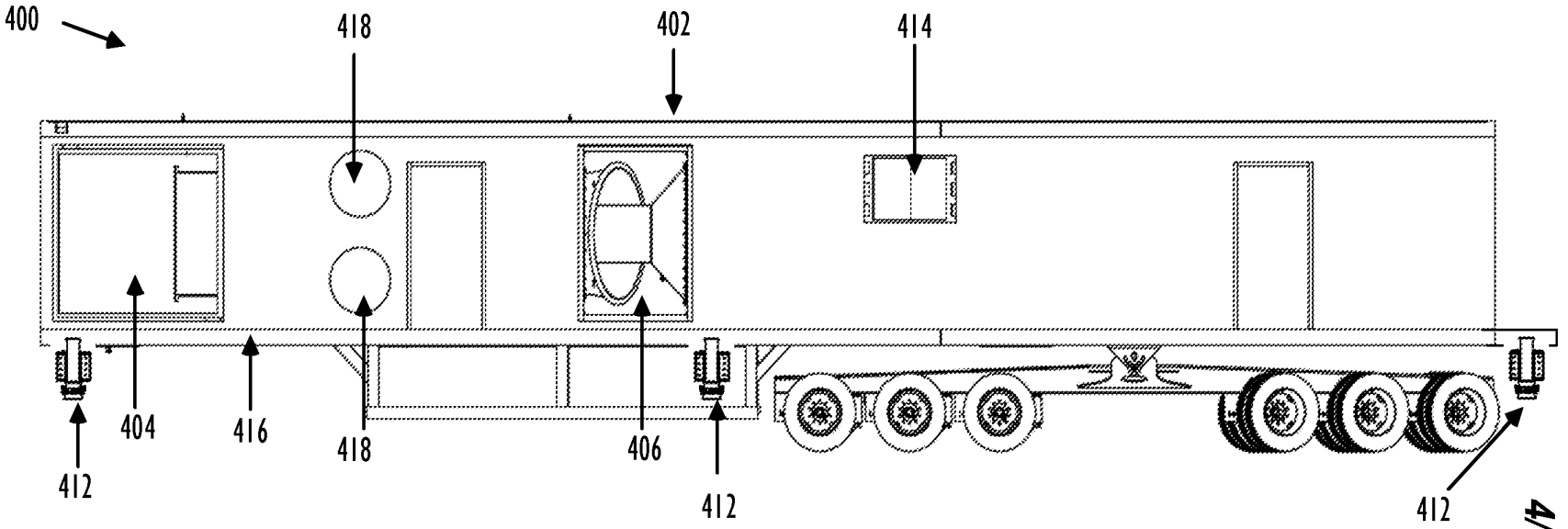

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FIG. 4A

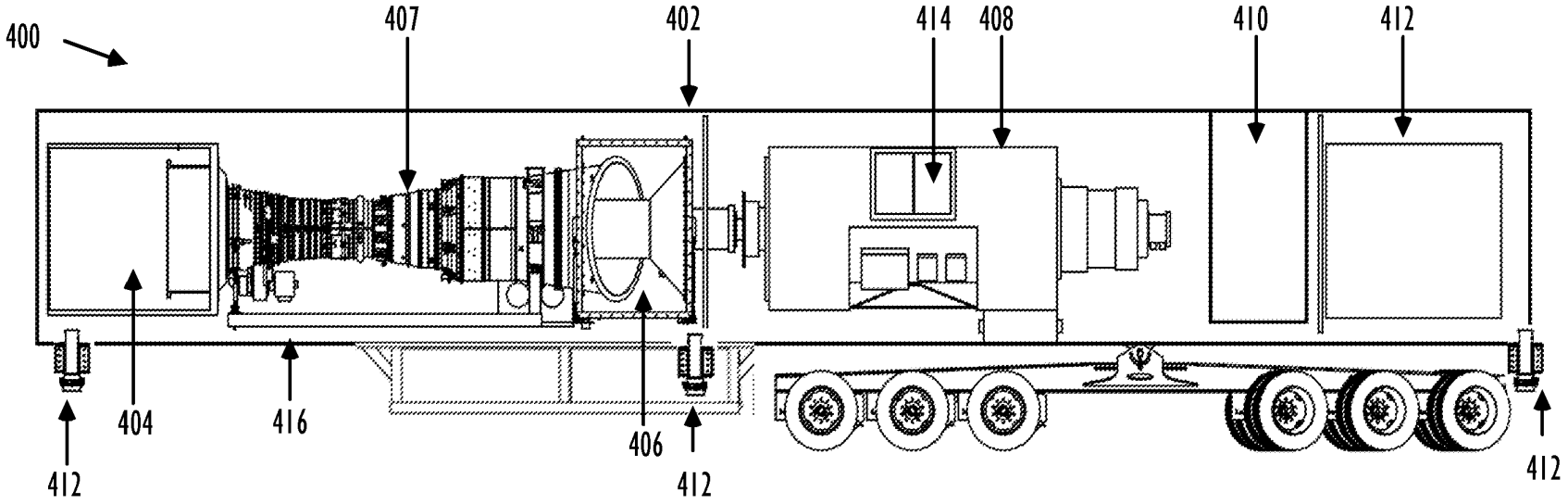

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412

FIG. 4B

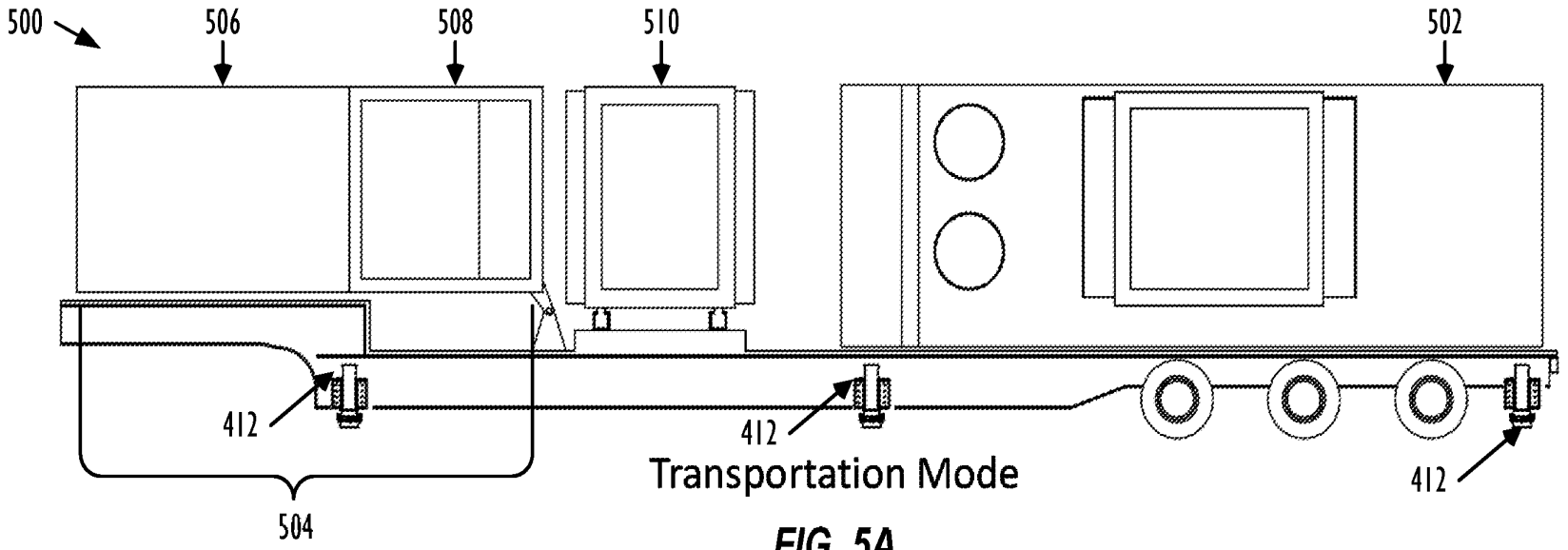

500
506
508
510
502
412
412
412
504
Transportation Mode

FIG. 5A

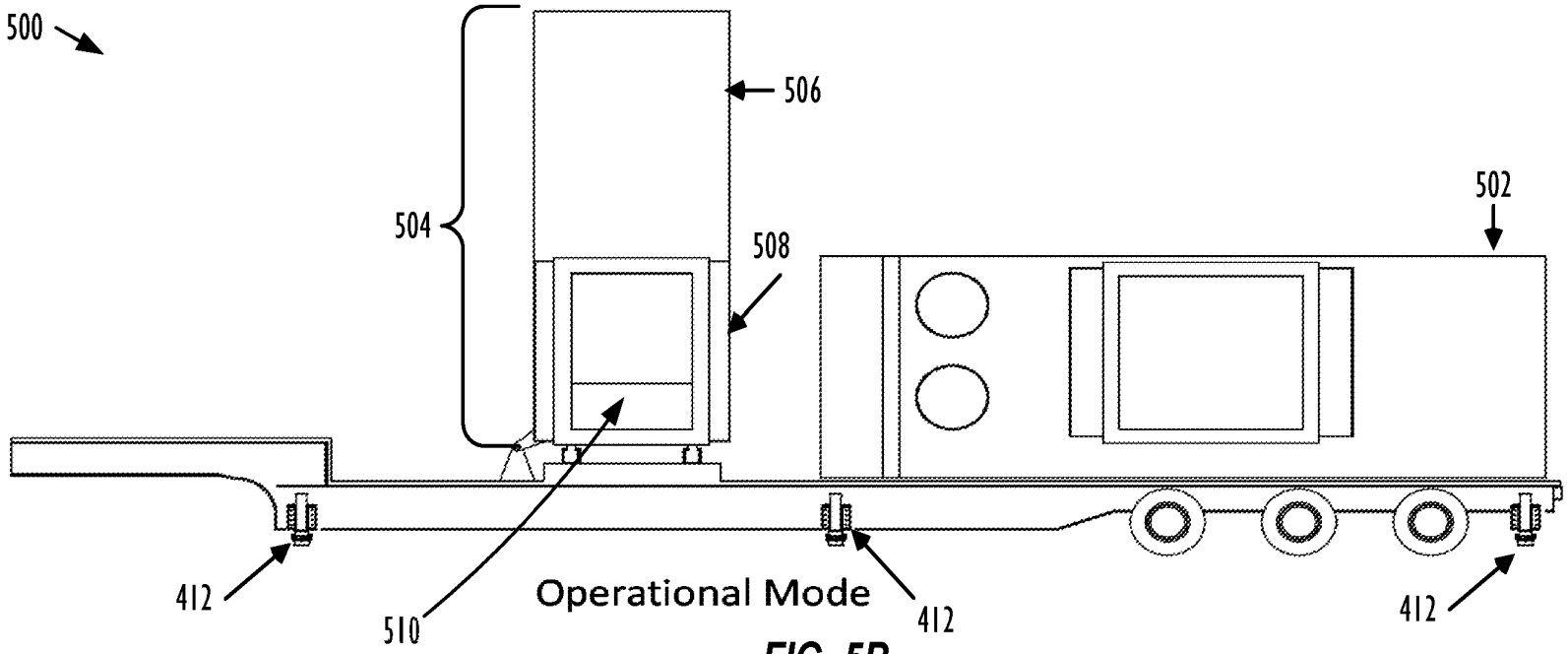

500
506
504
508
502
412
510
Operational Mode
412
412

FIG. 5B

LIBERTY EXHIBIT 1002, Page 249

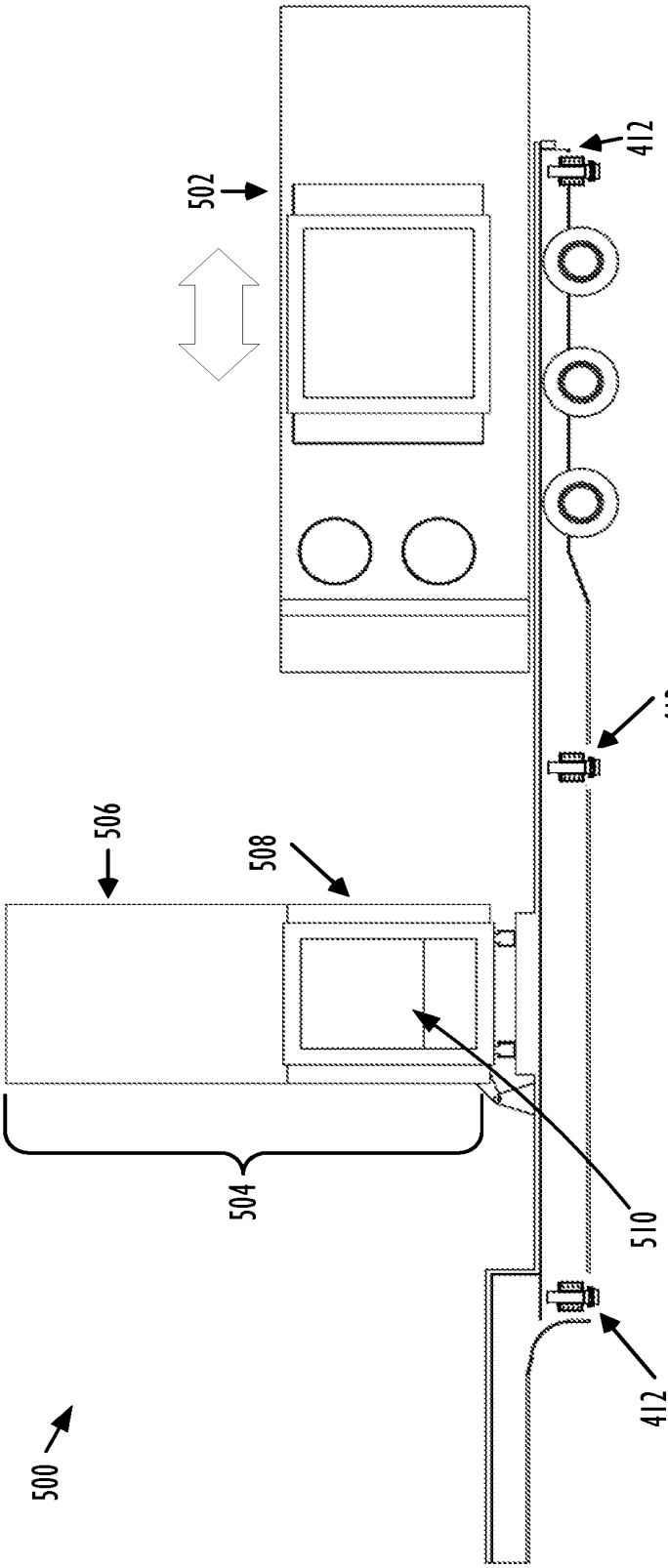


FIG. 5C

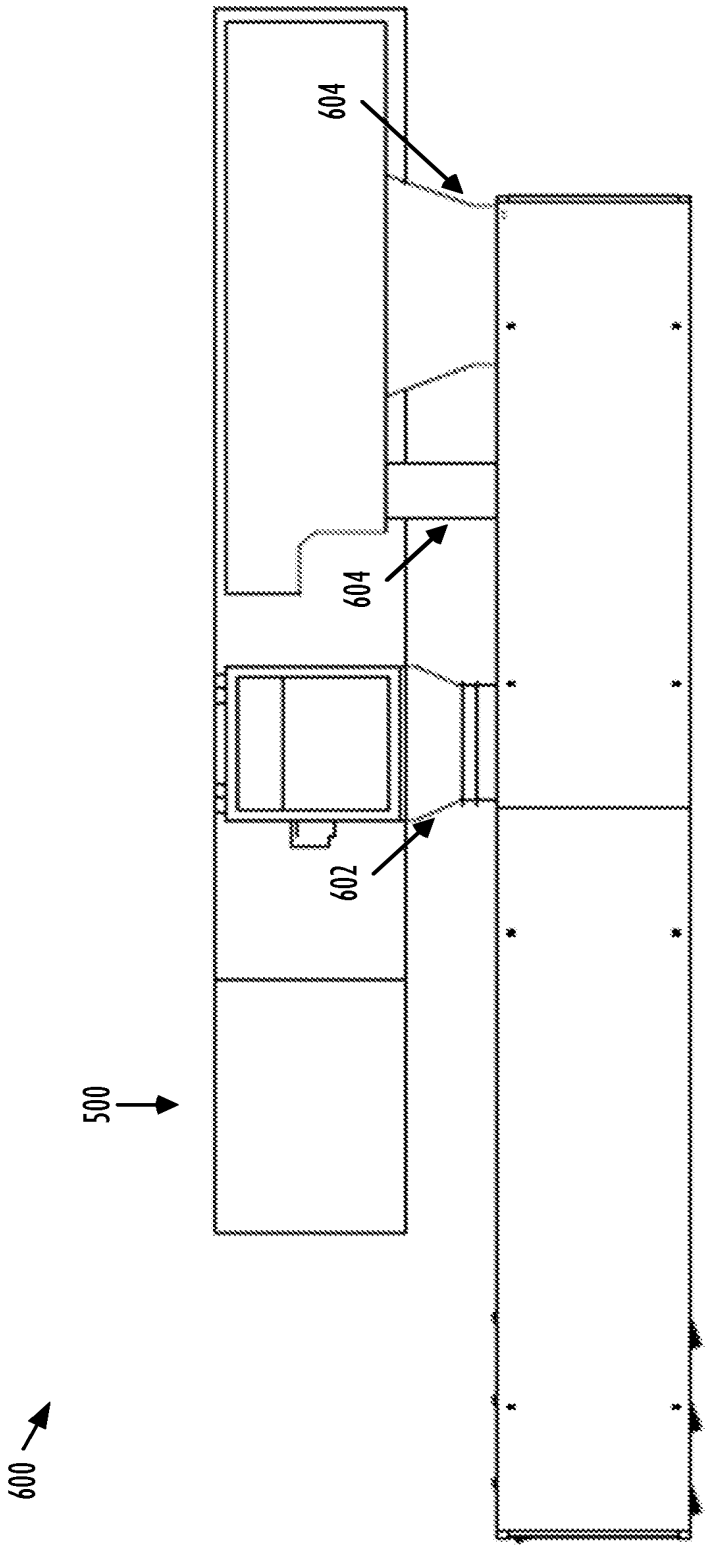


FIG. 6

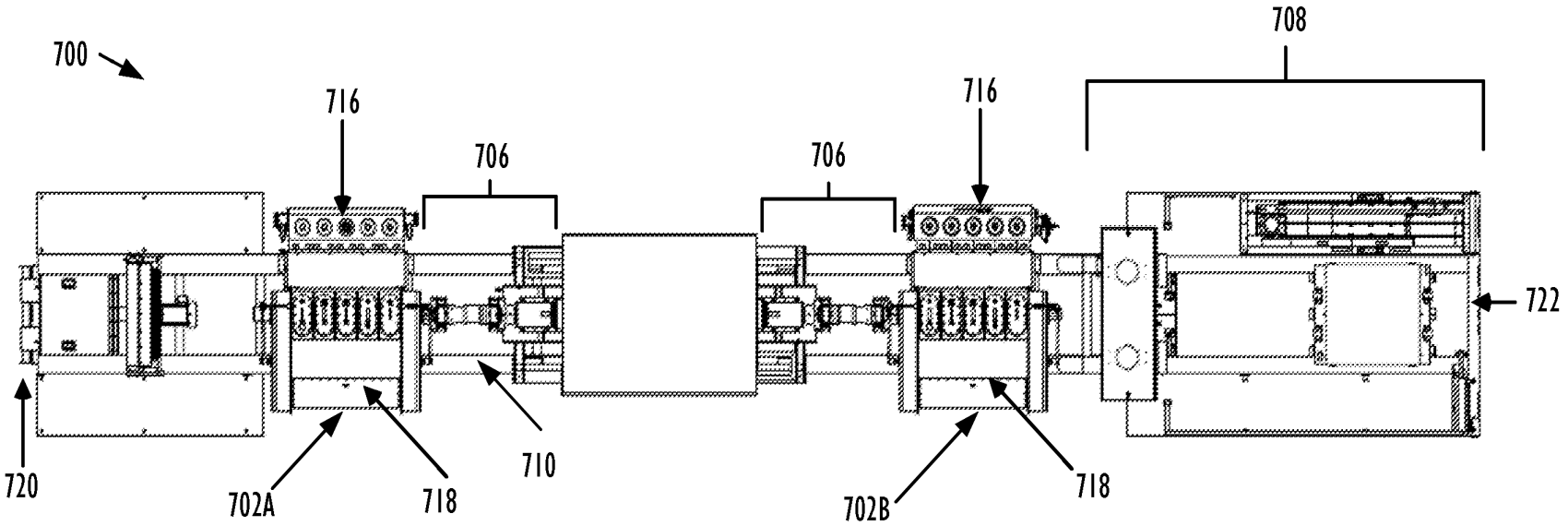

700
716
706
706
716
708
722
720
702A
718
710
702B
718

FIG. 7A

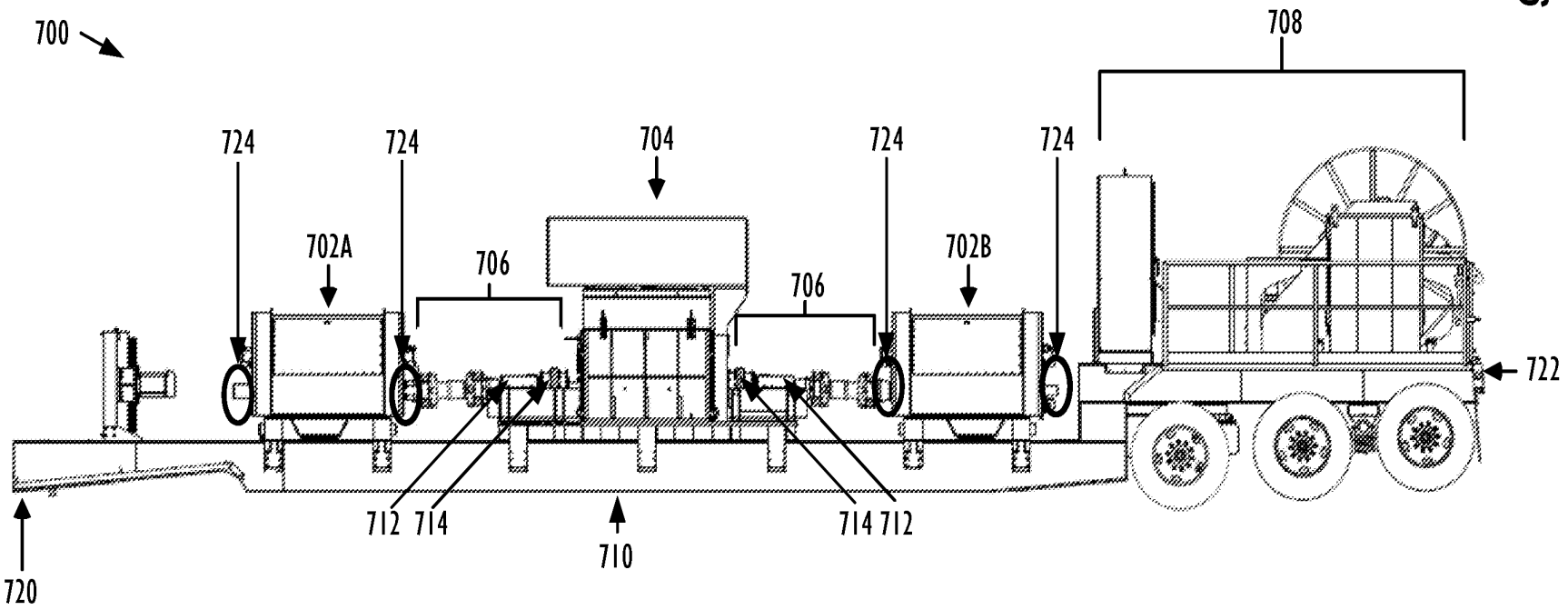

700
724
724
704
724
724
708
702A
706
706
702B
722
712
714
710
714
712
720

FIG. 7B

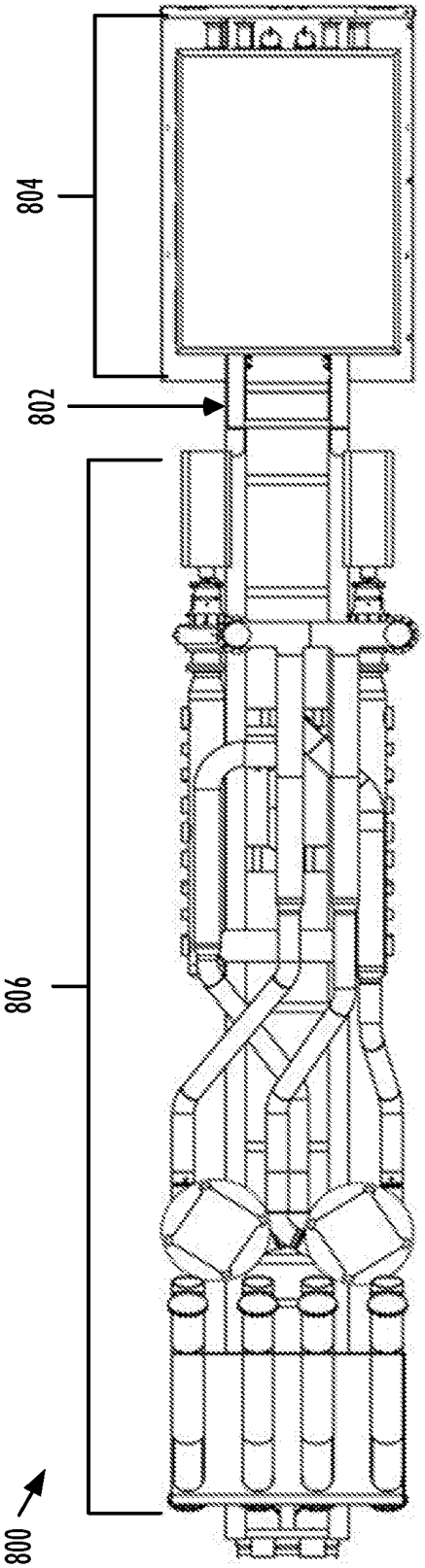


FIG. 8A

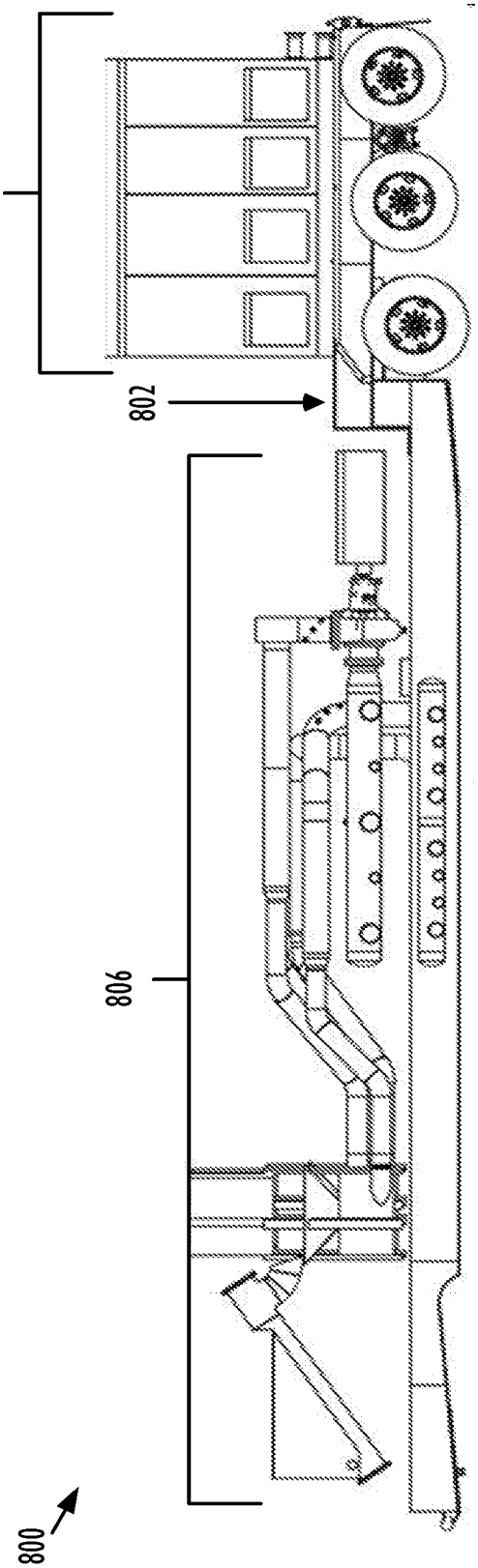


FIG. 8B

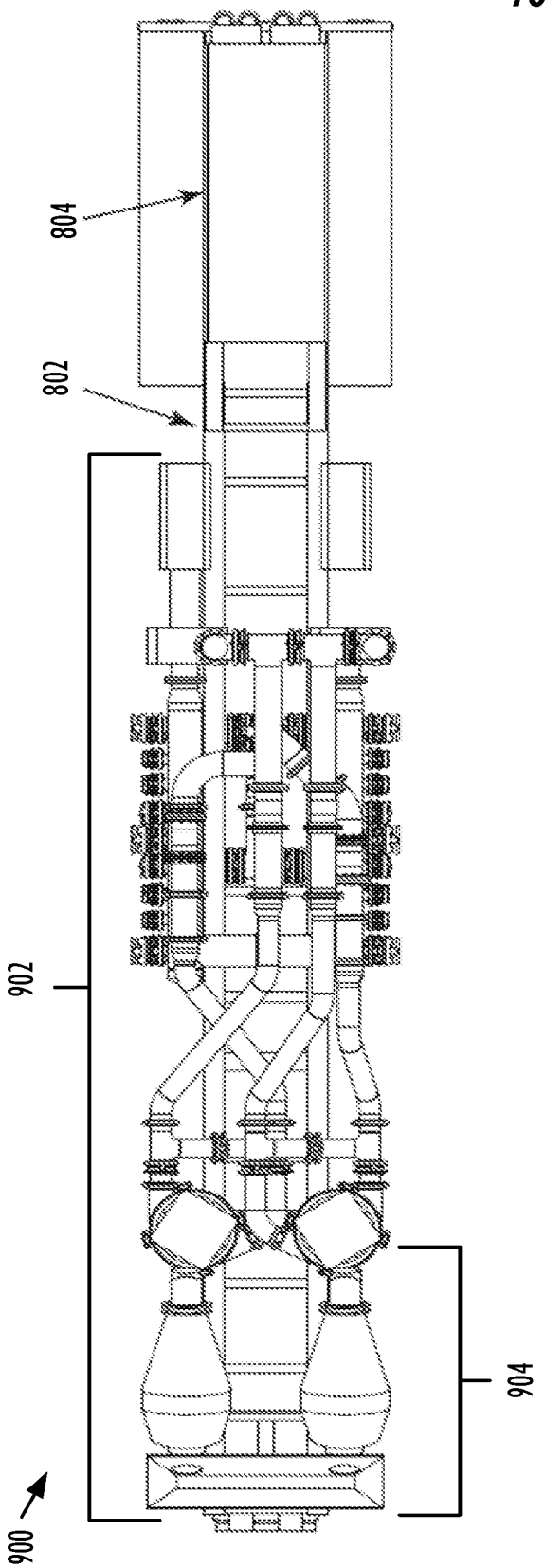


FIG. 9A

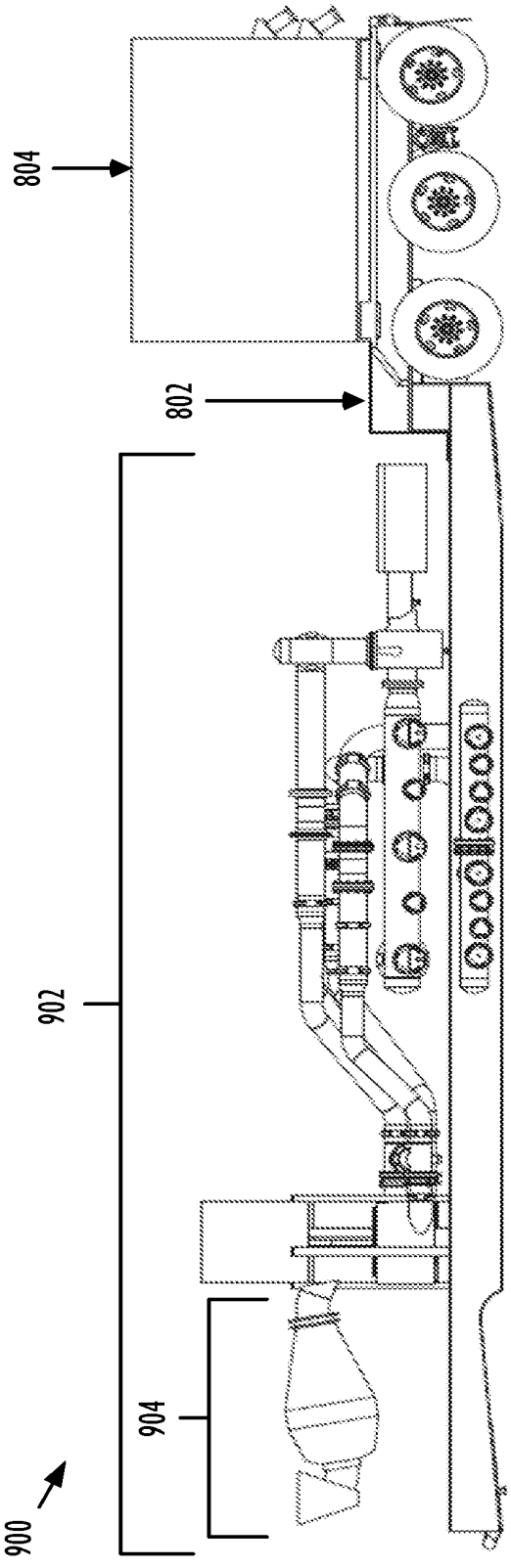


FIG. 9B

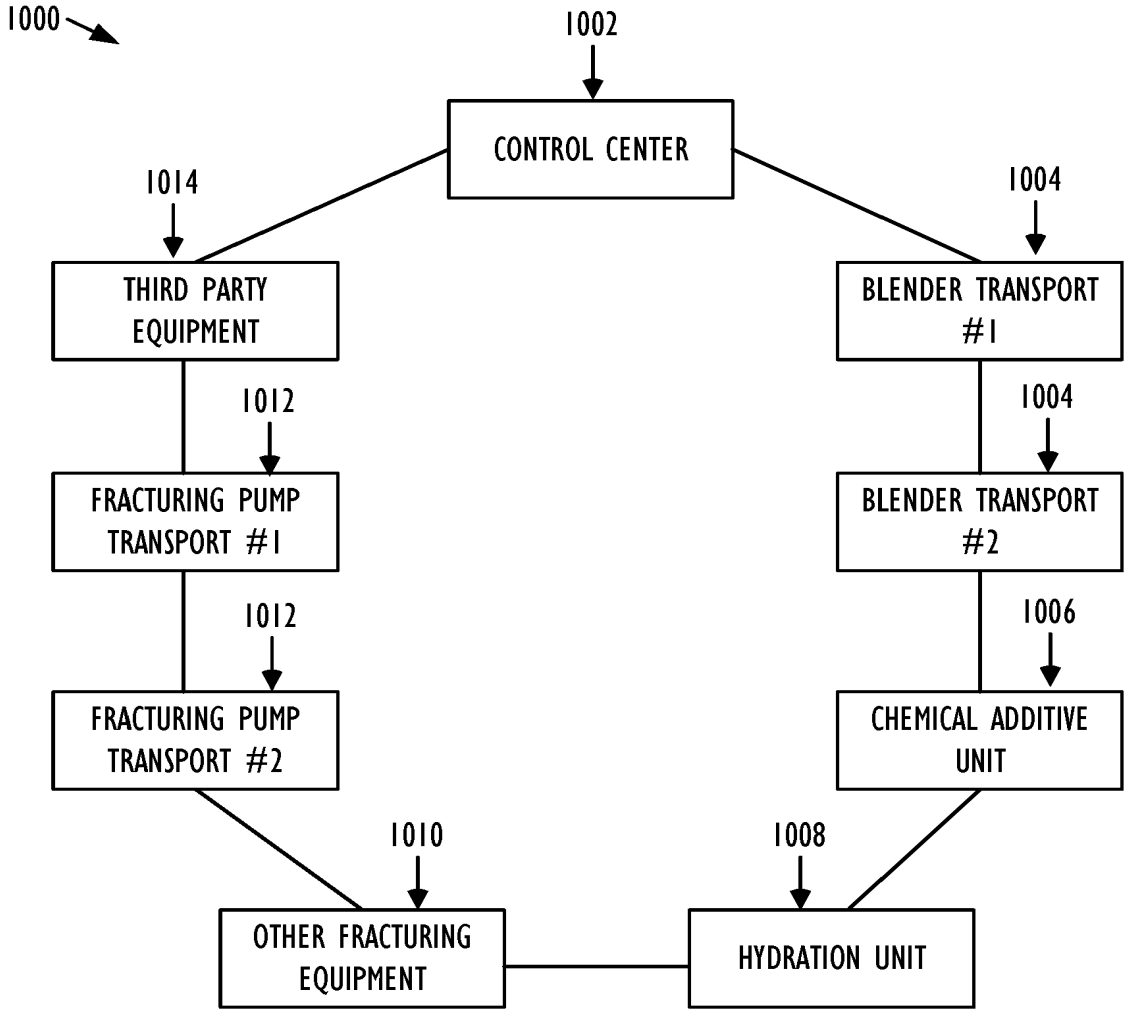

1000
1002
CONTROL CENTER
1014
1004
THIRD PARTY EQUIPMENT
BLENDER TRANSPORT #1
1012
1004
FRACTURING PUMP TRANSPORT #1
BLENDER TRANSPORT #2
1012
1006
FRACTURING PUMP TRANSPORT #2
CHEMICAL ADDITIVE UNIT
1010
1008
OTHER FRACTURING EQUIPMENT
HYDRATION UNIT

FIG. 10

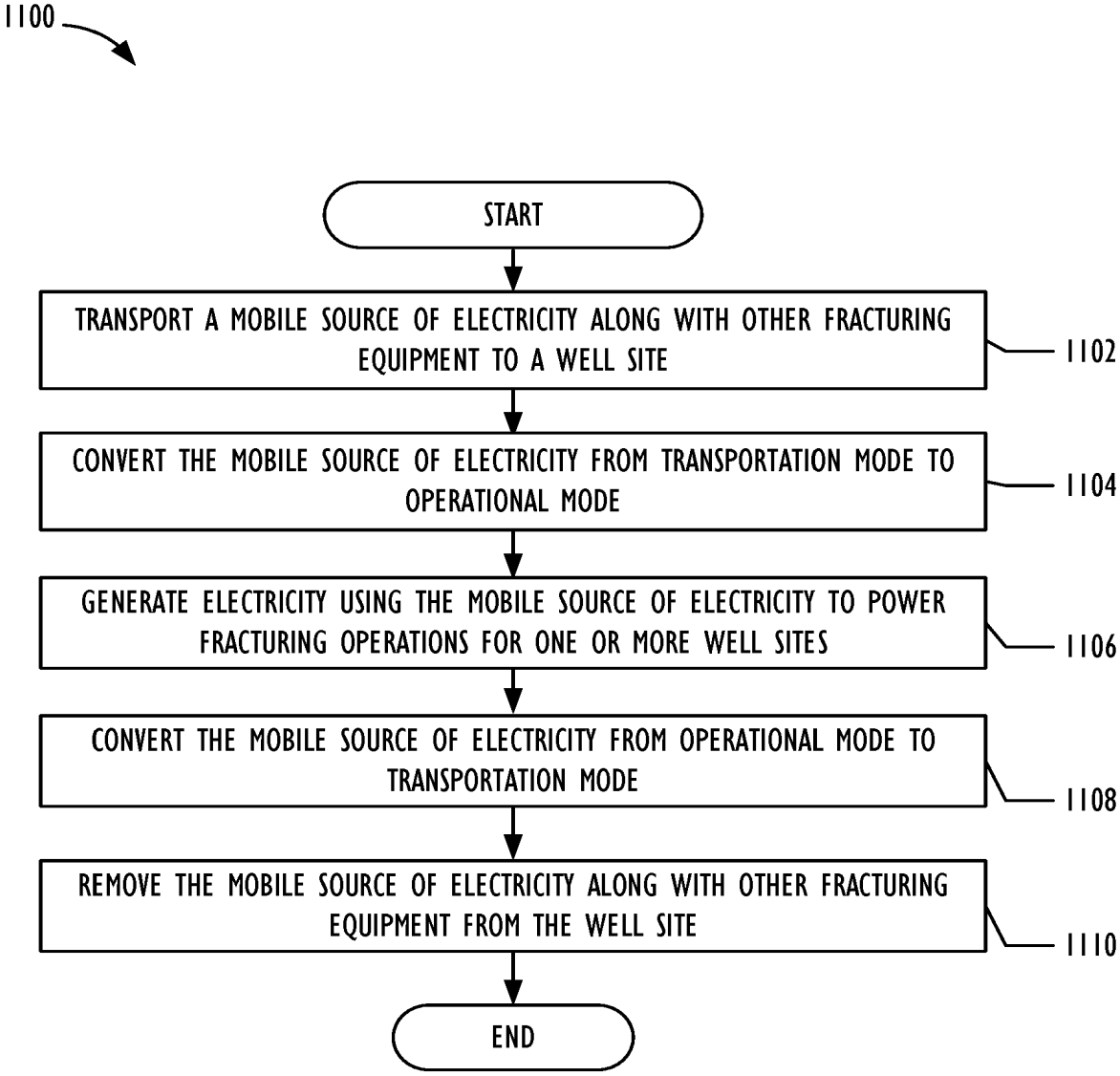

1100
START
TRANSPORT A MOBILE SOURCE OF ELECTRICITY ALONG WITH OTHER FRACTURING EQUIPMENT TO A WELL SITE
1102
CONVERT THE MOBILE SOURCE OF ELECTRICITY FROM TRANSPORTATION MODE TO OPERATIONAL MODE
1104
GENERATE ELECTRICITY USING THE MOBILE SOURCE OF ELECTRICITY TO POWER FRACTURING OPERATIONS FOR ONE OR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

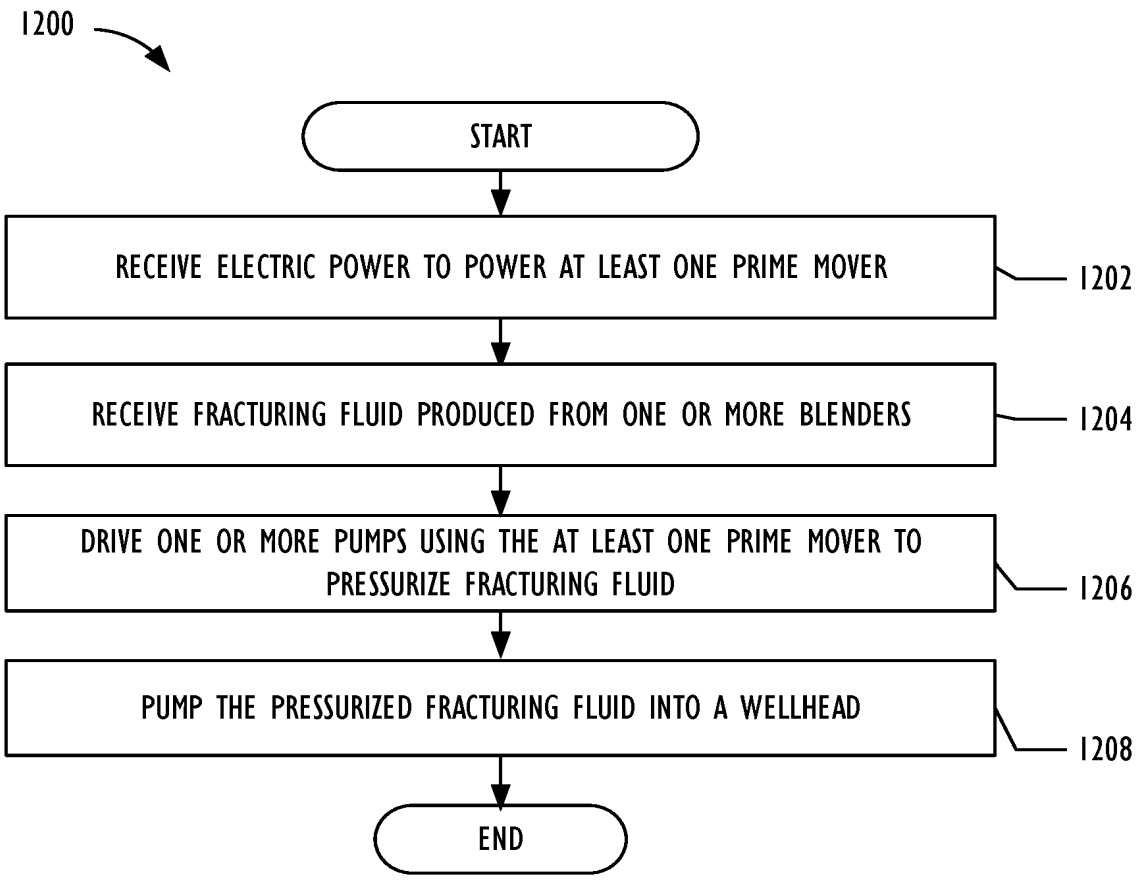

1200
START
RECEIVE ELECTRIC POWER TO POWER AT LEAST ONE PRIME MOVER
1202
RECEIVE FRACTURING FLUID PRODUCED FROM ONE OR MORE BLENDERS
1204
DRIVE ONE OR MORE PUMPS USING THE AT LEAST ONE PRIME MOVER TO PRESSURIZE FRACTURING FLUID
1206
PUMP THE PRESSURIZED FRACTURING FLUID INTO A WELLHEAD
1208
END

FIG. 12

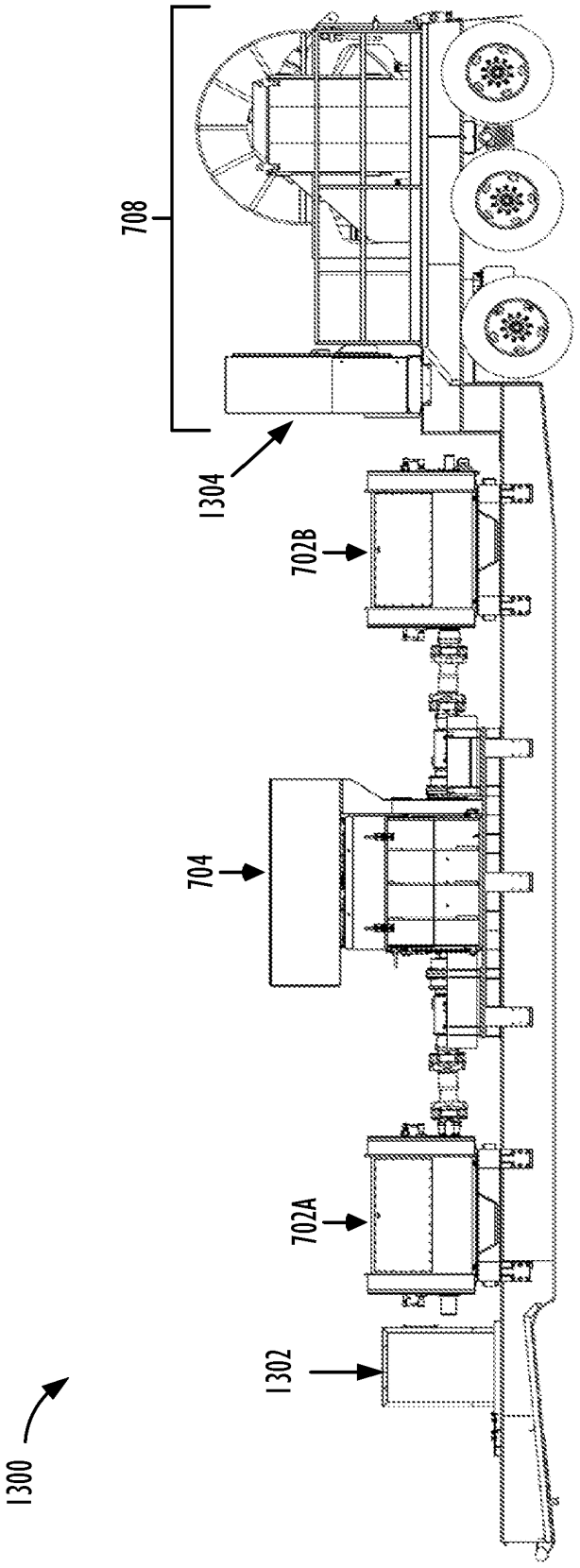


FIG. 13

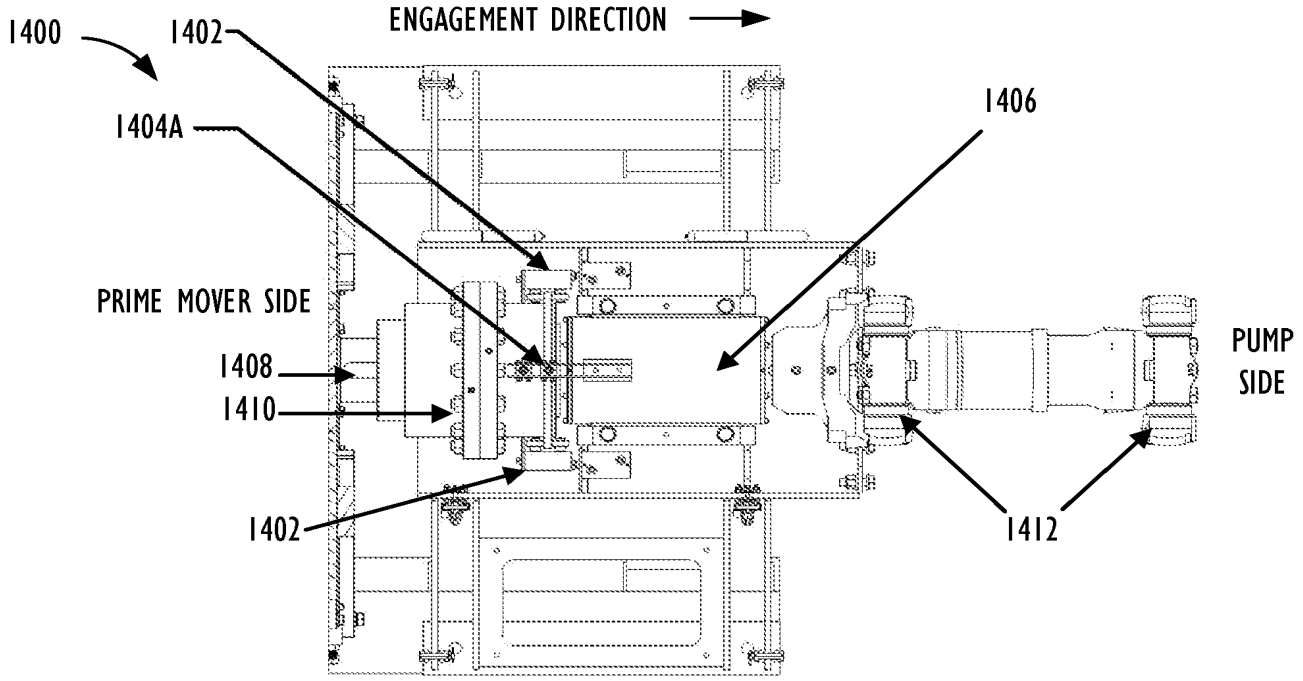


FIG. 14A

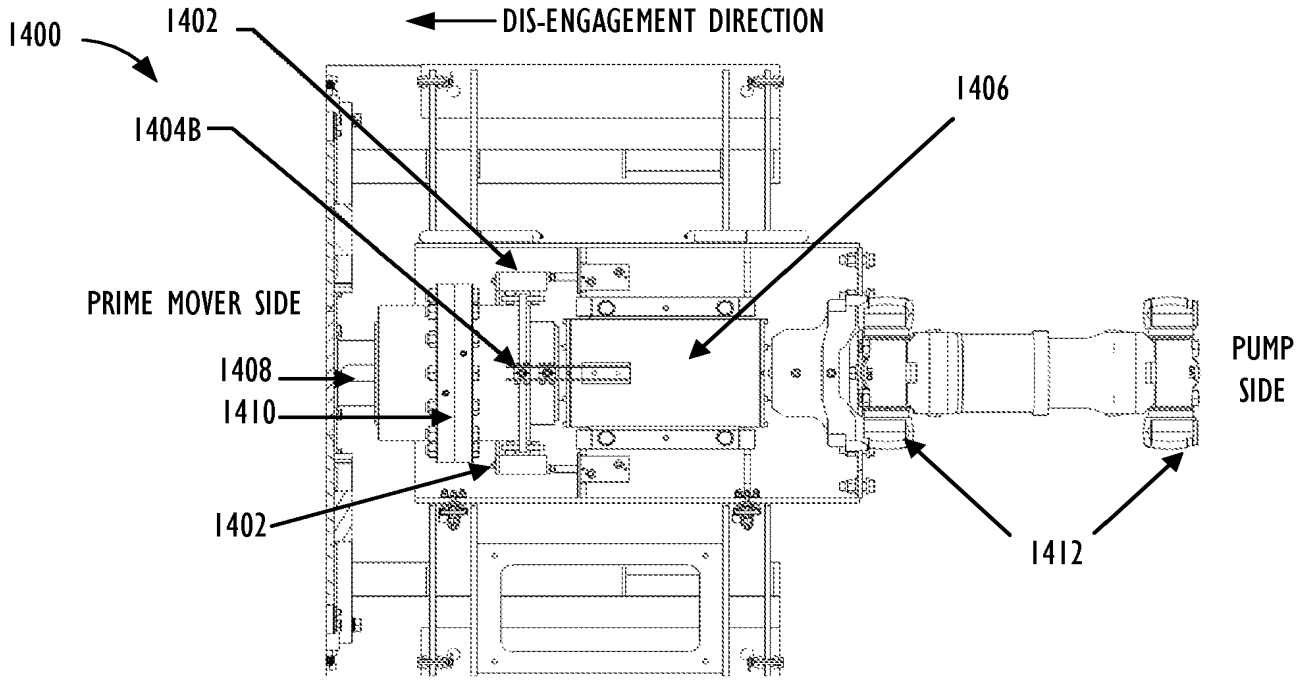


FIG. 14B

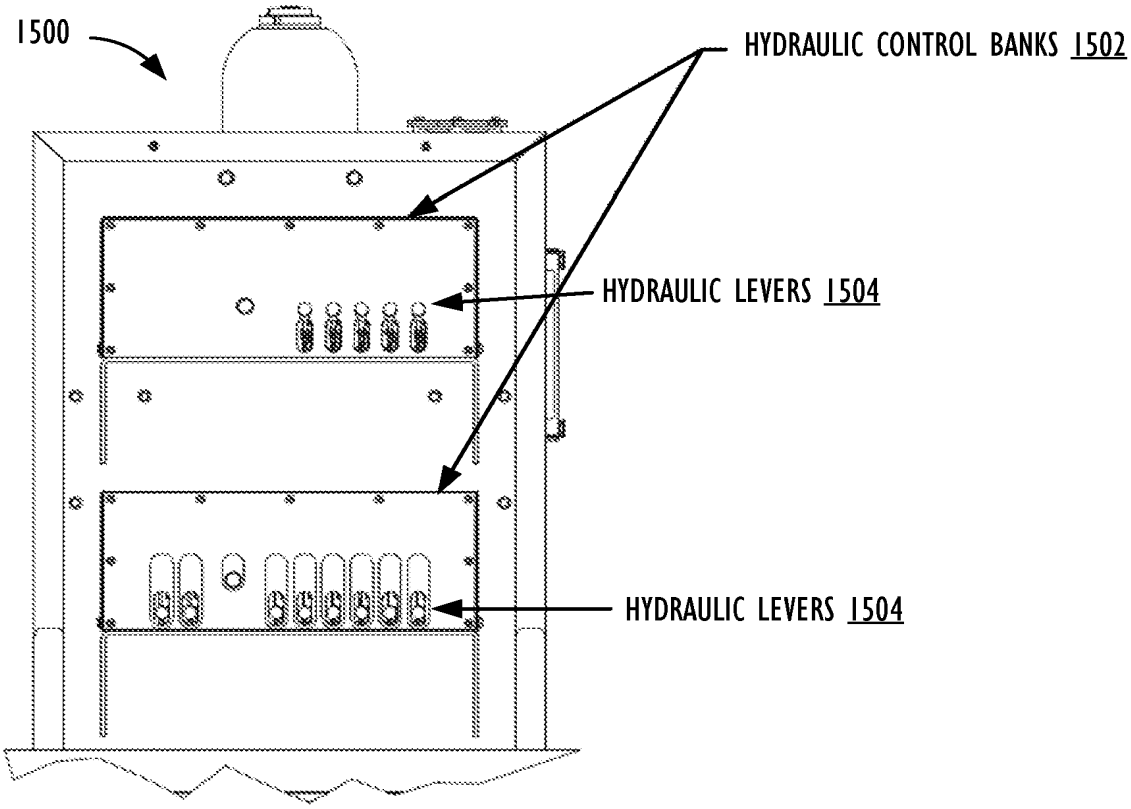


FIG. 15A

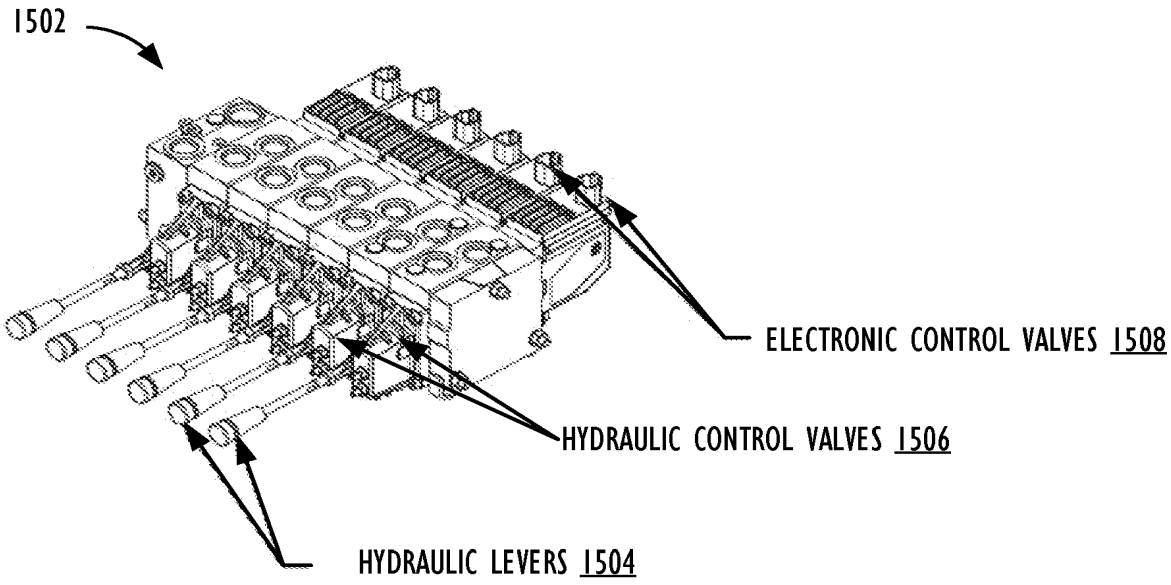


FIG. 15B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US16/49777

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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"E" earlier application or patent but published on or after the international filing date

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"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
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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International Bureau

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WIPO | PCT

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WO 2018/213925 A1

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E21B 41/00 (2006.01) *E21B 43/26* (2006.01)
E21B 21/00 (2006.01)

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PCT/CA2018/050601

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23 May 2018 (23.05.2018)

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(54) Title: DRILLING RIG POWER SUPPLY BUS MANAGEMENT

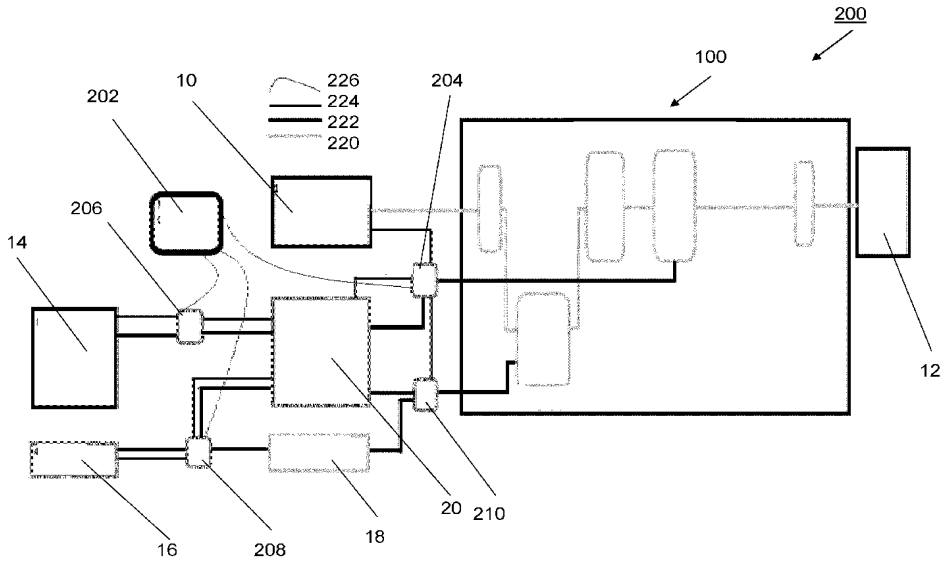


Figure 2

(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.

WO 2018/213925 A1

[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.

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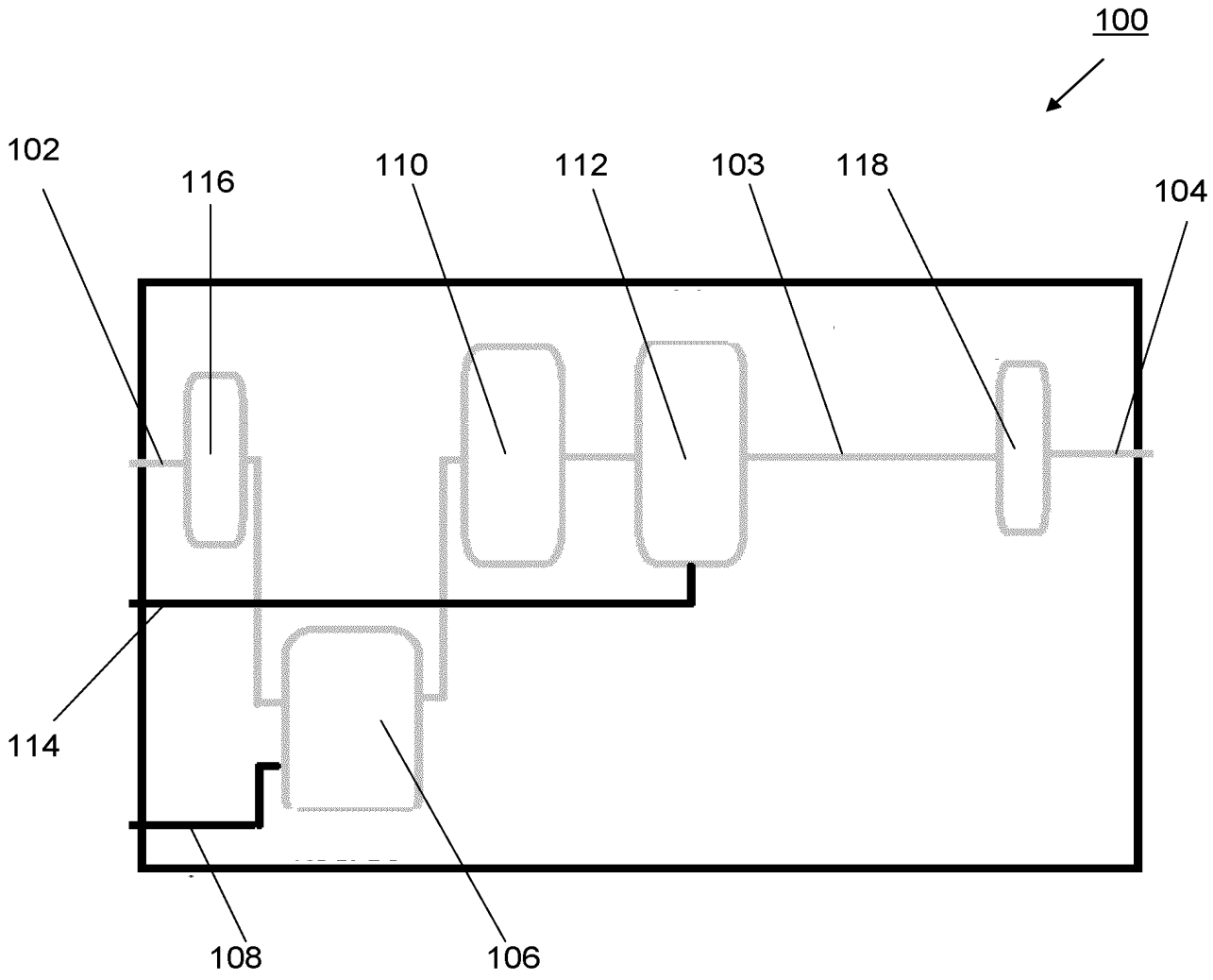


Figure 1a

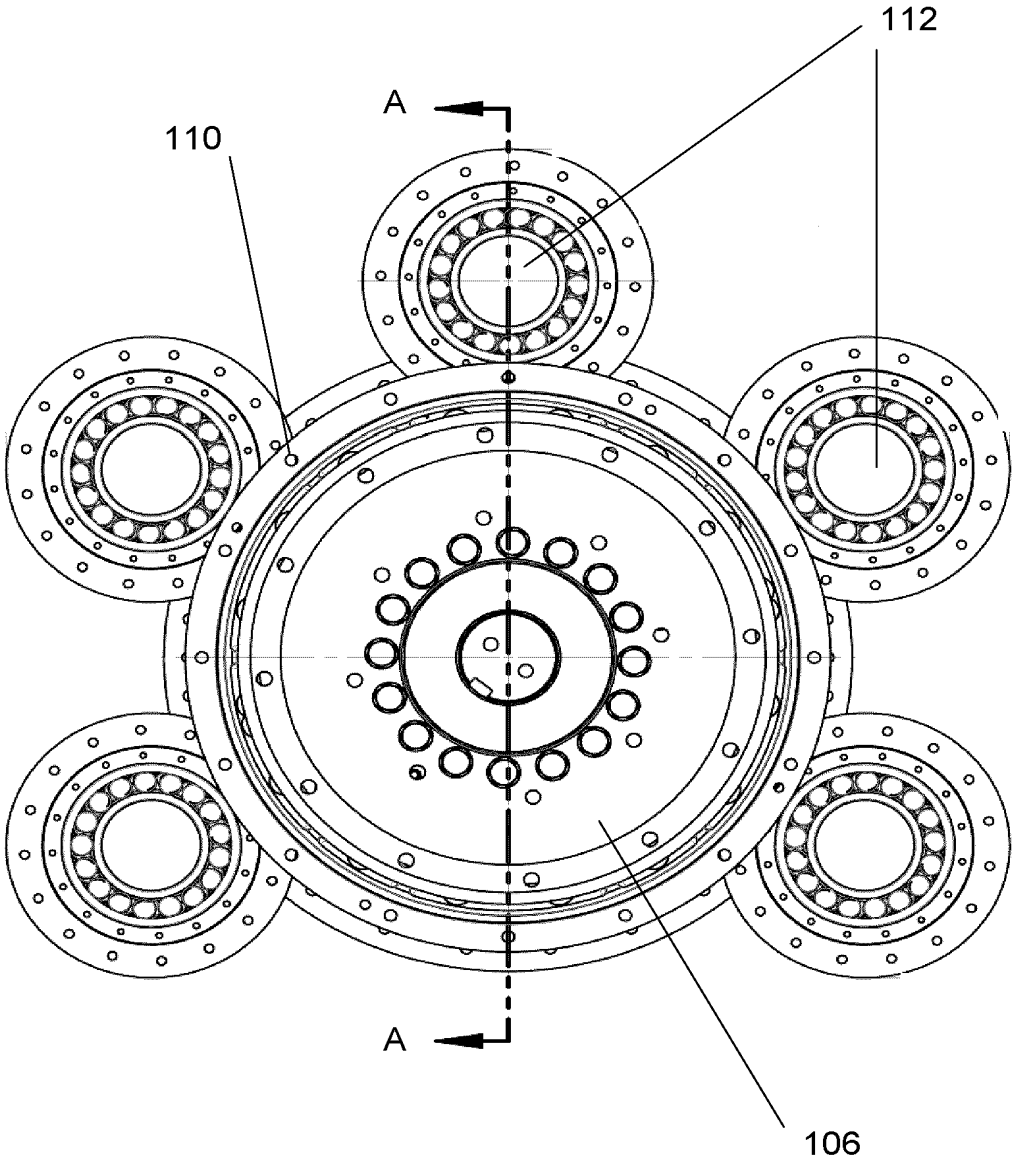


Figure 1b

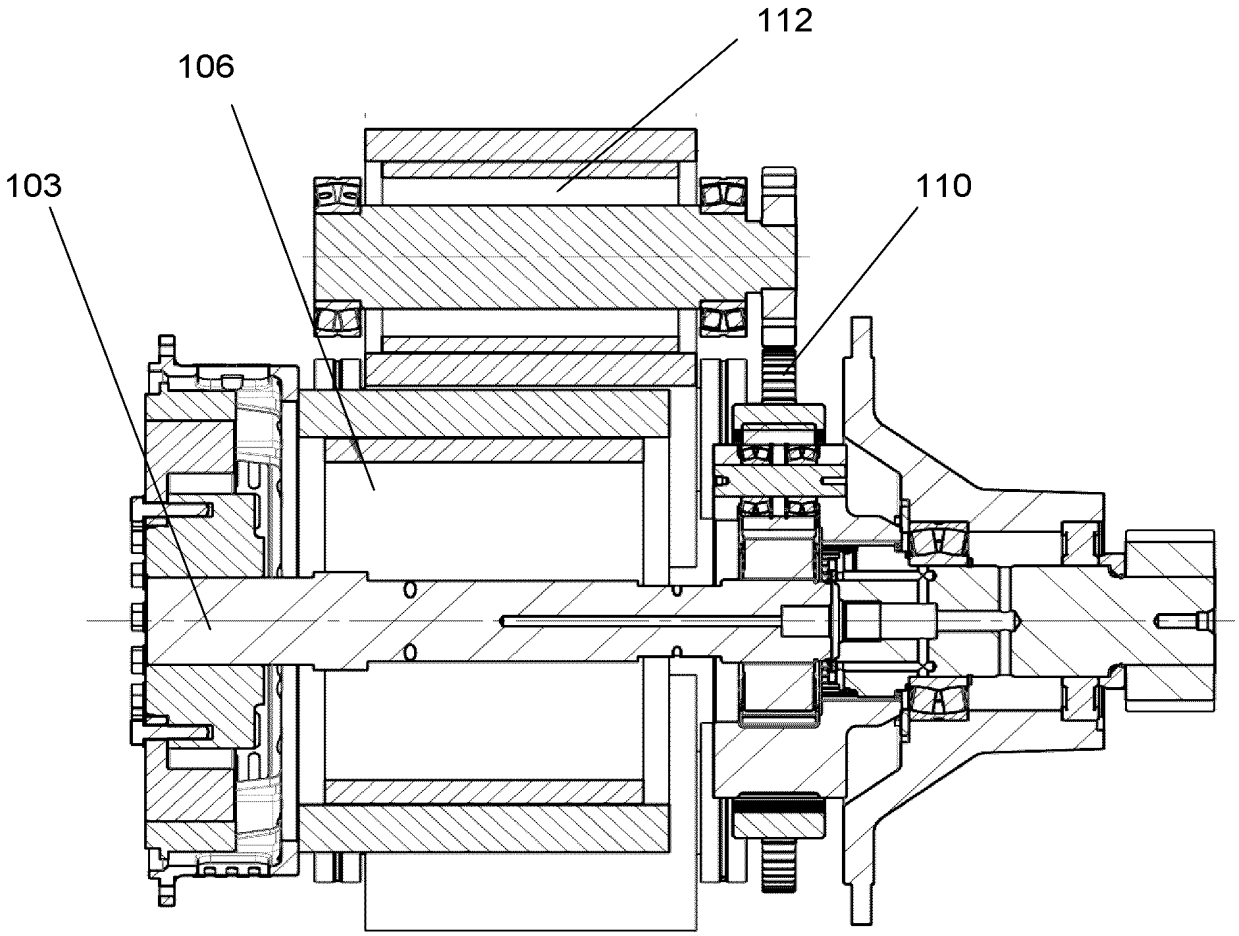


Figure 1c (Section A – A)

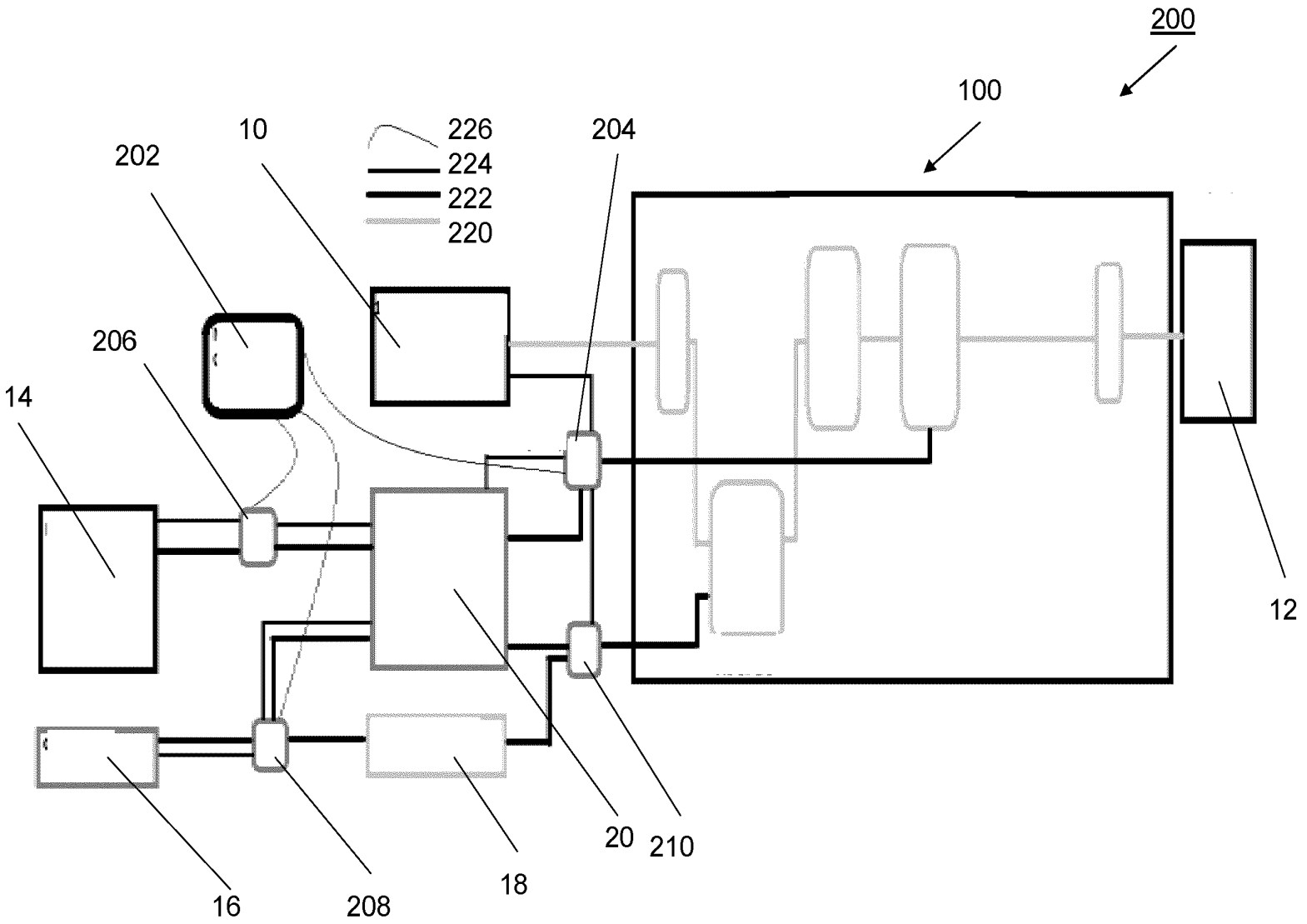
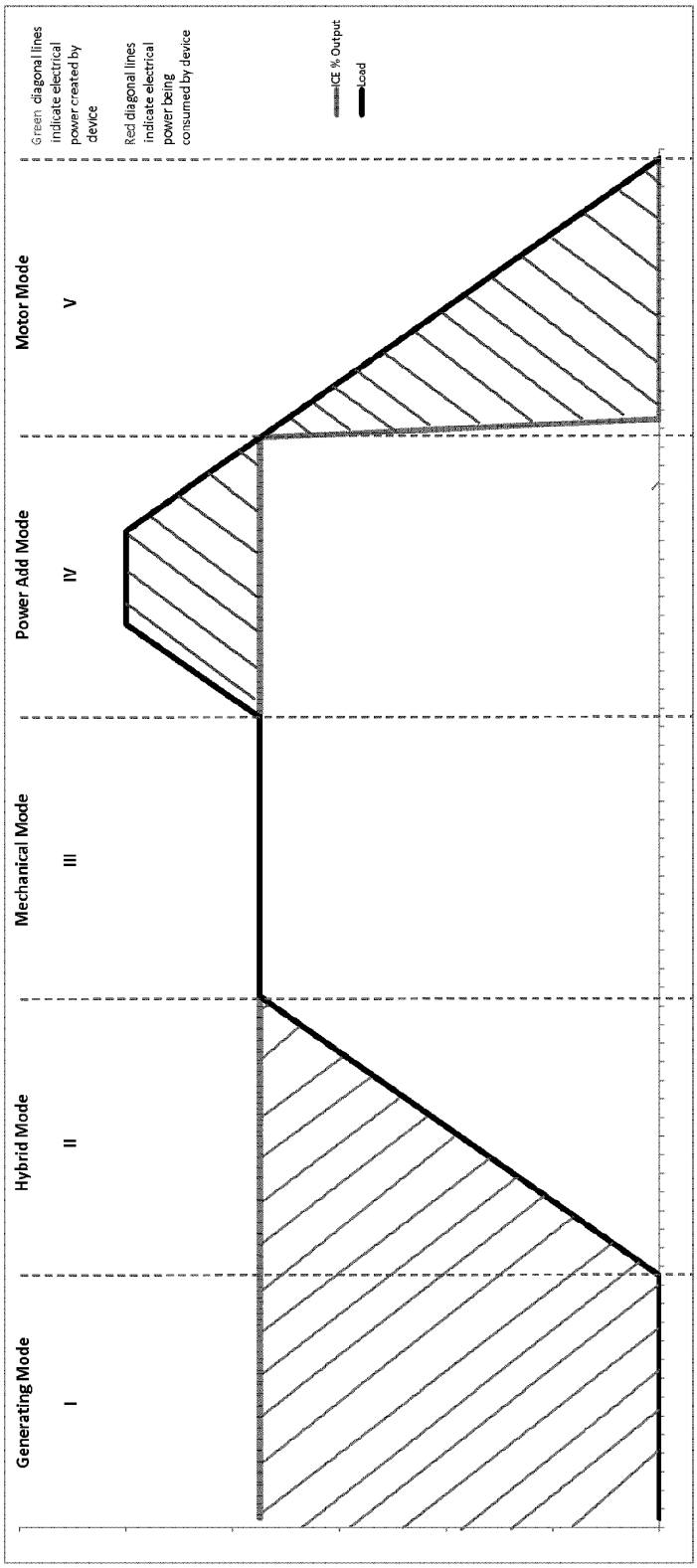


Figure 2

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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

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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	
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		CA2607466C	11 December 2012 (11-12-2012)
CN2546617Y	23 April 2003 (23-04-2003)	None	

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First Named Inventor/Applicant Name:	Jared Oehring
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1	Information Disclosure Statement (IDS) Form (SB08)	047158-100048-IDS.pdf	1035849 07239307c98287e9418b422bc7f130e3d8968c6c	no	7
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2	Foreign Reference	047158-CN104196613A.pdf	602165 640d7c784711f7b9e6dfbf72a3aeb1df5136d9a3	no	10
Warnings:					
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3	Foreign Reference	047158-CN104196613A-abstract1.pdf	69377 bb4adb4e13a78bdbe9dd9e4f27f41d4e4117fd10	no	1
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4	Non Patent Literature	047158-FOA-100048.pdf	1870514 1c2bc074a5b87b3cb70af7afb8408c72e41b5c7c	no	20
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5	Non Patent Literature	047158-FOA-100054.pdf	719596 5e7347f833aa8a4816966894e6b26d5d23c372f5	no	8
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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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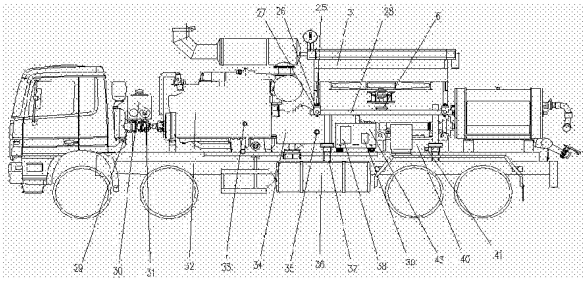
权利要求书1页 说明书3页 附图5页

(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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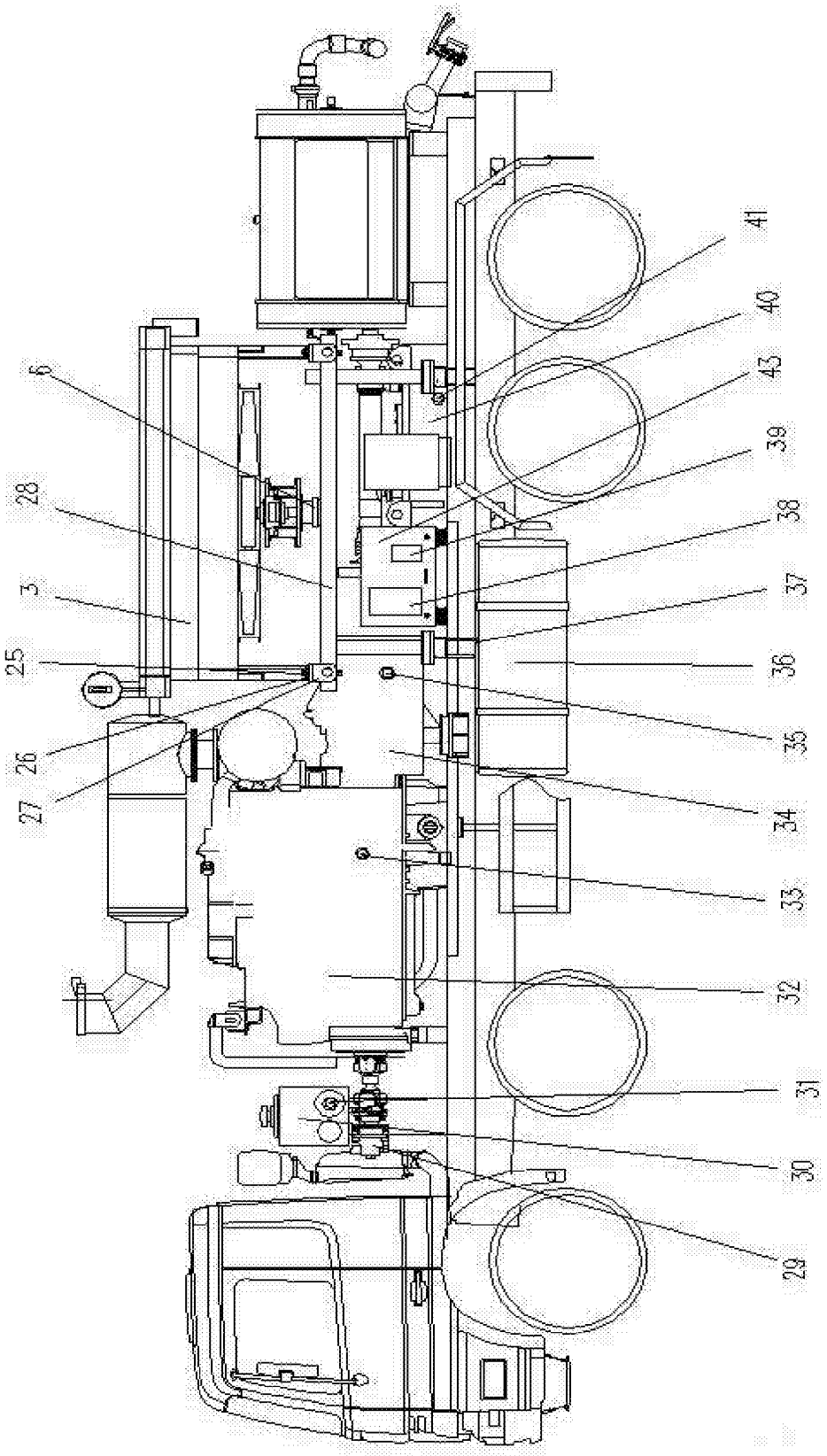


图 1

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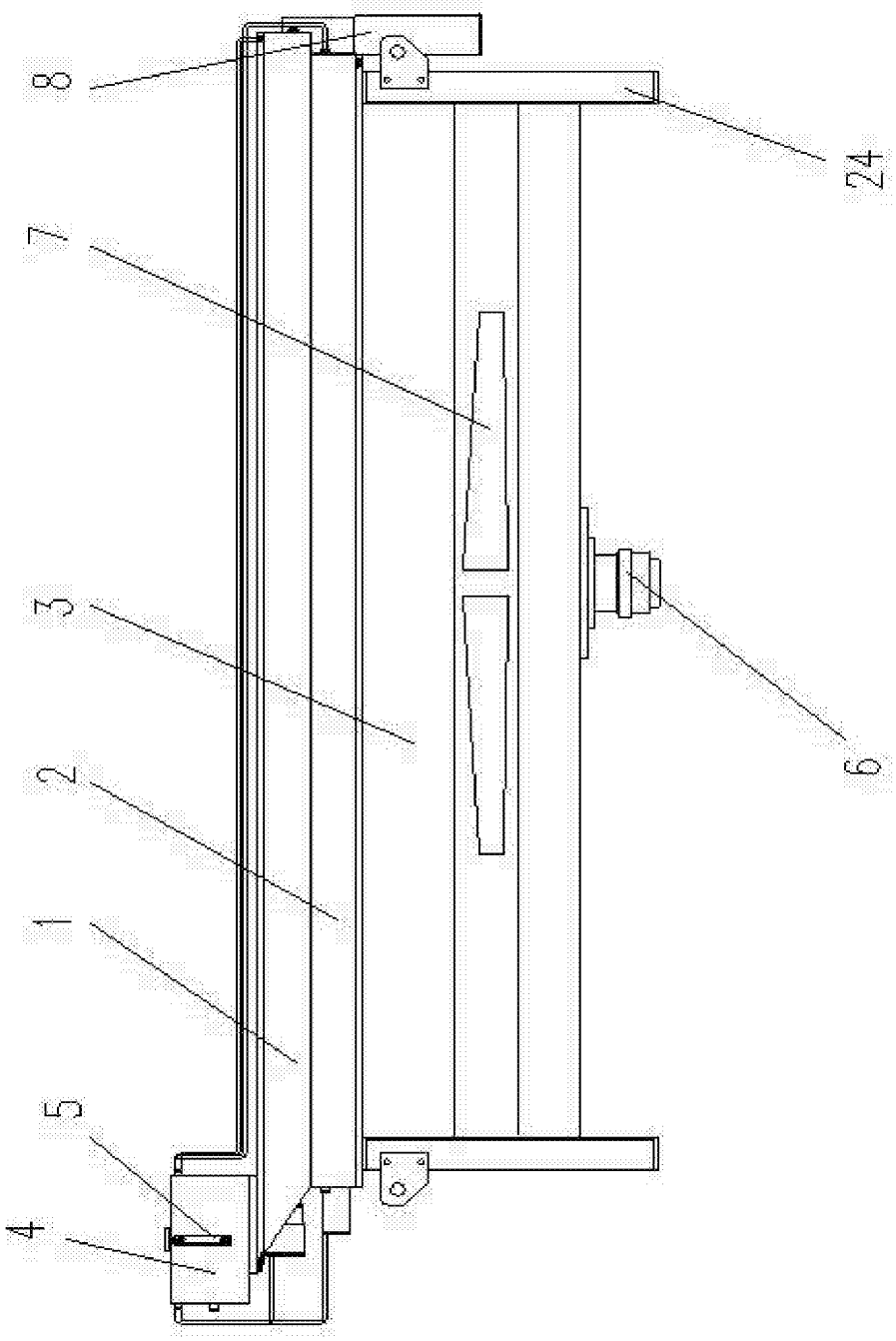


图 2

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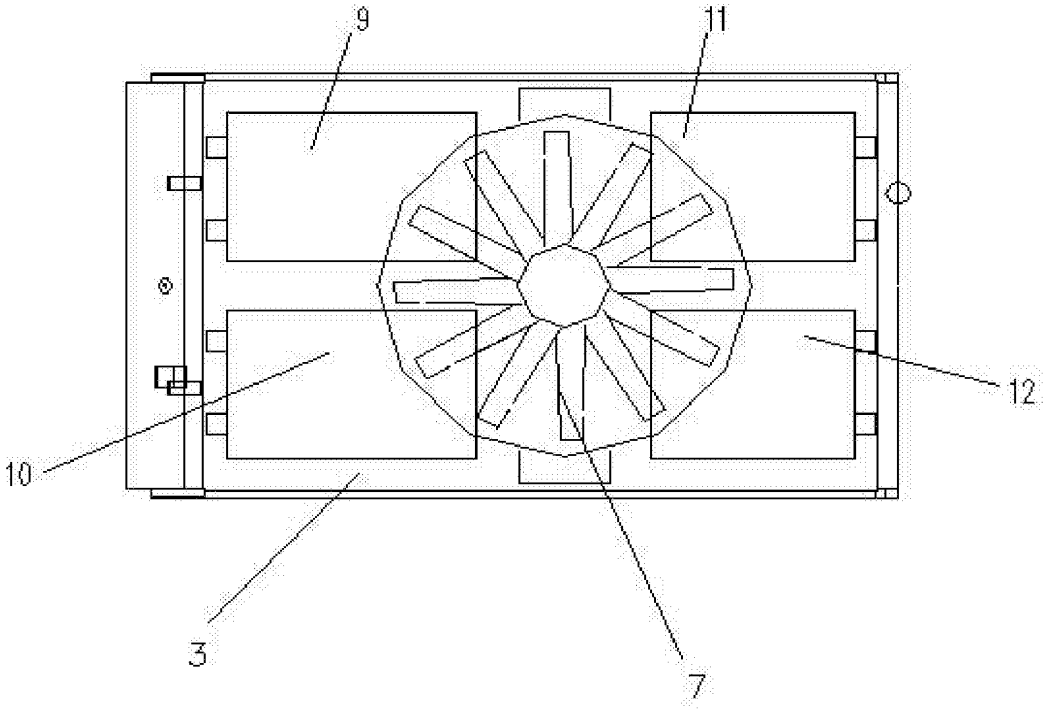


图 3

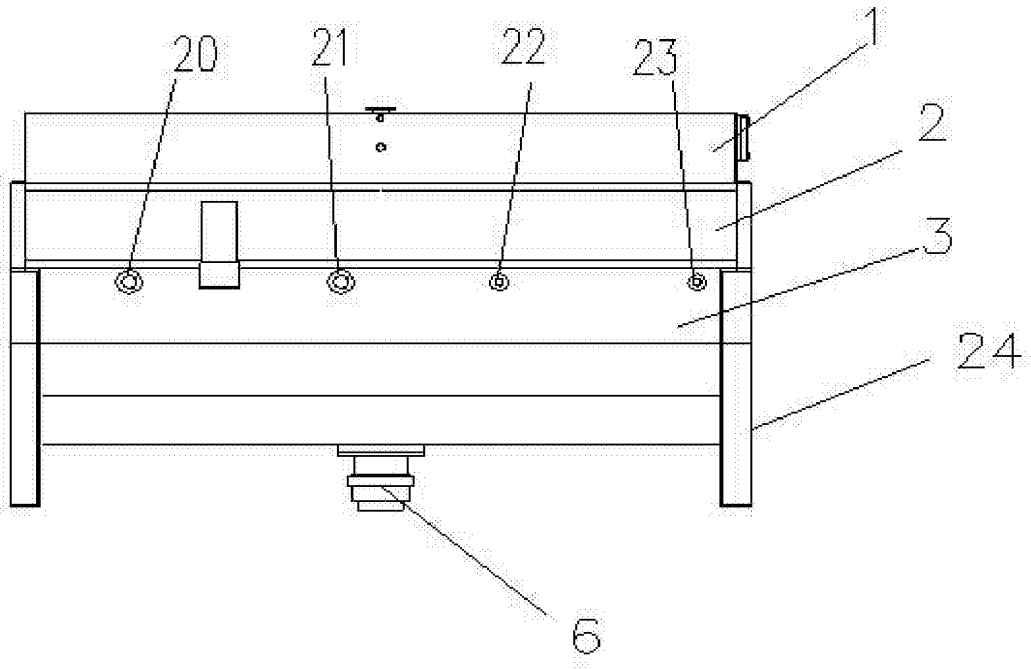


图 4

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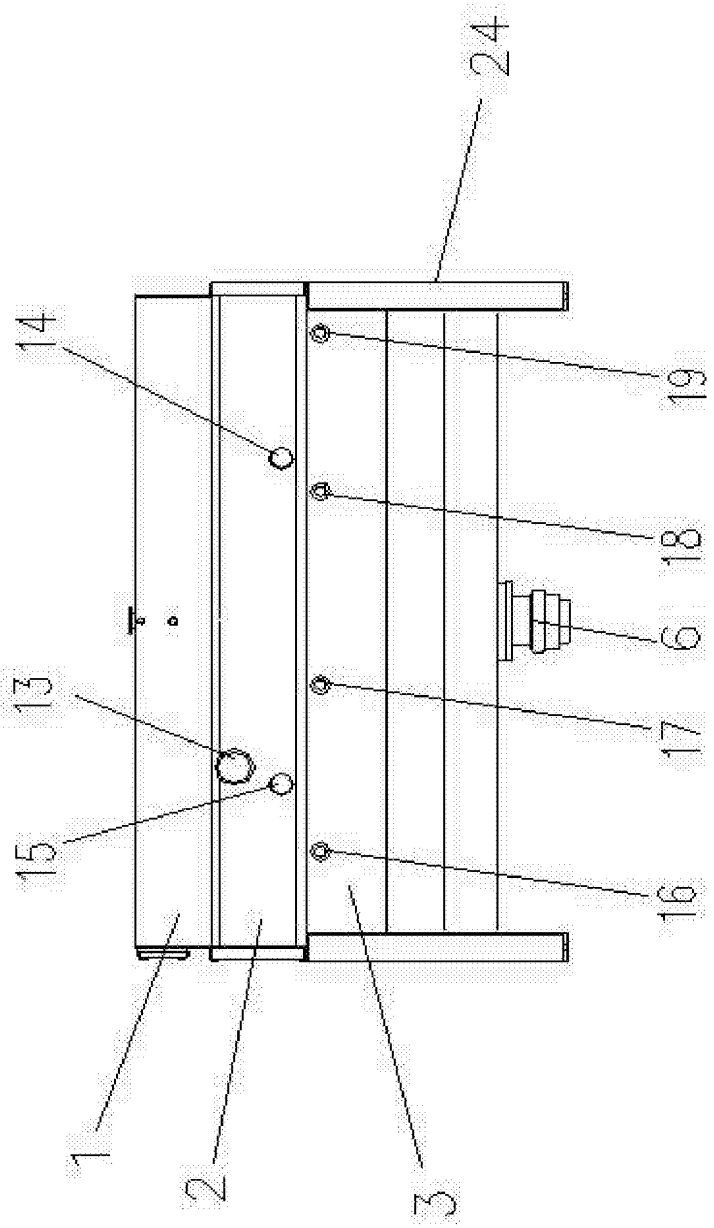


图 5

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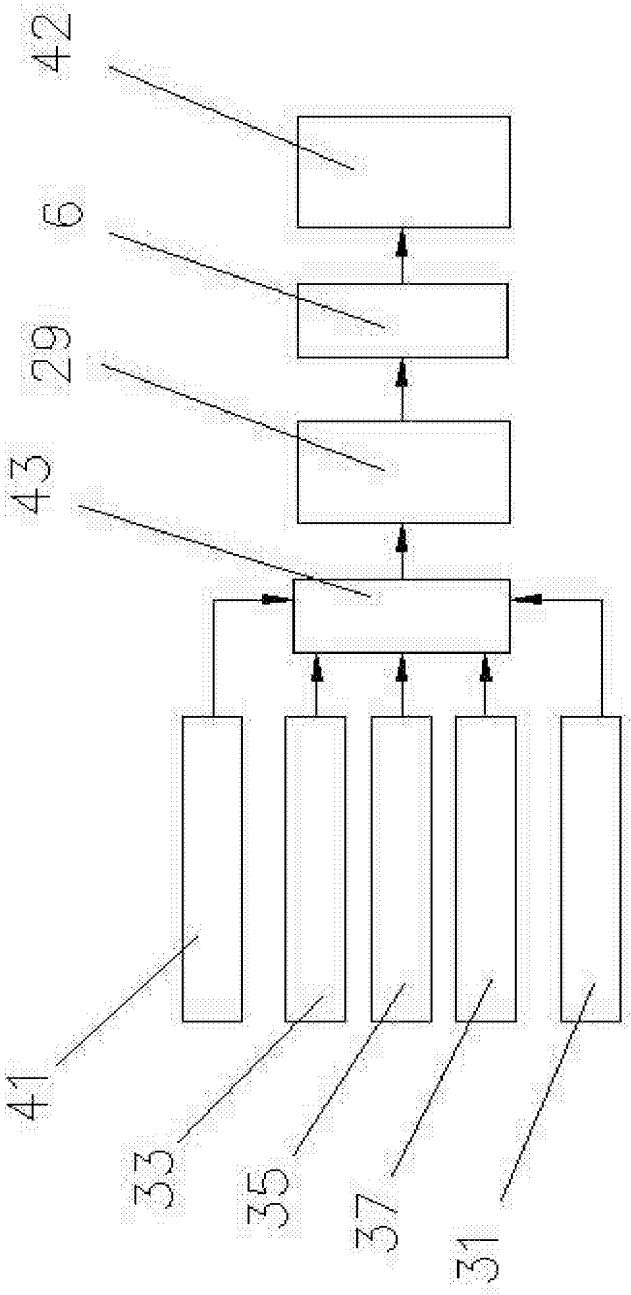


图 6

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Espacenet

Bibliographic data: CN104196613 (A) — 2014-12-10

Cooling device of fracturing truck

Inventor(s): LI LILI; WU HANCHUAN; XU YABIN; PENG PINGSHENG; LEI GANG; LIU ZHUO; FAN JIE; CHEN YONG; WANG YUNHAI ± (LI LILI, ; WU HANCHUAN, ; XU YABIN, ; PENG PINGSHENG, ; LEI GANG, ; LIU ZHUO, ; FAN JIE, ; CHEN YONG, ; WANG YUNHAI)

Applicant(s): SJ PETROLEUM MACHINERY CO LTD SINOPEC ± (SJ PETROLEUM MACHINERY CO., LTD. SINOPEC)

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.

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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(Not for submission under 37 CFR 1.99)

Application Number	16598014
Filing Date	2019-10-09
First Named Inventor	Jared OEHRING
Art Unit	3746
Examiner Name	Christopher S. BOBISH
Attorney Docket Number	047158.100048

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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.	

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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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	Art Unit	3746
	Examiner Name	Christopher S. BOBISH
	Attorney Docket Number	047158.100048

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

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	Application Number	16598014
	Filing Date	2019-10-09
	First Named Inventor	Jared OEHRING
	Art Unit	3746
	Examiner Name	Christopher S. BOBISH
	Attorney Docket Number	047158.100048

	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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	Filing Date	2019-10-09
	First Named Inventor	Jared OEHRING
	Art Unit	3746
	Examiner Name	Christopher S. BOBISH
	Attorney Docket Number	047158.100048

	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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Application Number	16598014
Filing Date	2019-10-09
First Named Inventor	Jared OEHRING
Art Unit	3746
Examiner Name	Christopher S. BOBISH
Attorney Docket Number	047158.100048

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)	2021-03-08
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.

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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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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.

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:

- [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, 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)

	Date of mailing *(day/month/year)*: 14DEC 2020
Applicant's or agent's file reference: 047158.500065	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 43.6*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/US2020/053980

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 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, 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 (VFD's) [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 [0078]).

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 (VFD's) [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 [0078]) 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 [0078]).

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 quintuplex pumps (each of the pumps 702A and 702B may be quintiplex pumps; see [0078]).

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 (VFD's) [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 (VFD's) [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)

	Date of mailing *(day/month/year)* 02 FEB 2021
Applicant's or agent's file reference 047158-500068	**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 --- Y --- A	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 ----- 1-4, 6-9, 11, 13 ----- 5, 12
Y --- A	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 ----- 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.

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(54) Title: MOBILE FRACTURING PUMP TRANSPORT FOR HYDRAULIC FRACTURING OF SUBSURFACE GEOLOGICAL FORMATIONS

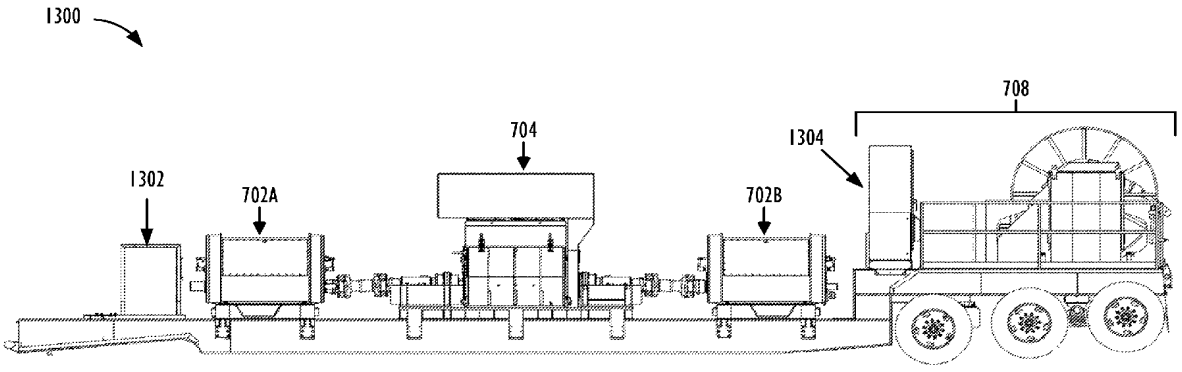


FIG. 13

(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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(Continued on next page)

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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.

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

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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

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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.

LIBERTY EXHIBIT 1002, Page 386

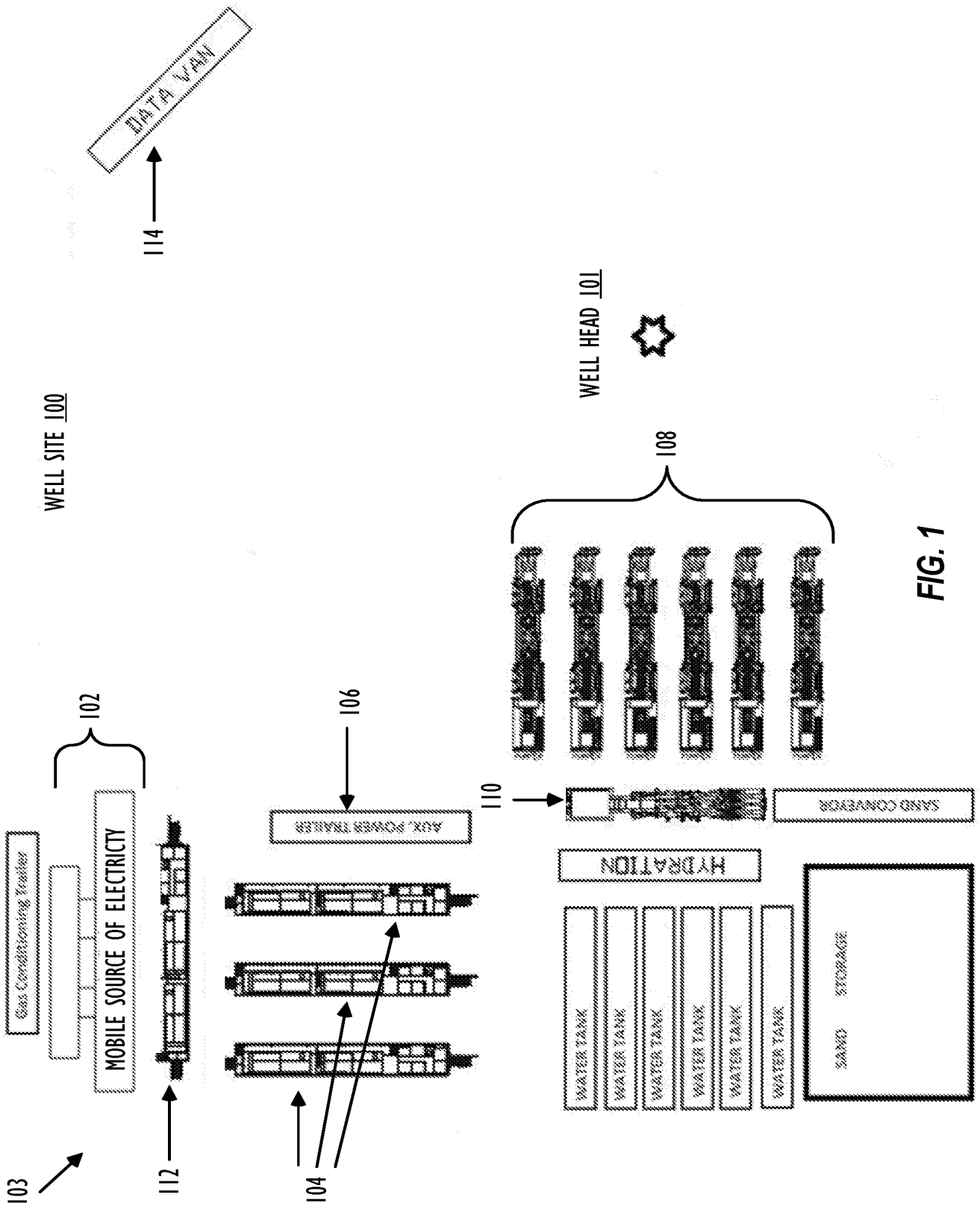


FIG. 1

LIBERTY EXHIBIT 1002, Page 387

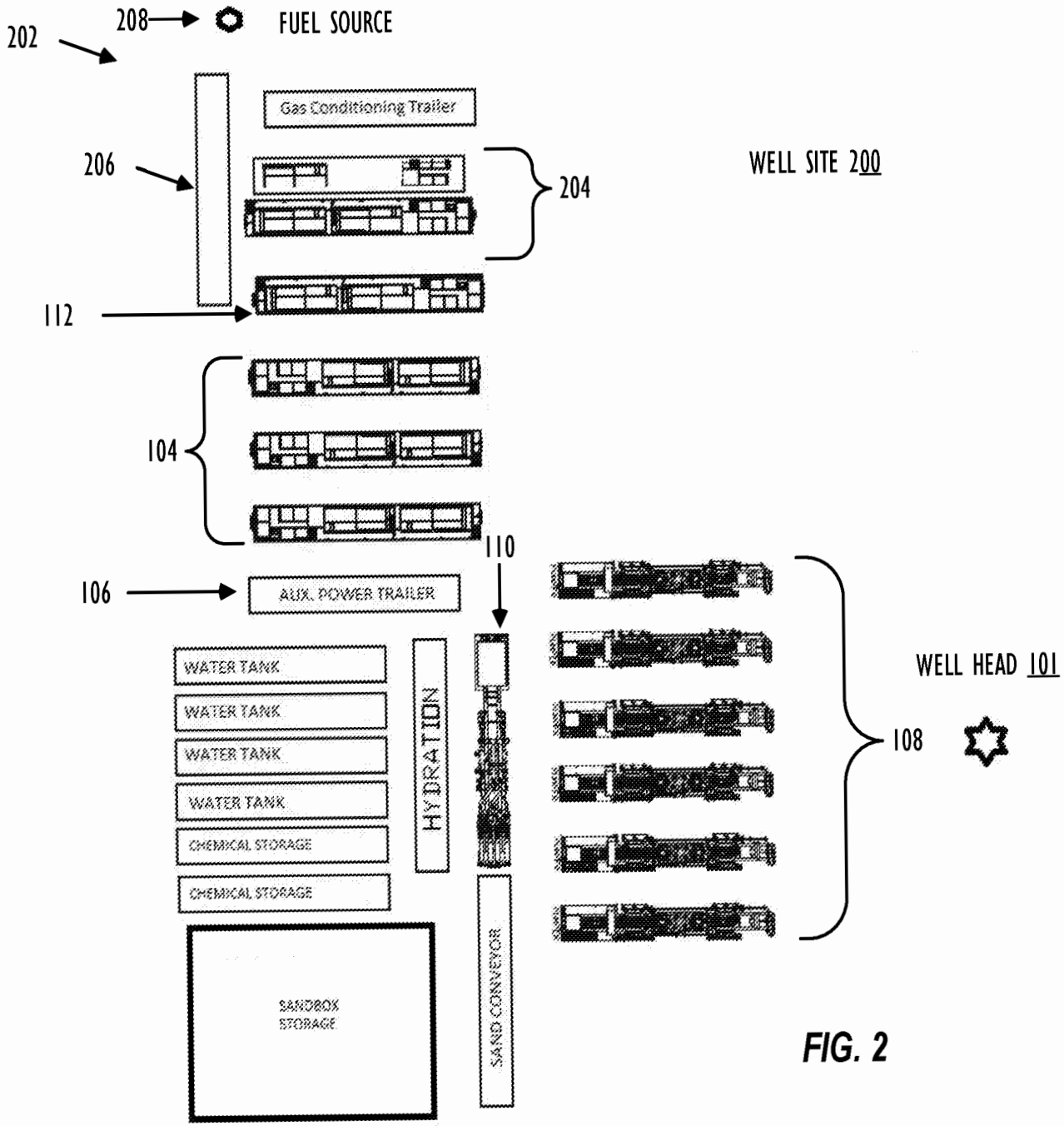

202
208
FUEL SOURCE
Gas Conditioning Trailer
206
204
WELL SITE 200
114
DATA VAN
112
104
110
106
AUX. POWER TRAILER
WATER TANK
WATER TANK
WATER TANK
WATER TANK
CHEMICAL STORAGE
CHEMICAL STORAGE
HYDRATION
WELL HEAD 101
108
SAND CONVEYOR
SANDBOX STORAGE

FIG. 2

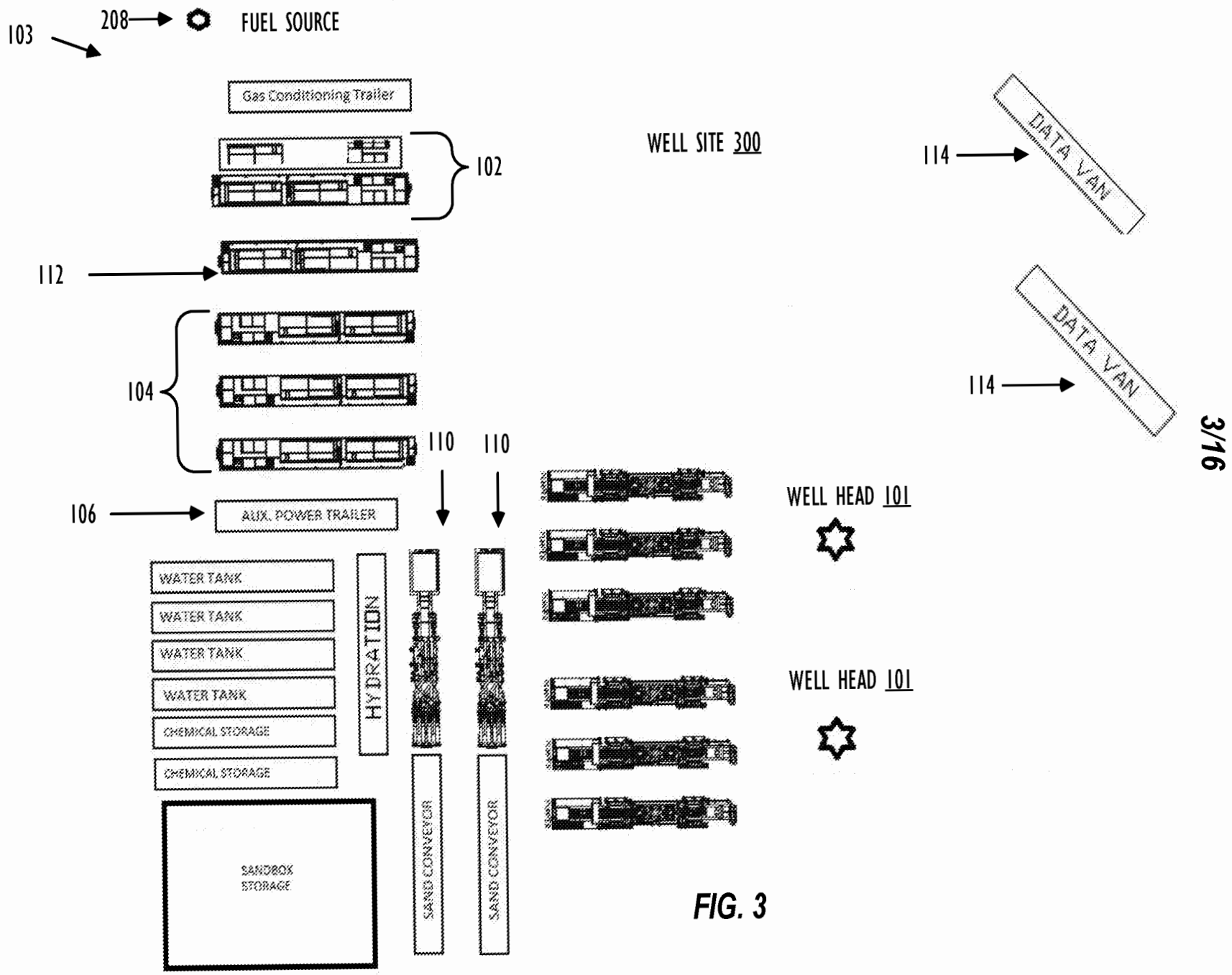

103
208
FUEL SOURCE
Gas Conditioning Trailer
102
WELL SITE 300
114
DATA VAN
112
104
114
DATA VAN
110
110
106
AUX. POWER TRAILER
WELL HEAD 101
WATER TANK
WATER TANK
WATER TANK
WATER TANK
CHEMICAL STORAGE
CHEMICAL STORAGE
HYDRATION
WELL HEAD 101
SANDBOX STORAGE
SAND CONVEYOR
SAND CONVEYOR

FIG. 3

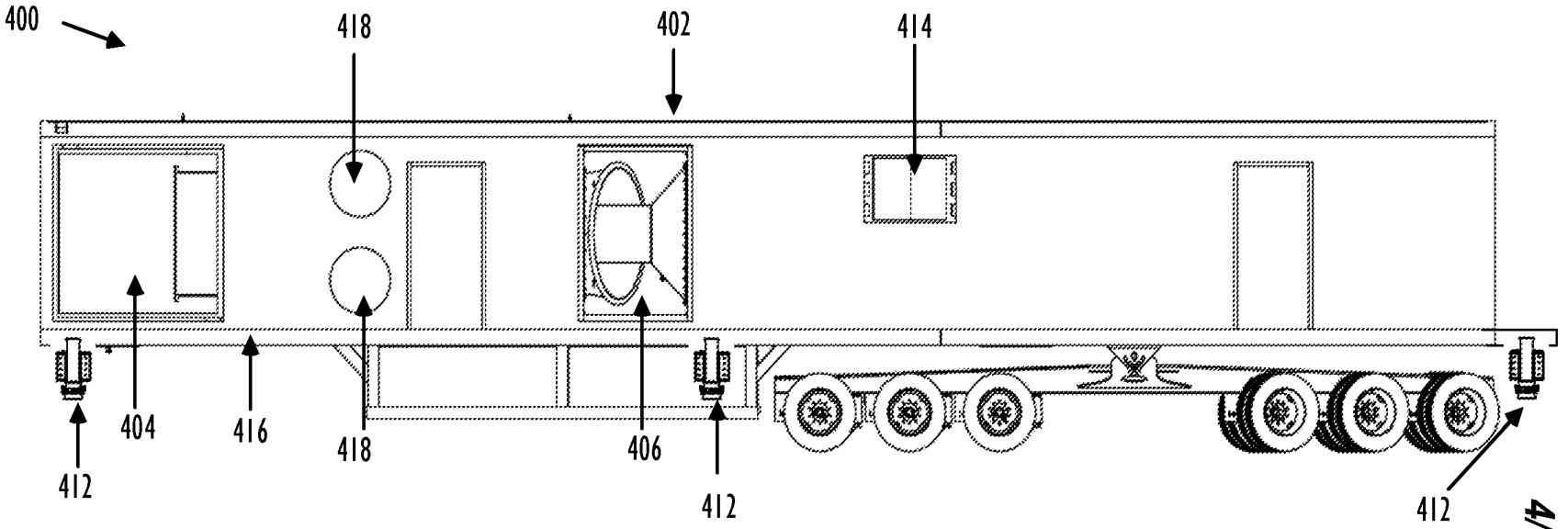

400
418
402
414
404
416
418
406
412
412
412

FIG. 4A

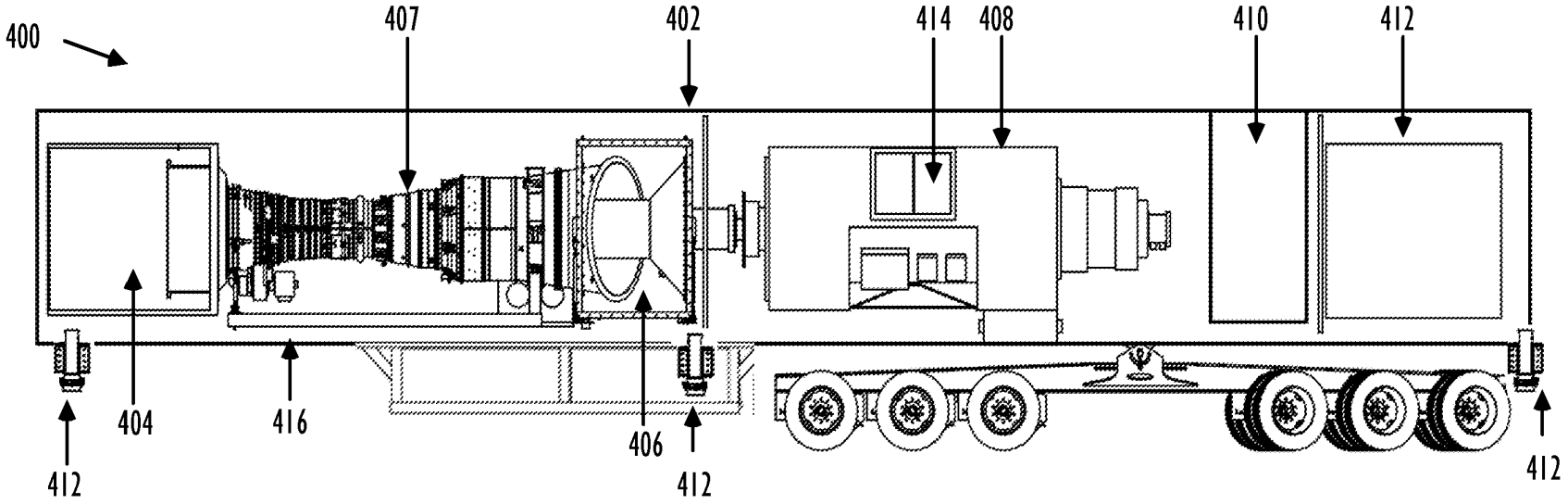

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404
416
406
412
412
412

FIG. 4B

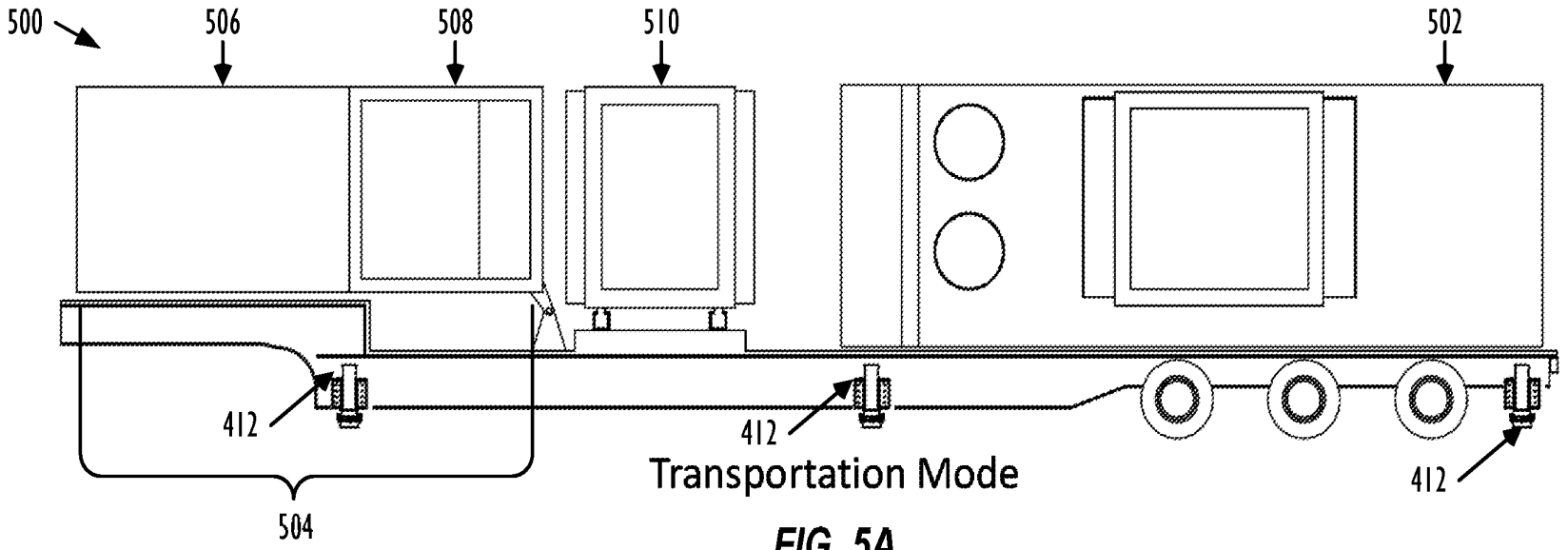

500
506
508
510
502
412
412
412
504
Transportation Mode

FIG. 5A

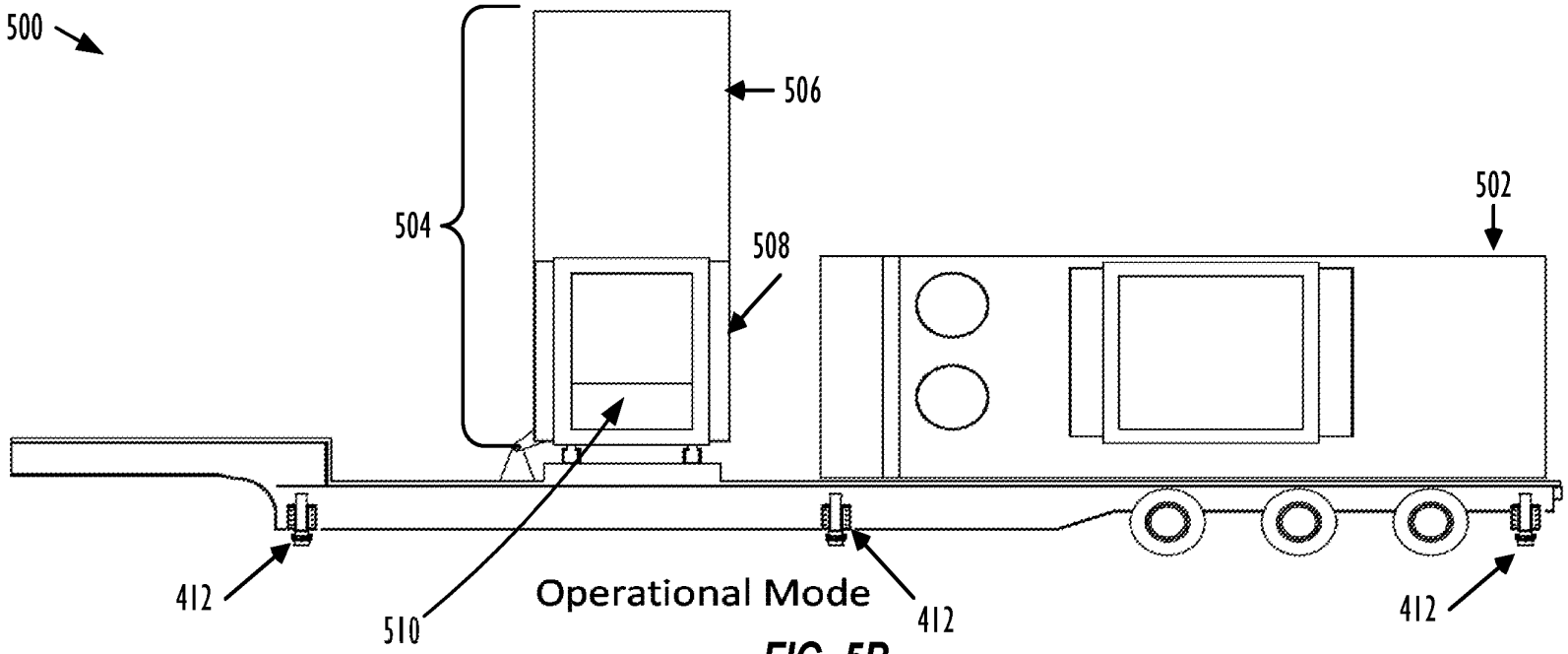

500
506
504
508
502
412
510
Operational Mode
412
412

FIG. 5B

LIBERTY EXHIBIT 1002, Page 392

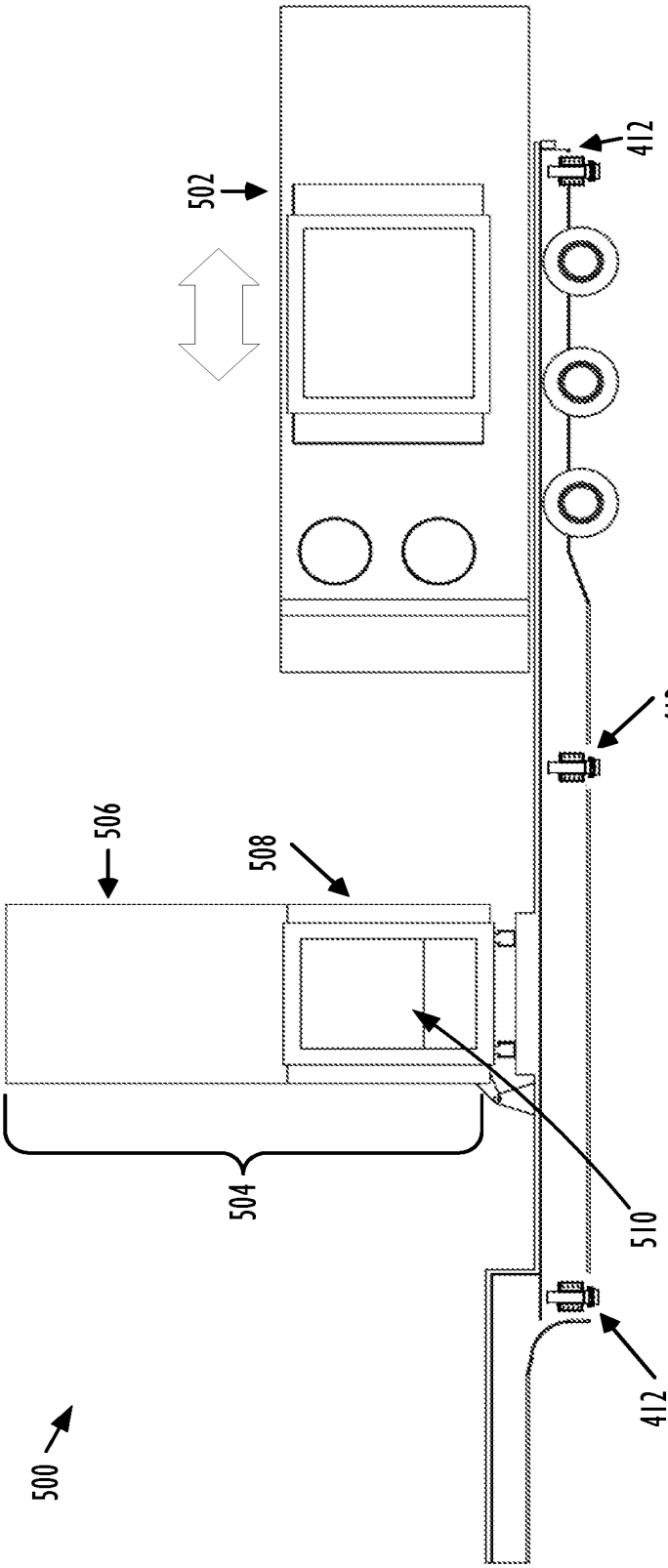


FIG. 5C

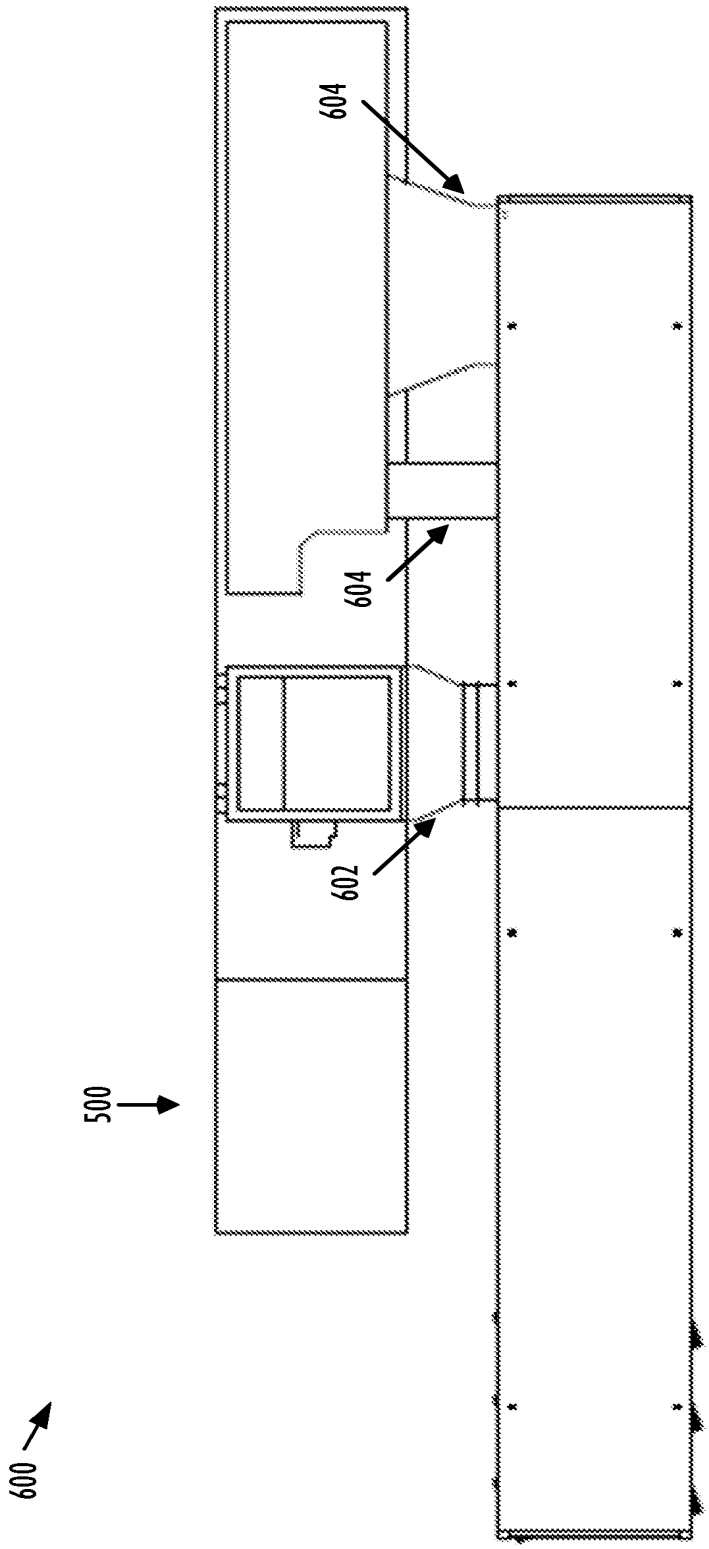


FIG. 6

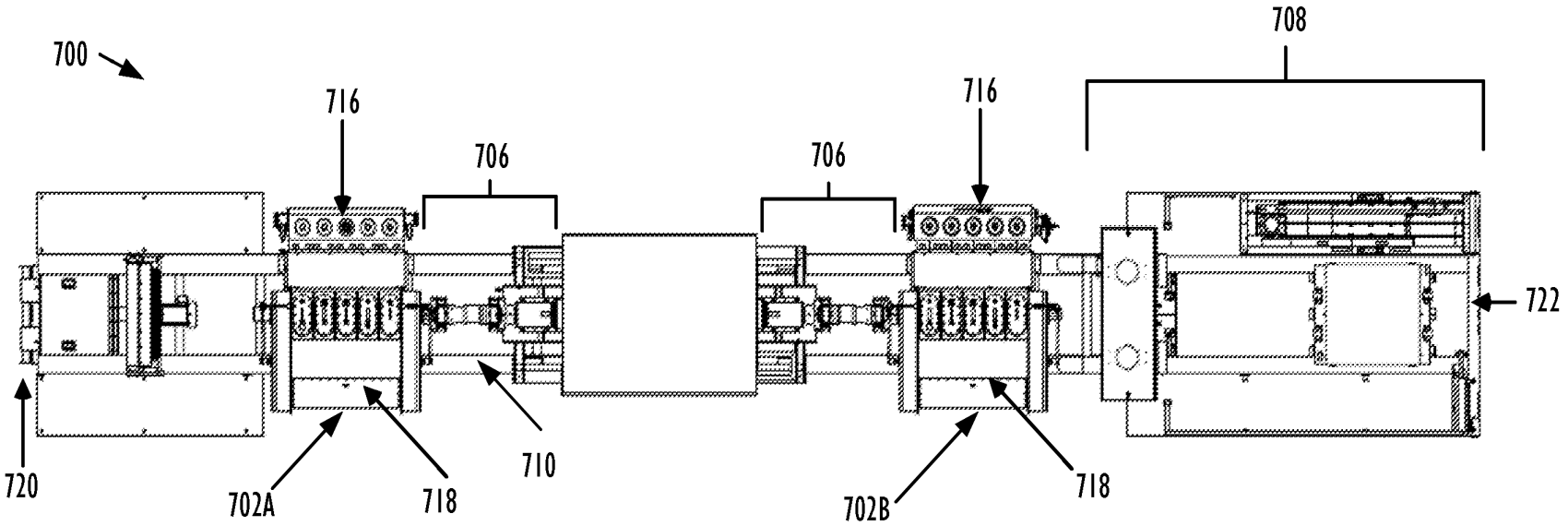

700
716
706
706
716
708
722
720
702A
718
710
702B
718

FIG. 7A

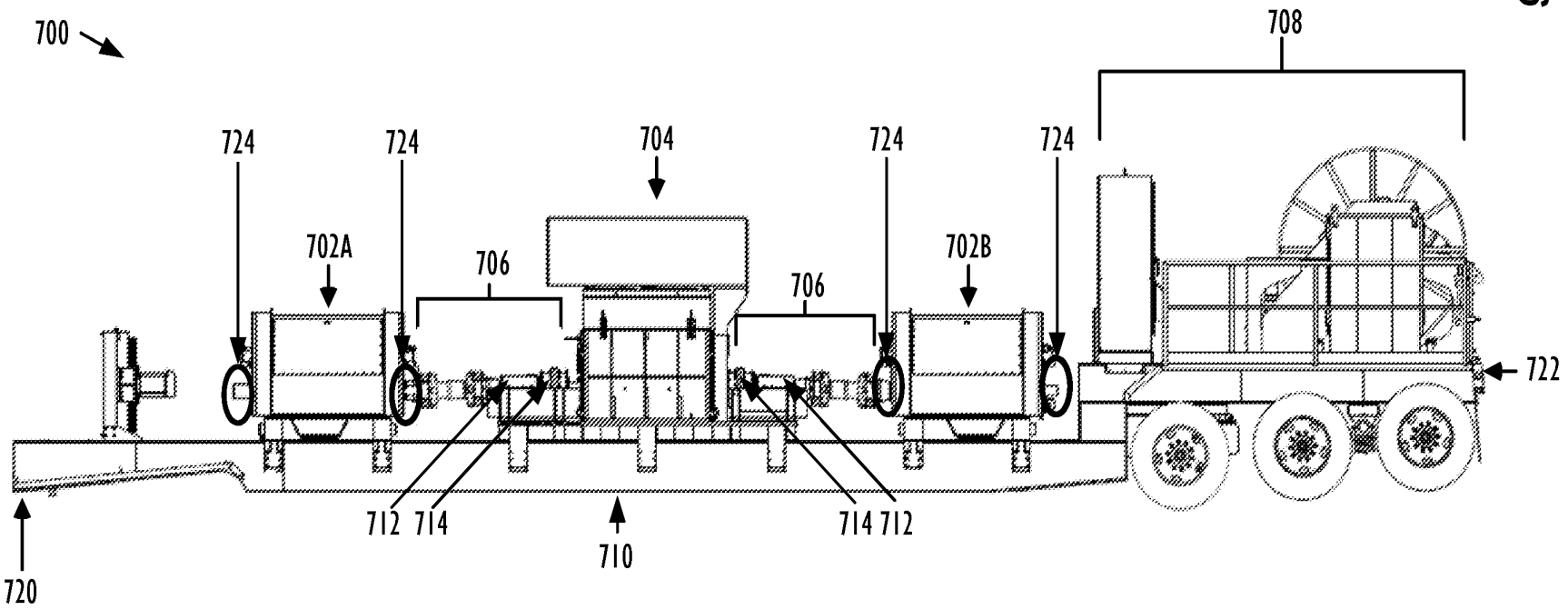

700
724
724
704
724
724
708
702A
706
706
702B
722
712
714
710
714
712
720

FIG. 7B

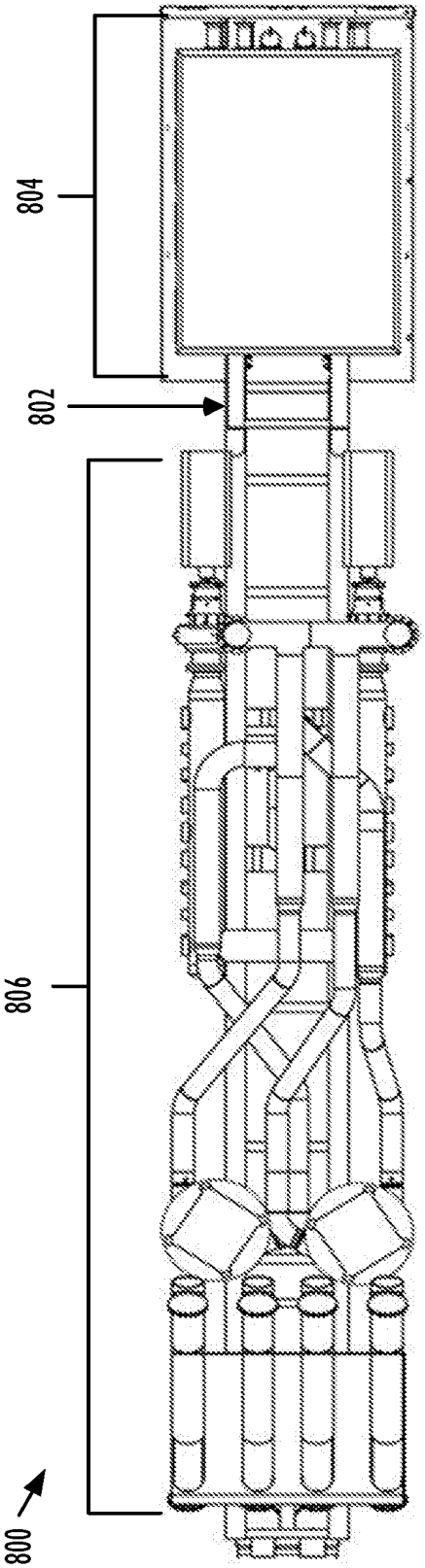


FIG. 8A

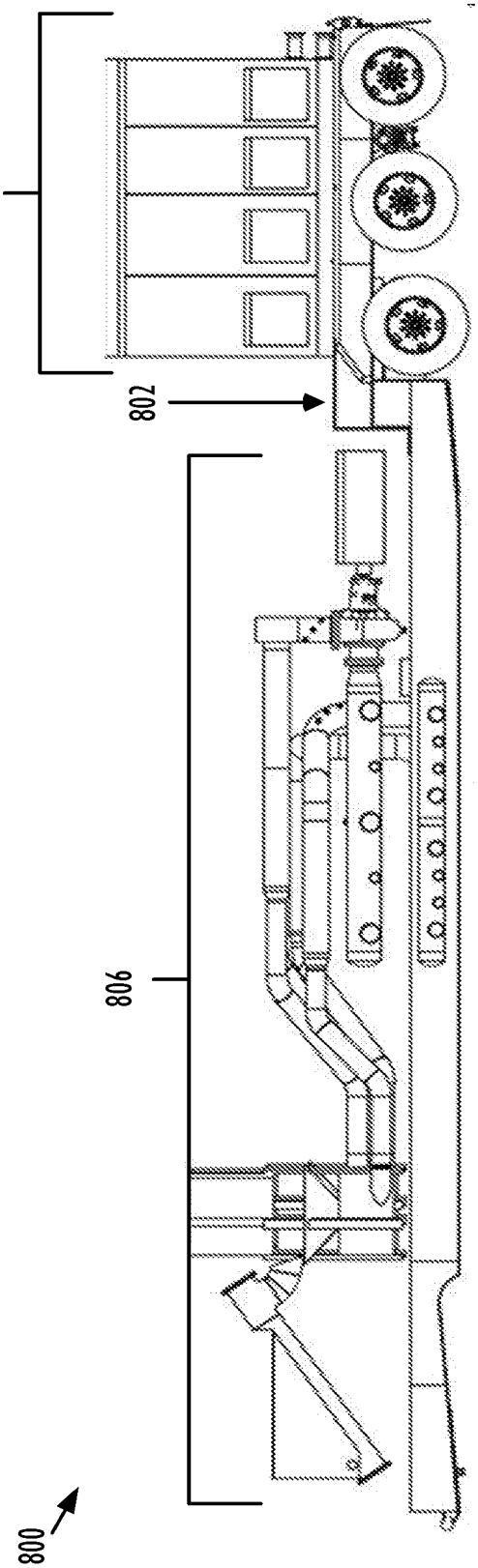


FIG. 8B

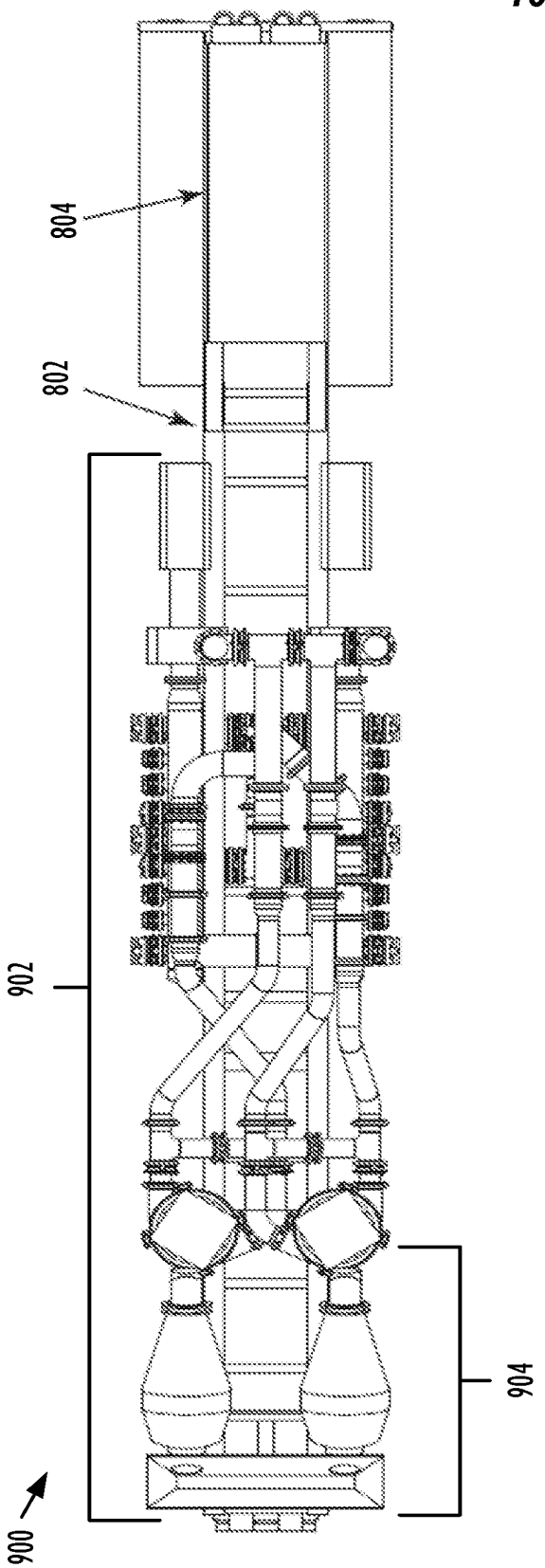


FIG. 9A

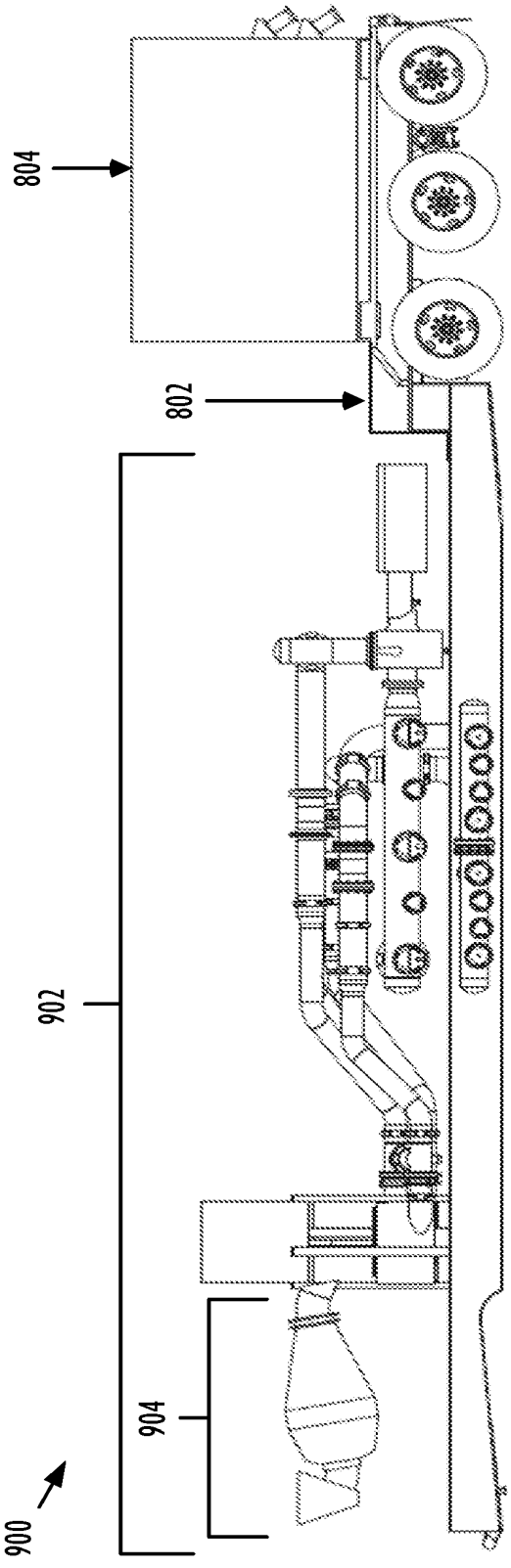


FIG. 9B

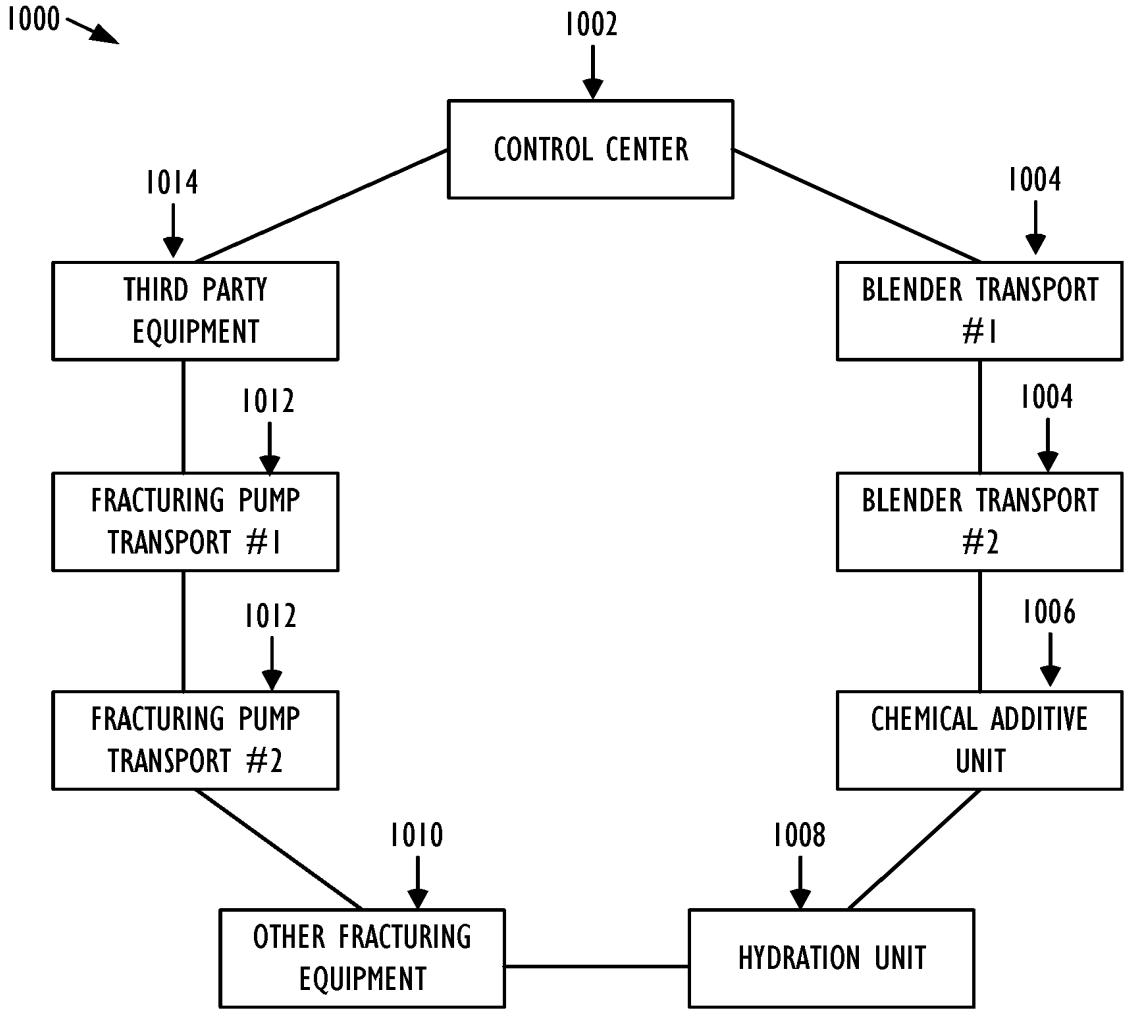

1000
1002
CONTROL CENTER
1014
1004
THIRD PARTY EQUIPMENT
BLENDER TRANSPORT #1
1012
1004
FRACTURING PUMP TRANSPORT #1
BLENDER TRANSPORT #2
1012
1006
FRACTURING PUMP TRANSPORT #2
CHEMICAL ADDITIVE UNIT
1010
1008
OTHER FRACTURING EQUIPMENT
HYDRATION UNIT

FIG. 10

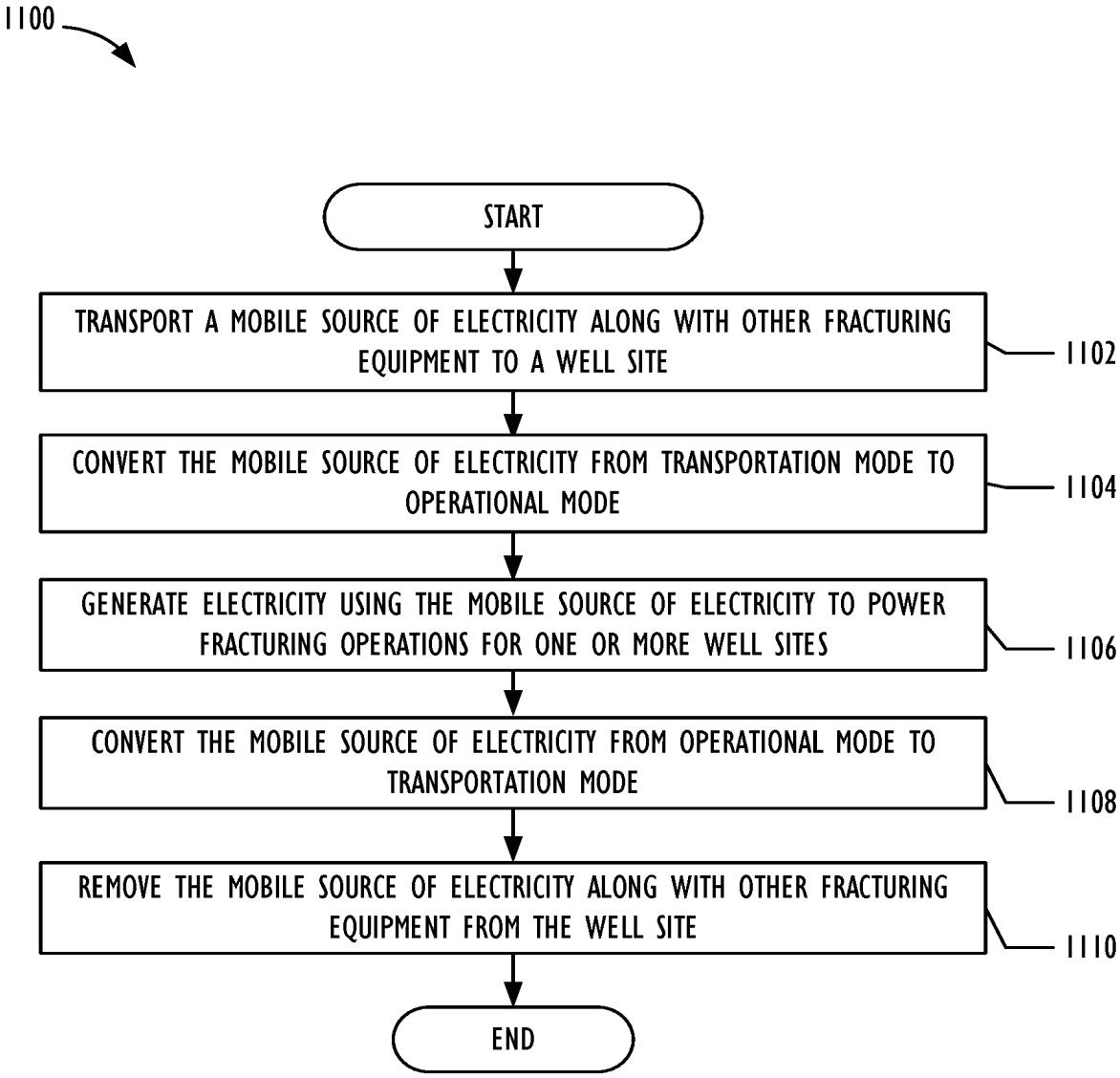

1100
START
TRANSPORT A MOBILE SOURCE OF ELECTRICITY ALONG WITH OTHER FRACTURING EQUIPMENT TO A WELL SITE
1102
CONVERT THE MOBILE SOURCE OF ELECTRICITY FROM TRANSPORTATION MODE TO OPERATIONAL MODE
1104
GENERATE ELECTRICITY USING THE MOBILE SOURCE OF ELECTRICITY TO POWER FRACTURING OPERATIONS FOR ONE OR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

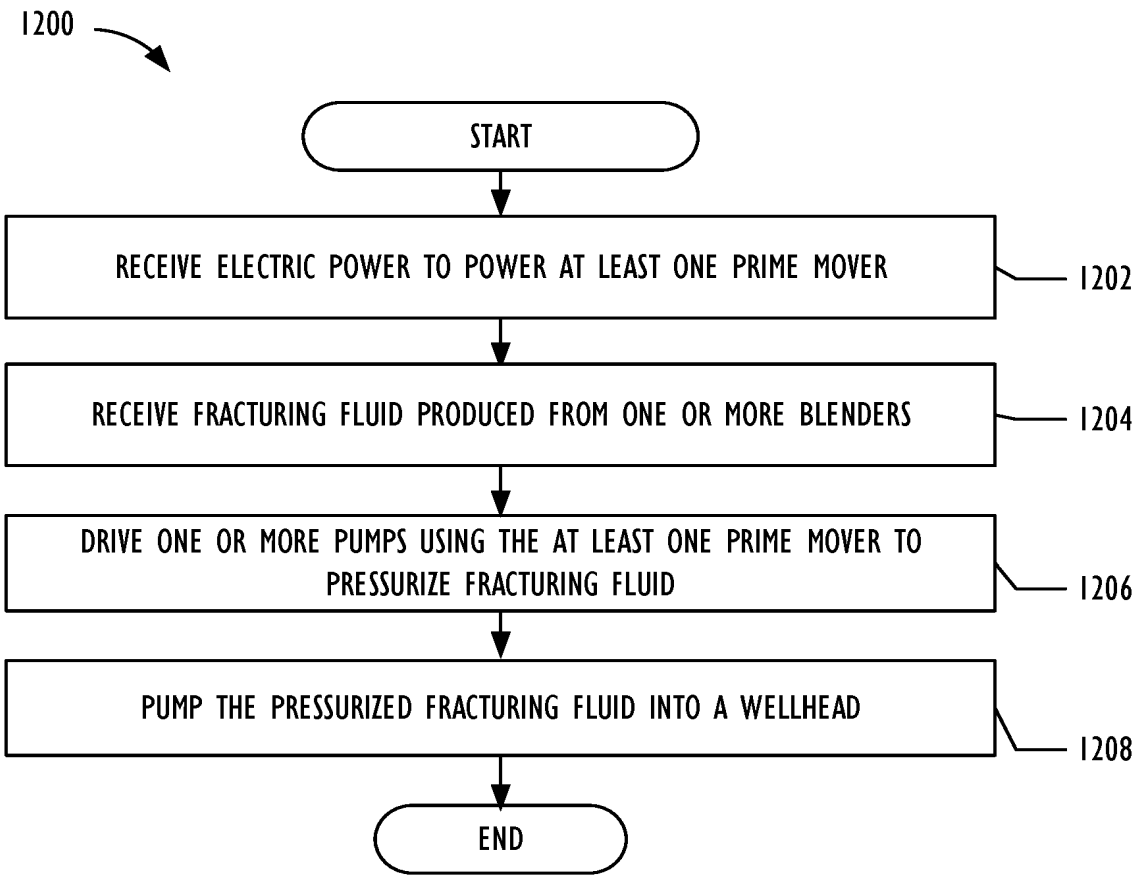

1200
START
RECEIVE ELECTRIC POWER TO POWER AT LEAST ONE PRIME MOVER
1202
RECEIVE FRACTURING FLUID PRODUCED FROM ONE OR MORE BLENDERS
1204
DRIVE ONE OR MORE PUMPS USING THE AT LEAST ONE PRIME MOVER TO PRESSURIZE FRACTURING FLUID
1206
PUMP THE PRESSURIZED FRACTURING FLUID INTO A WELLHEAD
1208
END

FIG. 12

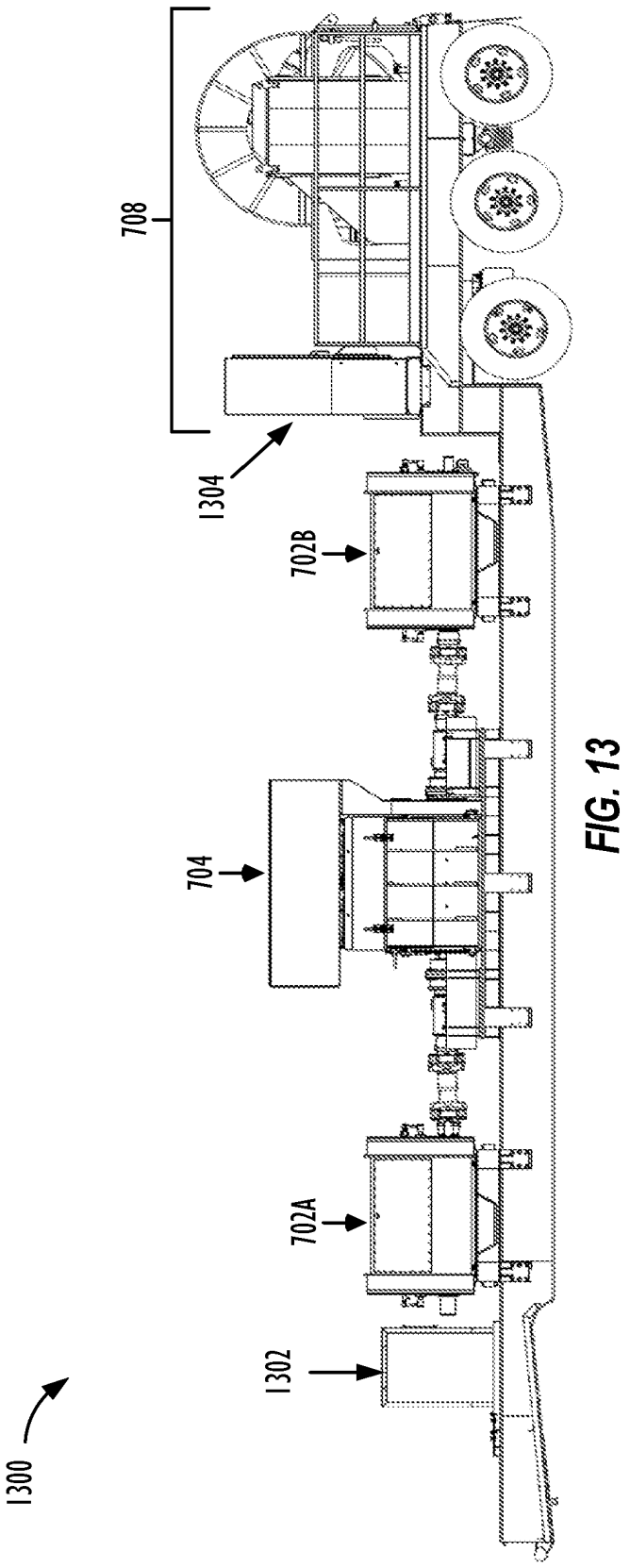


FIG. 13

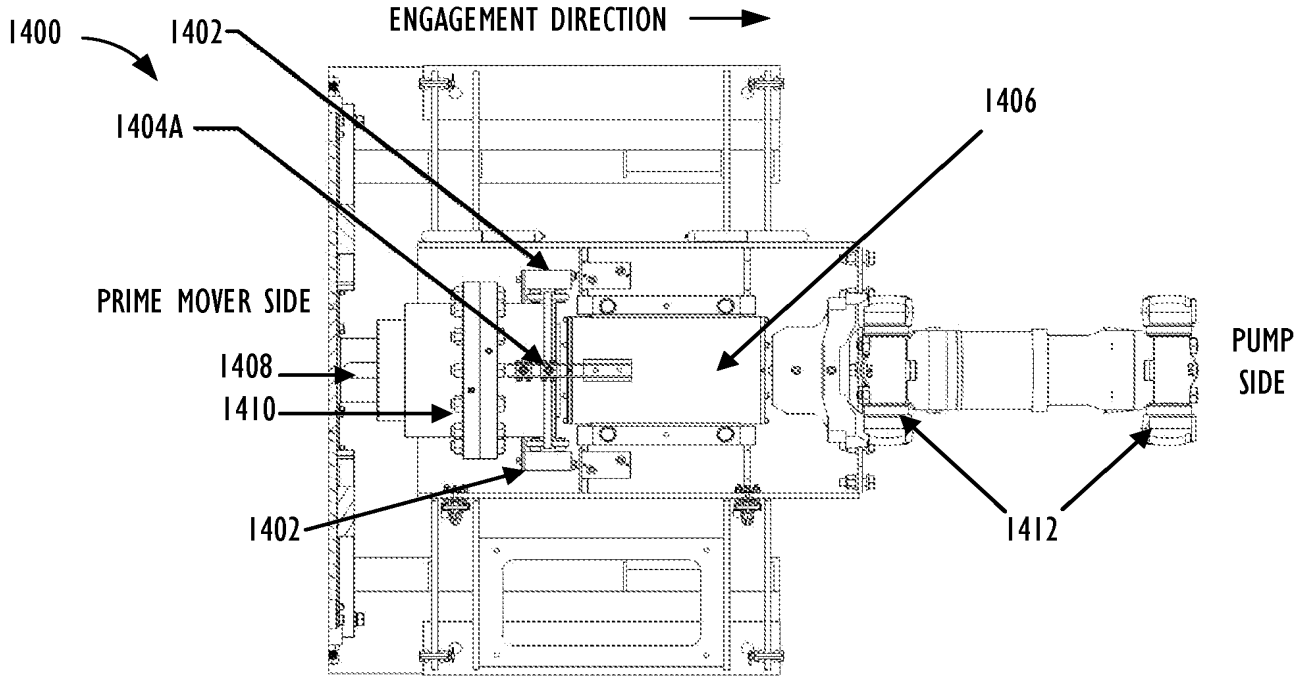


FIG. 14A

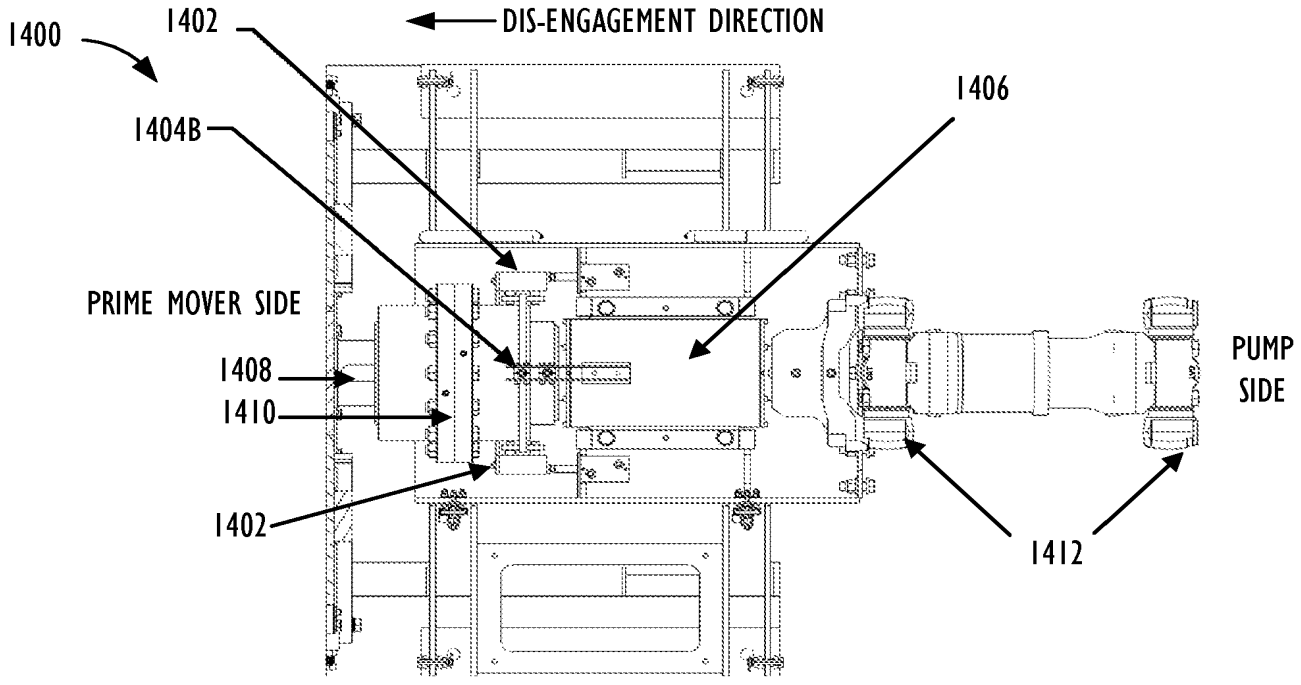


FIG. 14B

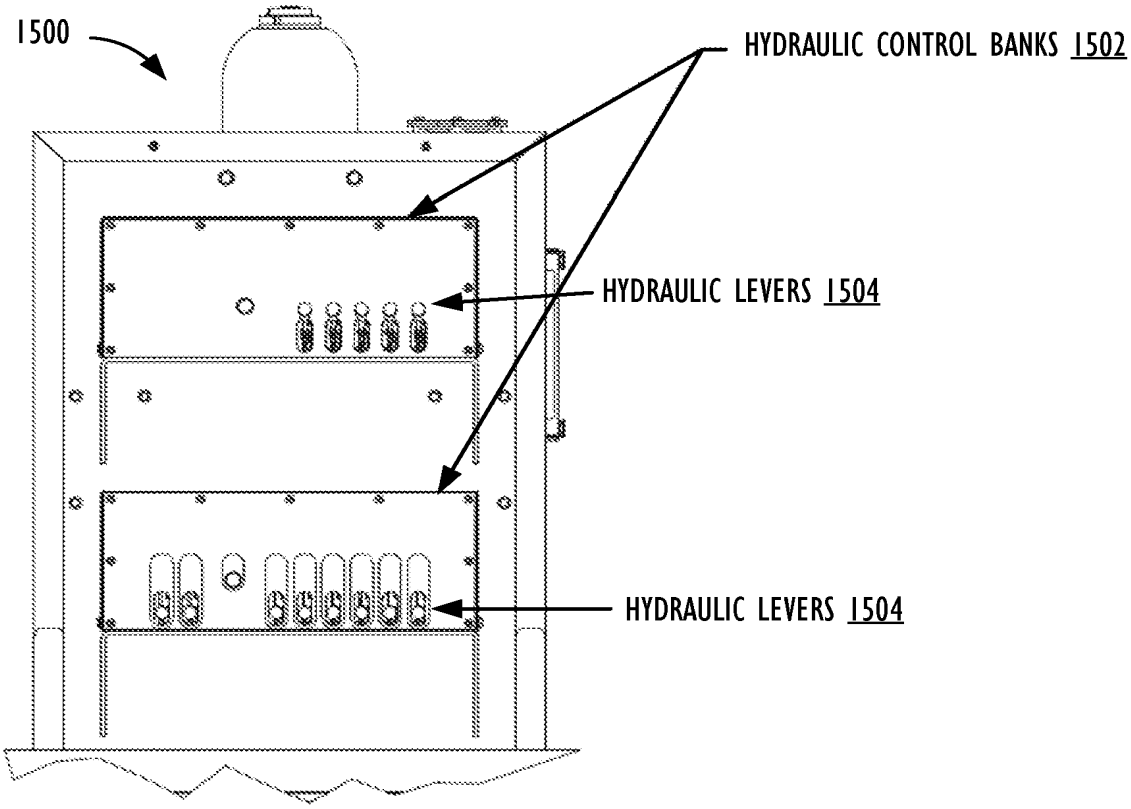


FIG. 15A

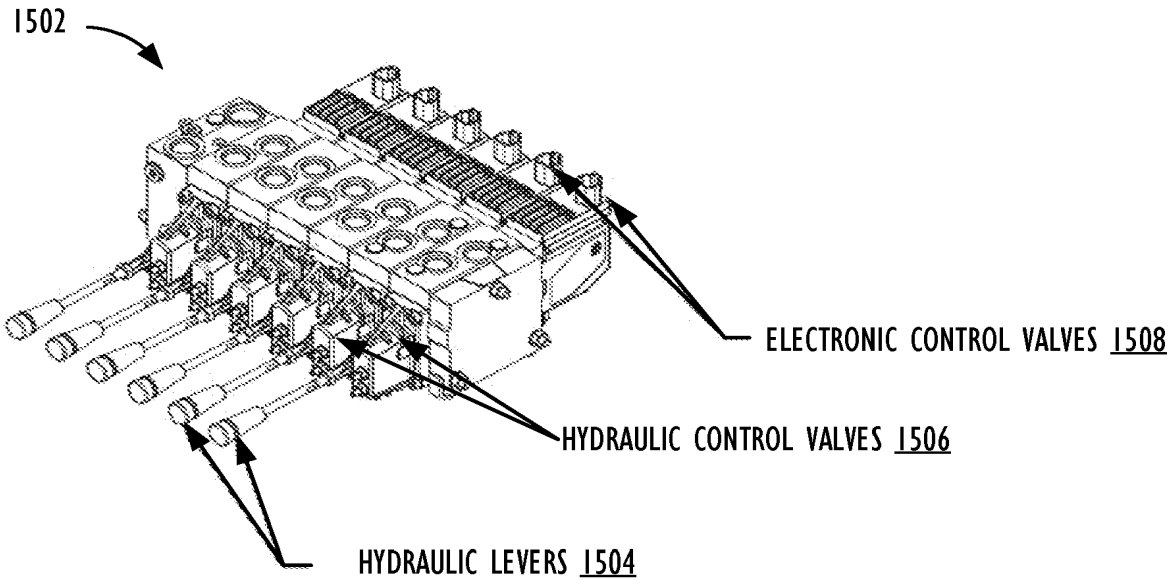


FIG. 15B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US16/49777

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:

"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
31 October 2016 (31.10.2016)	21 NOV 2016

Name and mailing address of the ISA/US	Authorized officer
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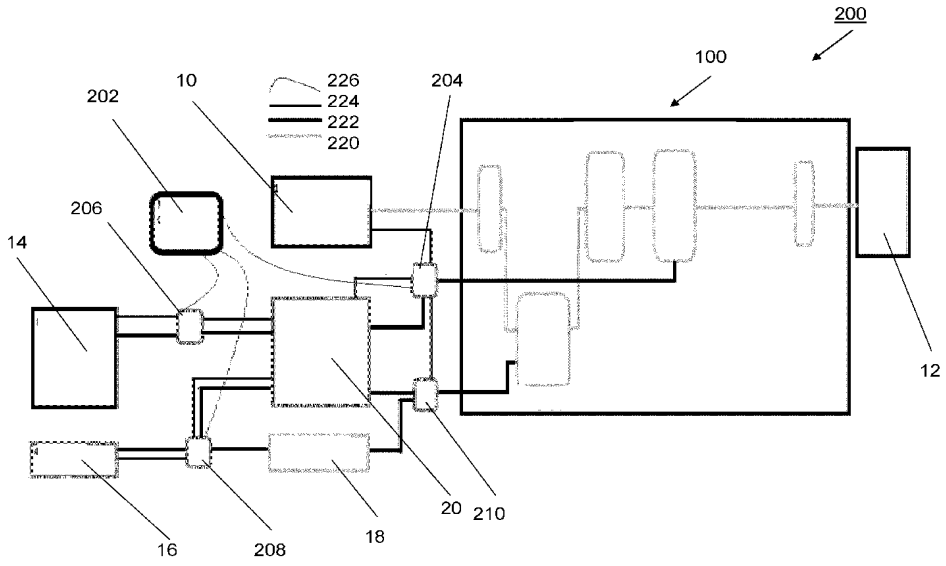


Figure 2

(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.

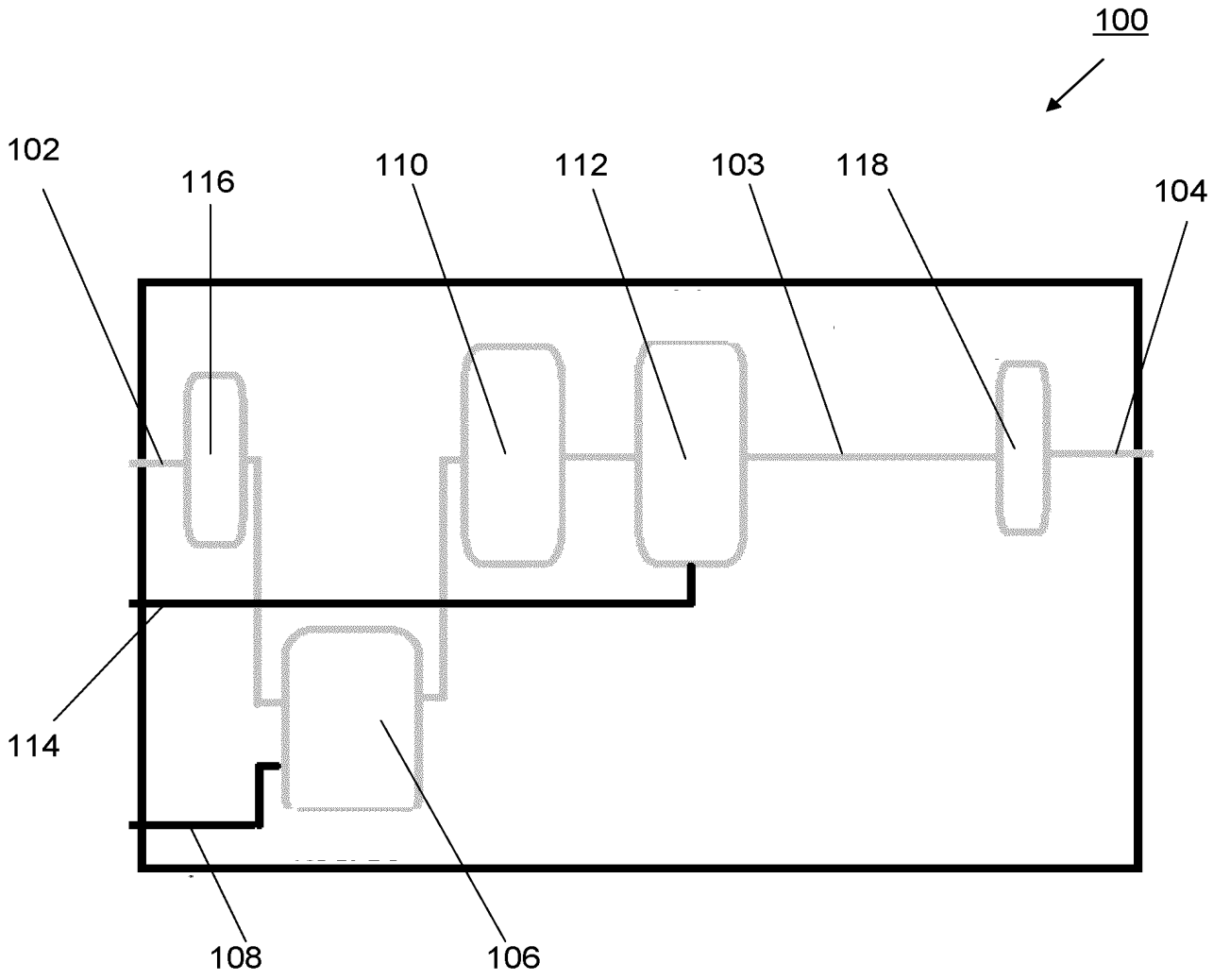


Figure 1a

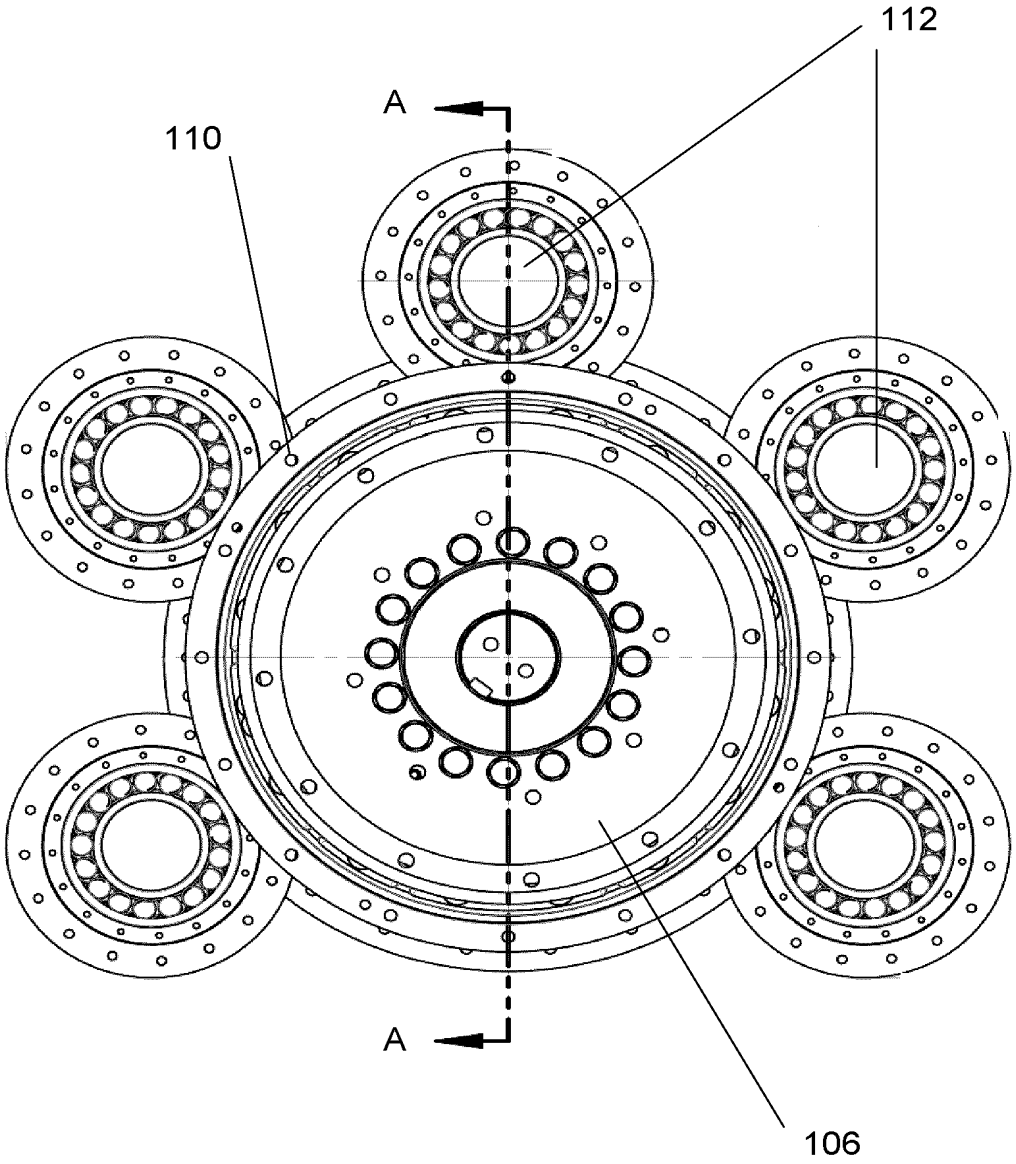


Figure 1b

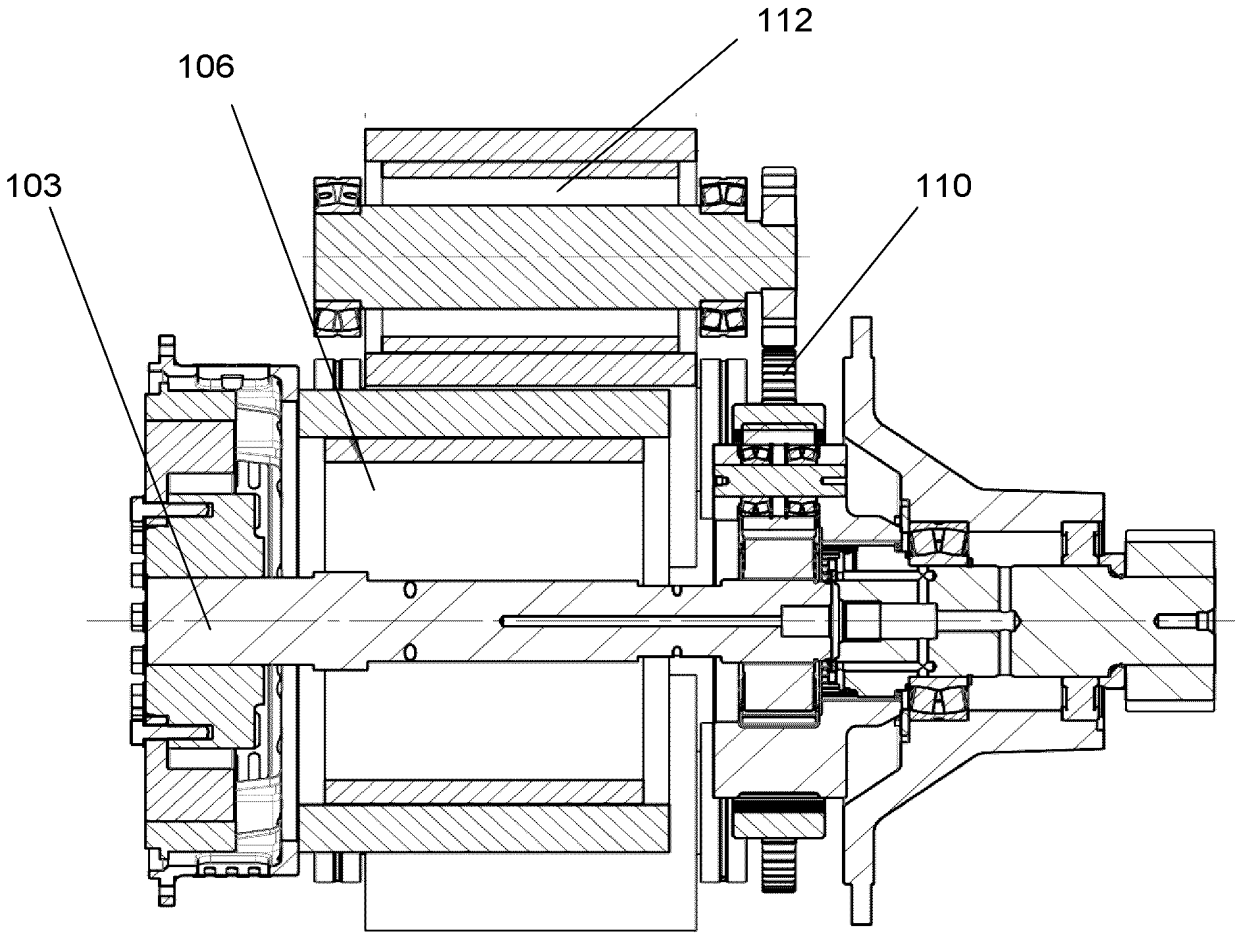


Figure 1c (Section A – A)

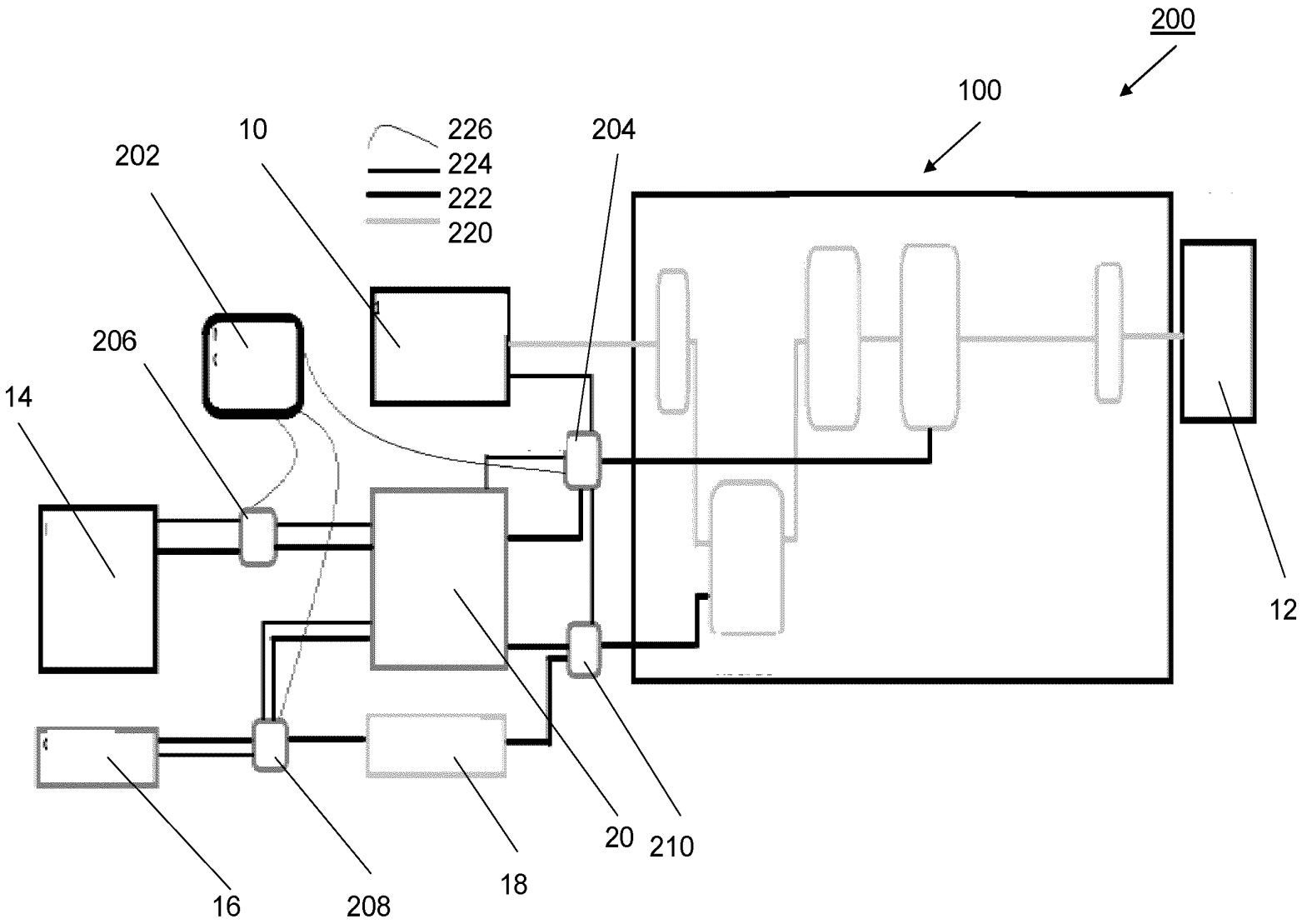
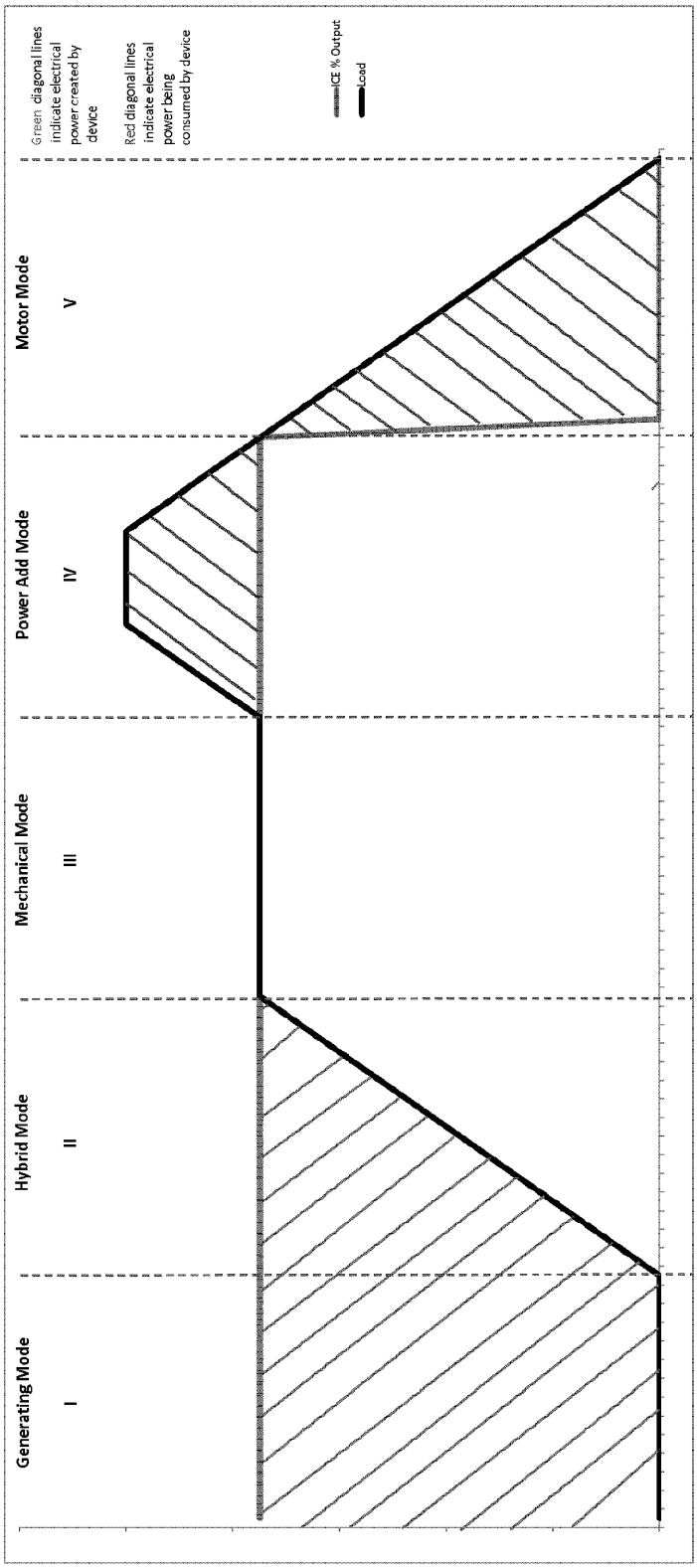


Figure 2

LIBERTY EXHIBIT 1002, Page 430

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 1002, Page 431

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)
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		EP2126268B1	22 February 2012 (22-02-2012)
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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:	16597014
Filing Date:	09-Oct-2019
Title of Invention:	MODULAR SWITCHGEAR SYSTEM AND POWER DISTRIBUTION FOR ELECTRIC OILFIELD EQUIPMENT
First Named Inventor/Applicant Name:	Jared Oehring
Filer:	Taylor P. Evans/Tina Fluharty
Attorney Docket Number:	047158.100048

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
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Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
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SUBMISSION- INFORMATION DISCLOSURE STMT	1806	1	260	260
		Total in USD ($)		**260**

Electronic Acknowledgement Receipt

EFS ID:	42114595
Application Number:	16597014
International Application Number:	
Confirmation Number:	4687
Title of Invention:	MODULAR SWITCHGEAR SYSTEM AND POWER DISTRIBUTION FOR ELECTRIC OILFIELD EQUIPMENT
First Named Inventor/Applicant Name:	Jared Oehring
Customer Number:	132858
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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)	047158-100048-IDS.pdf	1035849 07239307c98287e9418b422bc7f130e3d8968c6c	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
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5	Non Patent Literature	047158-FOA-100054.pdf	719596 5e7347f833aa8a4816966894e6b26d5d23c372f5	no	8
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Information:					
6	Non Patent Literature	047158-FOA-100058.pdf	1483347 0d7a4a73f3d8edde25a7652ff8c34d1a61a550ad	no	14
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7	Non Patent Literature	047158-ISR-WO-50069.pdf	1443141 98ca53c5b4dcc05b5aa9baa734e4d00f2e94200e	no	8
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8	Non Patent Literature	047158-ISR-WO-500065.pdf	720293 78127bd1a5534edfc36bbeafeff316ed456dcd20	no	10
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9	Non Patent Literature	047158-ISR-WO-500067.pdf	1324294 440598ae1e25dd1bf8e36d91ff310041d1324a46	no	8
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10	Non Patent Literature	047158-ISR-WO-500068.pdf	506844 03abdbbfb19f9f16d6d919f01c00776b87a398a5	no	8
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Information:					
11	Non Patent Literature	047158-Morris.pdf	1066638 57894cc17802012c9ed66f63a5dd012e7b23cf9a	no	18
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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
Warnings:					
Information:					
14	Foreign Reference	047158-WO2018044307A1.pdf	2913956 98ae95d003b5c43bedd7b5bd50e596652f7c597a	no	55
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15	Foreign Reference	047158-WO2018213925A1.pdf	1032780 be122de12e0e40296ab3a82a07c7cf370bb66d41	no	30
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16	Fee Worksheet (SB06)	fee-info.pdf	30722 9bc1b7c10d64501c1987c700c5eea4e44b0a507e	no	2

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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.

Espacenet

Bibliographic data: CN104196613 (A) — 2014-12-10

Cooling device of fracturing truck

Inventor(s): LI LILI; WU HANCHUAN; XU YABIN; PENG PINGSHENG; LEI GANG; LIU ZHUO; FAN JIE; CHEN YONG; WANG YUNHAI ± (LI LILI, ; WU HANCHUAN, ; XU YABIN, ; PENG PINGSHENG, ; LEI GANG, ; LIU ZHUO, ; FAN JIE, ; CHEN YONG, ; WANG YUNHAI)

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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.

(19)中华人民共和国国家知识产权局

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E21B 43/26(2006.01)

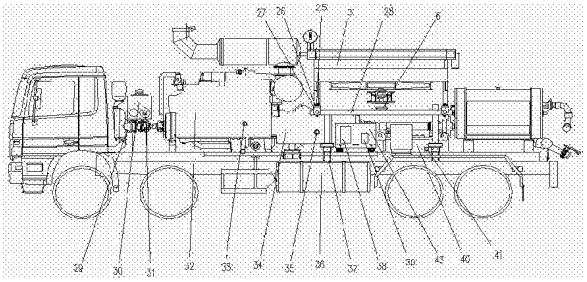
权利要求书1页 说明书3页 附图5页

(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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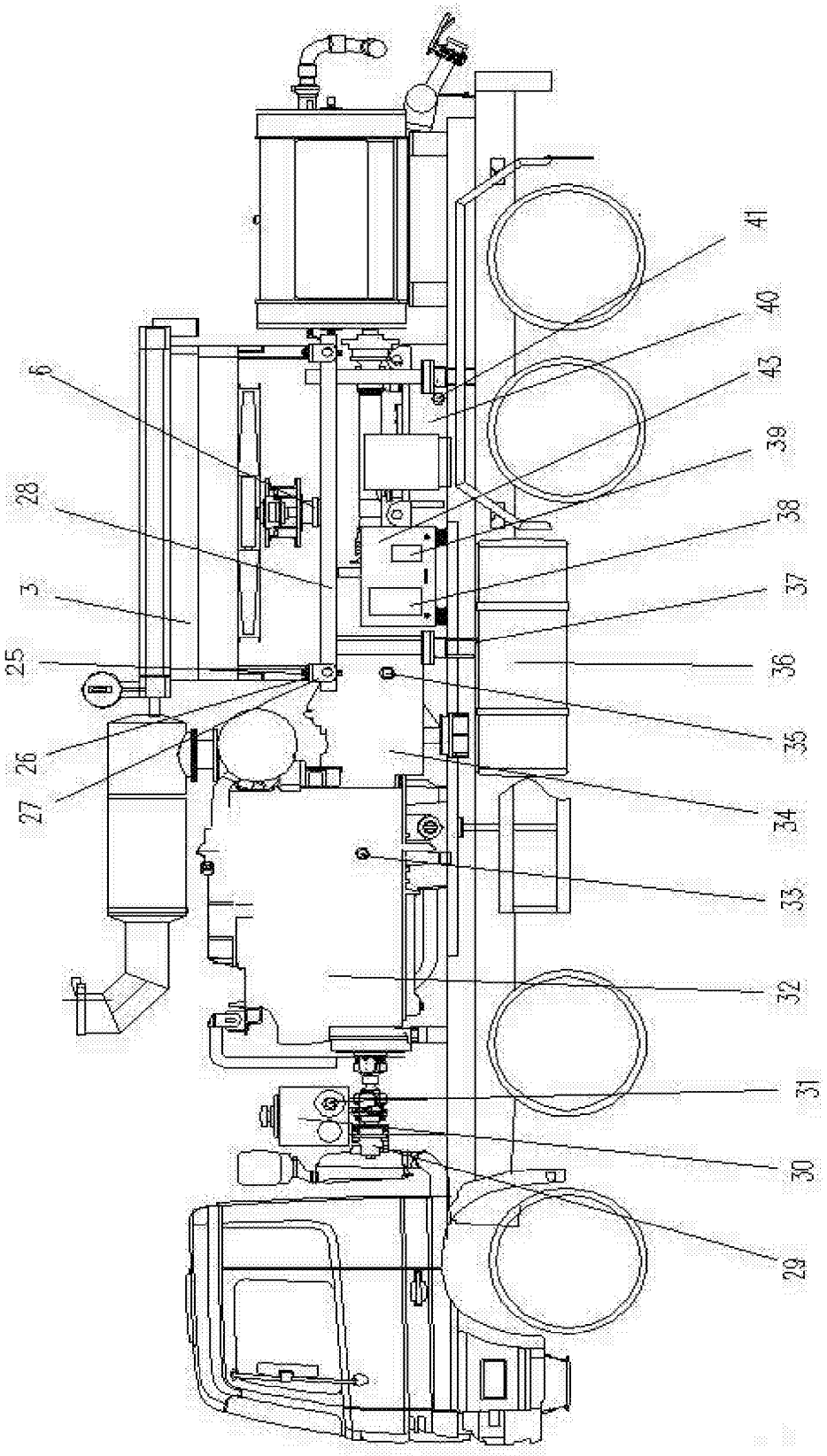


图 1

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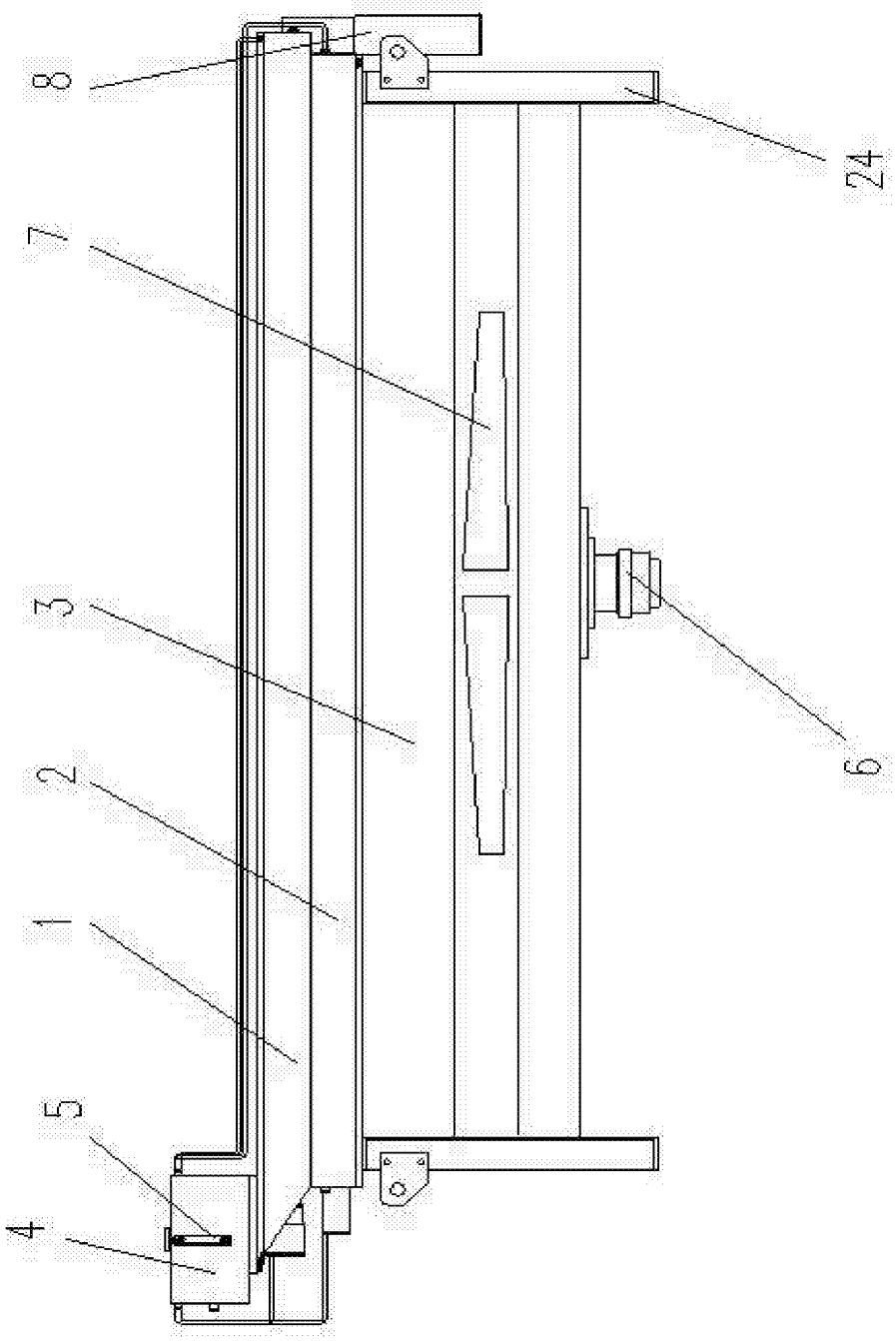


图 2

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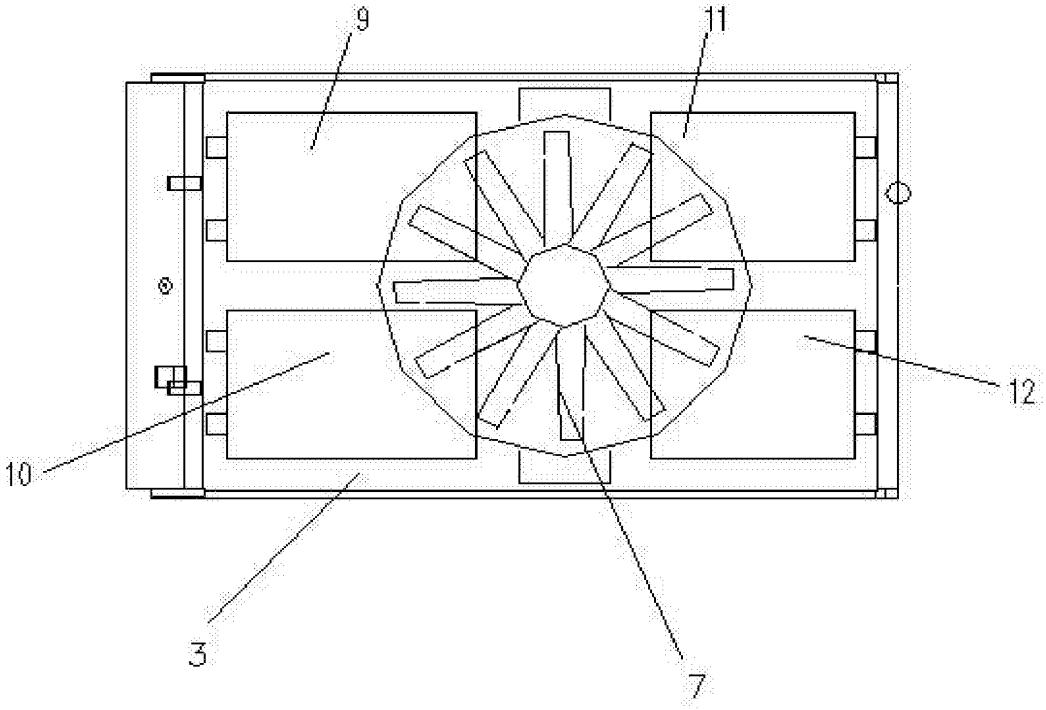


图 3

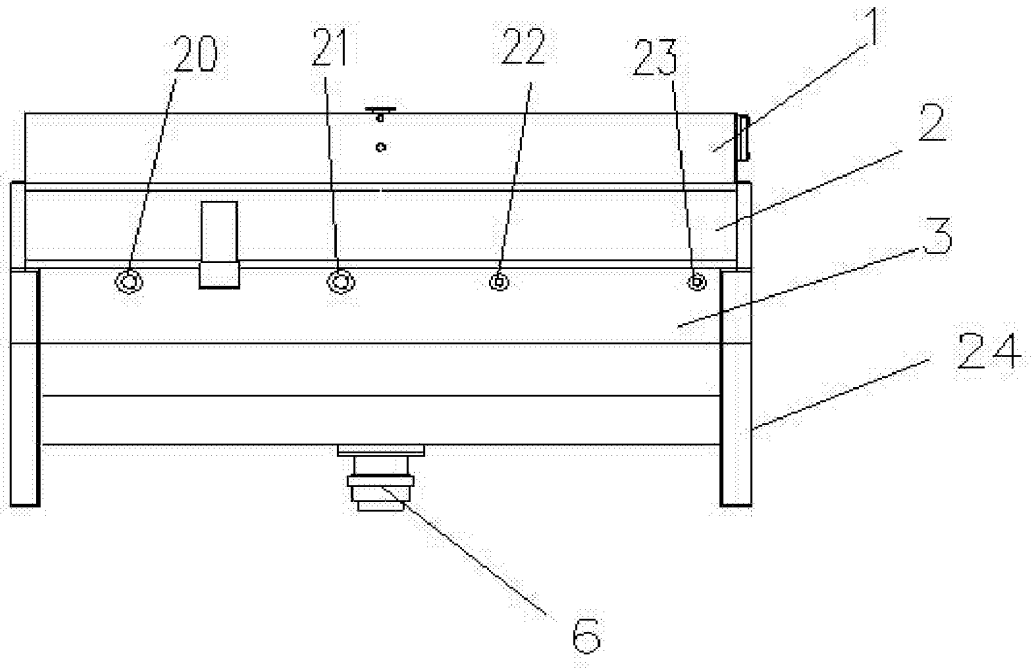


图 4

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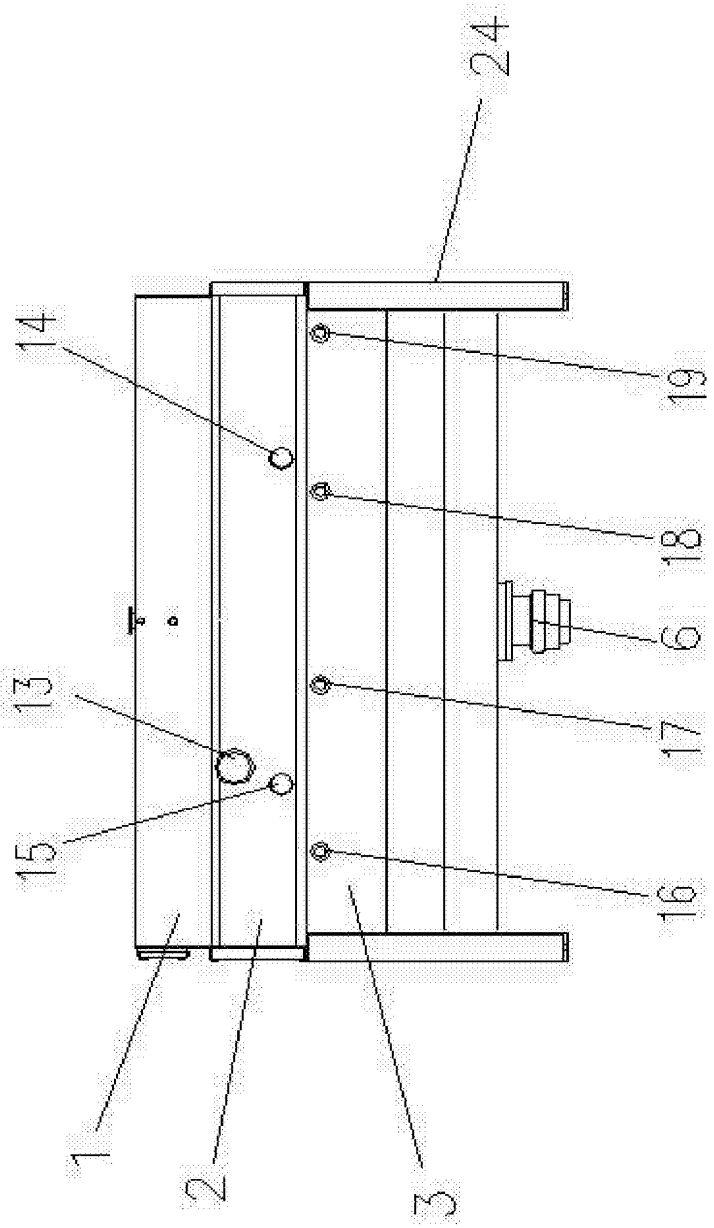


图 5

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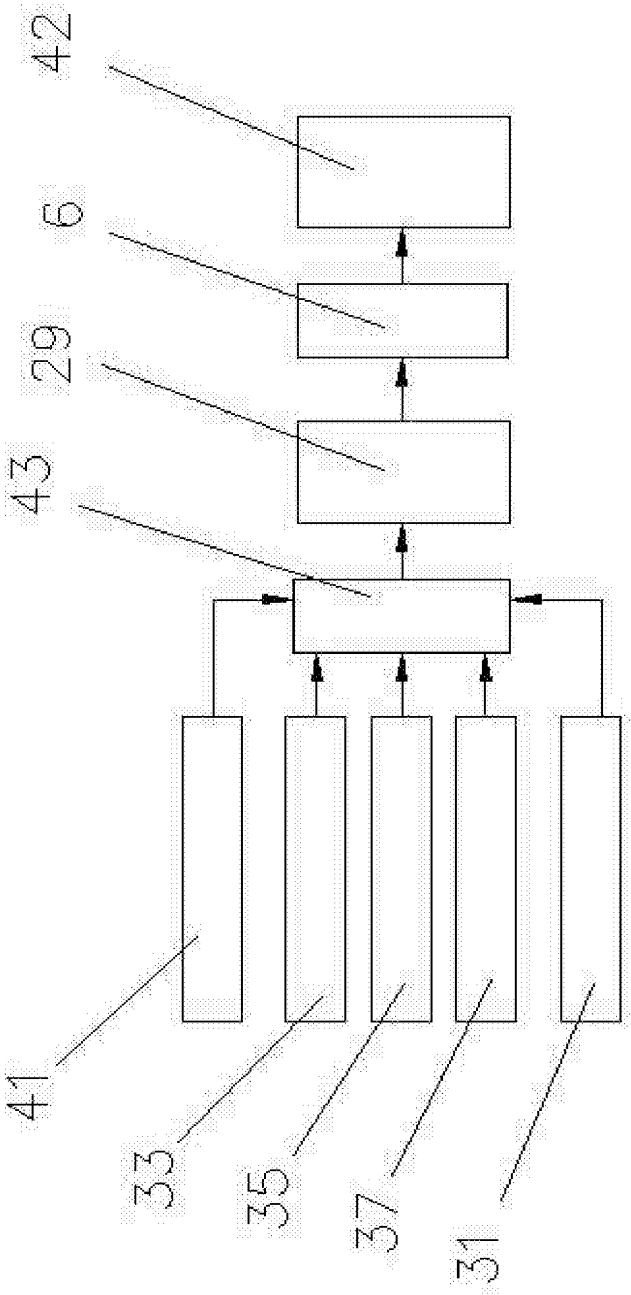


图 6

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132858 7590 02/04/2021

Hogan Lovells US LLP
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EXAMINER	
BOBISH, CHRISTOPHER S	

ART UNIT	PAPER NUMBER
3746	

NOTIFICATION DATE	DELIVERY MODE
02/04/2021	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

Office Action Summary	Application No. 16/597,014	Applicant(s) Oehring et al.	
	Examiner CHRISTOPHER S BOBISH	Art Unit 3746	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 10/22/2020.

☐ 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) 1-14 and 16-21 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) 1-14 and 16-20 is/are rejected.

8) ☑ Claim(s) 21 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.

Claim Rejections - 35 USC § 112

The following is a quotation of 35 U.S.C. 112(b):
(b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:
The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claim 18 rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor (or for applications subject to pre-AIA 35 U.S.C. 112, the applicant), regards as the invention.

Claim 18 recites the limitation "the plurality of electric pumps" in lines 3-4. There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 103

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

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

Claims 1-2, 5-6, 9, 12-13, and 16 is/are rejected under 35 U.S.C. 103 as being unpatentable over Morris et al (US PGPub No. 2019/0203572) in view of Broussard et al (US PGPub No. 2016/0032703).

Morris teaches:

limitations from claims 1 and 9, a hydraulic fracturing system for fracturing a subterranean formation (FIG. 7; paragraph 77), comprising: a support structure (710) having a first area, a second area, a third area, and a fourth area arranged adjacent one another (see FIG. 7A-7B with various components at different locations on the trailer 710); an electric powered, multi-plunger pump (702) with up to 15 plungers (paragraph 77), arranged in the first area, the electric powered pump coupled to a well associated with the subterranean formation (see paragraph 39 for example) and powered by at least one electric motor (704, paragraph 79), also arranged in the first area (next to the pumps 702), 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 (see paragraph 2); a transformer (see paragraph 78), arranged in the third area proximate the second area (near controls 708), the transformer positioned within an enclosure (see FIG. 7, the controls are enclosed), the transformer distributing power to the electric pump, the power being received from at least one generator at a voltage higher than an operating voltage of the electric pump (paragraph 77 teaches the pump transport receives power from a mobile source of electricity; paragraph 51 teaches the generator of the mobile power source; paragraph 78 teaching control of the pumps, it is the purpose of the transformer to condition power for a

particular use); and a cooling system (paragraph 46), the cooling system providing a cooling fluid to the VFD via one or more headers (Paragraph 46; Morris teaches cooling VFD's using water cooling for example);

Morris teaches a variable frequency drive (paragraph 77, 79 teaching the use of VFD with the motors; and paragraph 78 teaching electric drives being located in the control system 708), arranged in the second area proximate the first area, connected to the at least one electric motor to control the speed of the at least one electric motor (paragraph 77, 79);

While Morris teaches electric drives in the control system 708 of pump transports 700, Morris does not explicitly state that the electric drives are VFD (instead teaching VFD's on power transports 104 for example);

However, Broussard teaches a pumping transport (12) including a pump (10) and associated electric motor (14); wherein a VFD is connected to the electric motor and located in a proximate area of a support structure (12; paragraph 15);

It would have been obvious to one of ordinary skill in the art to locate the VFD and associated cooling system of Morris adjacent the pump/motor, in a manner as taught by Broussard, as a matter of design choice such that the necessary components to operating the pumping system are contained in a single mobile structure. The examiner notes that it has been held that the rearrangement of parts otherwise taught by the art is an obvious matter of design choice; see MPEP 2104.4 Section VI. C. In this case the location of associated parts on a single transport would reduce the footprint needed in the well site.

Morris further teaches:

limitations from claim 2, further comprising: a control system (708; “PLC”) arranged in the fourth area, the control system including one or more operating parameters of the electric pump, VFD, transformer, or cooling system (paragraph 78);

limitations from claim 5, wherein the fourth section (722) is arranged at a higher elevation than the first section, the fourth section associated with a gooseneck portion of a trailer (see FIG. 7B; paragraph 82);

limitations from claims 6 and 13, wherein the support structure is at least one of a trailer, a skid, a pad, a truck bed, or a combination thereof (710; paragraph 78);

limitations from claim 12, further comprising: a transformer service platform (at back end 722) that provides access to the transformer, the transformer service platform positioned at a higher elevation than at least a portion of a base of the electric powered pump (see FIG. 7B; paragraph 78);

limitations from claim 16, further comprising: a human machine interface (1304), positioned proximate the VFD (at 708; paragraph 78 and 88; the VFD is part of the transport 710 in the combination with Broussard); and a platform cover at least partially covering the humane machine interface and VFD (see FIG. 7 and FIG. 13 showing a box (cover) about the control unit 708);

Claims 3-4, 10-11 is/are rejected under 35 U.S.C. 103 as being unpatentable over Morris et al (US PGPub No. 2019/0203572) in view of Broussard et al (US PGPub

No. 2016/0032703) as applied to claims 1 and 9 above, and in further view of Mori et al (US Patent No. 7,835,140).

Morris teaches a switchgear assembly (112) but does not teach details of the assembly;

Mori teaches:

limitations from claims 3-4 and 10-11, an electric supply system including a switchgear assembly (for example FIG. 1); wherein the switchgear subassembly having integrated core units configured to operate in a connected position, an open position, or a grounded position (isolator/ground switches DS1/ES1; C. 7 Lines 5-18); and wherein the switchgear subassembly comprises: a busbar (X, Y) shielded, at least partially, by solid insulation (for example GIBT2); an isolating ground switch (E1, E2), enclosed within a tank arranged proximate the busbar (FIG. 2; GIBT1-2); and cable connections for coupling to the switchgear (C. 7 Lines 5-18); such that the bus can isolate the components of the assembly including a power source, switch gear, and load (via isolators DS1-2; C. 6 Line 61 through C. 7 Line 18);

It would have been obvious to one of ordinary skill in the art of switchgears to include common elements such as switches and busbars in the system of Morris, and to insulate the elements as taught by Mori, in order to convey a desired electrical power safely and efficiently to the pumps while maintain a small footprint (C. 2 Lines 55-59 of Mori);

Claims 8 and 15 is/are rejected under 35 U.S.C. 103 as being unpatentable over Morris et al (US PGPub No. 2019/0203572) in view of Broussard et al (US PGPub No. 2016/0032703) as applied to claims 1 and 9 above, and in further view of Symchuk (US Patent No. 9,932,799).

Morris teaches cooling VFD's using water cooling and/or ac units, but does not explicitly teach a radiator and glycol;

However, Symchuk teaches a fracturing assembly (FIG. 1) wherein a cooling system includes a radiator and glycol based cooling system (C. 7 Lines 61-67);

It would have been obvious to one of ordinary skill in the art of pumping systems at the time the invention was filed, to substitute one known cooling system for another in order to cool components of the pumping system taught by Morris, such as the use of radiators and glycol as taught by Symchuk, in order to reach an expected result (i.e. cooling of system components).

Claims 7 and 14 is/are rejected under 35 U.S.C. 103 as being unpatentable over Morris et al (US PGPub No. 2019/0203572) in view of Broussard et al (US PGPub No. 2016/0032703) as applied to claims 1 and 9 above, and in further view of Oehring et al (US Patent No. 2016/0105022).

Morris does not teach cable trays;

Oehring teaches a fracturing system including pumps (110), motors (114), (VFD (115), and cable trays on a walkable portion (112) for running cables between the components (paragraph 41); Oehring does not teach that the trays are covered via doors, However, the examiner maintains that hinged cable trays are known in the art of electrical systems and would have been obvious to use to protect th cables while allowing accessability);

It would have been obvious to one of ordinary skill in the art of fracturing systems at the time of the invention to provide accessible cable trays in the system of Morris, as taught by Oehring, in order to allow for the organization of the various cables in a safe manner along the trailer;

Claims 17-18 and 20 is/are rejected under 35 U.S.C. 103 as being unpatentable over Morris et al (US PGPub No. 2019/0203572) in view of Benussi et al (US PGPub No. 2020/0194976) in view of Johnson et al (US PGPub No. 2018/0090914).

Morris teaches:

limitations from claim 17, a hydraulic fracturing system for fracturing a subterranean formation (FIG. 7. paragraph 77), comprising: a support structure (710) having a first area, a second area, a third area, and a fourth area arranged adjacent one another (see FIG. 7A-7B with various components at different locations on the trailer 710); an electric powered, multi-plunger pump (702) with up to 15 plungers (paragraph 77), arranged in the first area, the electric powered pump coupled to a well associated with the subterranean formation (see paragraph 39 for example) and powered by at least one electric motor (704,

paragraph 79), also arranged in the first area (next to the pumps 702), 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 (see paragraph 2); a transformer (see paragraph 78), arranged in the third area proximate the second area (near controls 708), the transformer positioned within an enclosure (see FIG. 7 wherein the controls 708 are enclosed), the transformer distributing power to the electric pump, the power being received from at least one generator at a voltage higher than an operating voltage of the electric pump (paragraph 77 teaches the pump transport receives power from a mobile source of electricity; paragraph 51 teaches the generator of the mobile power source; paragraph 78 teaching control of the pumps; it is the purpose of the transformer to condition power for a particular use); and a cooling system (paragraph 46), the cooling system providing a cooling fluid to the VFD via one or more headers (Paragraph 46; Morris teaches cooling VFD's using water cooling for example);

Morris teaches a switchgear assembly (112) receiving power from sources (102; paragraph 43 for example), and teaches transferring that power to multiple pump-motor assemblies (108; paragraph 44);

Morris does not explicitly teach a common bus bar;

However, Benussi teaches a power distribution arrangement including a switchgear (S1-S3) connected to a generator (G); wherein the switchgear assembly receives power from the generator to distribute power via a common bus (busbars B1-B3 and common node "N"; FIG. 1, paragraph 9 and 40-41);

It would have been obvious to one of ordinary skill in the art of power distribution at the time the invention was filed to utilize common buses in the system of Morris, as taught by Benussi, in order to provide even power supply via load-sharing (paragraph 42 for example);

Neither Morris nor Benussi teaches a particular orientation of the switchgear connections;

However, Johnson teaches a switchgear unit (FIG. 1-2) including an enclosure (100) with connections (100 for example) which are front aligned (paragraphs 14, 16, 63) and shielded (see paragraph 83 and components 144, 178, 206);

It would have been obvious to one of ordinary skill in the art of power systems at the time the invention was made to provide an enclosure for the switchgear of Morris, such as the front-aligned enclosure taught by Johnson, in order to allow for ease of access to all inside components while allowing for more versatile placement of the switchgear assembly (paragraphs 14 and 63 of Johnson);

Morris further teaches:

limitations from claim 18, the switch gear (112) receives power from multiple sources and distributes the power to the pumps from the generators (power sources; paragraph 44 and 47), and wherein the power is three phase (see paragraph 79 teaching AC current of which 3-phase is a known variant);

The system of claim 20, wherein the plurality of electric pumps, VFD, and transformer are mounted on a common support structure (710, paragraph 78) and a single cable couples the switchgear to the common support structure (paragraph 44, 78 teaching the use of cables connecting the power to the pumping components; Morris does not teach a particular number of cables, however the examiner maintains that the number of cables is a matter of design choice based upon the number of pumps to be power and the amount of electricity required);

Claim 19 is/are rejected under 35 U.S.C. 103 as being unpatentable over Morris et al (US PGPub No. 2019/0203572) in view of Broussard et al (US PGPub No. 2016/0032703) in view of Benussi et al (US PGPub No. 2020/0194976) as applied to claim 17 above, and in further view of Mori et al (US Patent No. 7,835,140).

Morris teaches a switchgear assembly (112) but does not teach details of the assembly;

Mori teaches:

limitations from claim 19, an electric supply system including a switchgear assembly (for example FIG. 1); wherein

the switchgear subassembly having integrated core units configured to operate in a connected position, an open position, or a grounded position (isolator/ground switches DS1/ES1; C. 7 Lines 5-18); and wherein the switchgear subassembly comprises: a busbar (X, Y) shielded, at least partially, by solid insulation (for example GIBT2); an isolating ground switch (E1, E2), enclosed within a tank arranged proximate the busbar (FIG. 2; GIBT1-2); and cable connections for coupling to the switchgear (C. 7 Lines 5-18); such that the bus can isolate the components of the assembly including a power source, switch gear, and load (via isolators DS1-2; C. 6 Line 61 through C. 7 Line 18);

It would have been obvious to one of ordinary skill in the art of switchgears to include common elements such as switches and busbars in the system of Morris,

and to insulate the elements as taught by Mori, in order to convey a desired electrical power safely and efficiently to the pumps while maintain a small footprint (C. 2 Lines 55-59 of Mori);

Response to Arguments

Regarding item 1 (claims 1 and 9):

Applicant argues (page 9-10 of the response) that the combination of Morris and Broussard fails to recognize an unsolved problem or solution. Particularly, applicant argues that the current invention discloses that a components arranged on a common structure reduces clutter on a well site (applicant additionally cites paragraph 97 of the disclosure). Applicant further argues "Without recognizing the problems or the source of the problems, the proposed combination does not disclose, teach, or suggest the solution provided by the instant application".

The examiner respectfully disagrees. Morris explicitly teaches that minimizing footprints of well sites, and providing adequate power in an efficient manner are typical concerns of a fracturing operation (see paragraph 3 for example). Broussard teaches that reducing needed space for equipment (particularly trailer space) is also a known solution to restricted well site space (paragraph 33). Therefore the examiner maintains that the prior art does in fact recognize the problem of constricted space in well sites, and that the structuring of well site components in general is a solution to the known problem. Further, the examiner notes that it has been held that the examiner is not

limited to prior art directed to exactly the problem the applicant is trying to solve (see MPEP 2141 under I and II (A) for example).

Applicant states "…Indeed, Morris explicitly teaches segregation of various features claimed on a common structure. By way of example, FIG. 2 illustrates separation and removal VFDs from the pumping units 108. *See* Morris at FIG. 2.". The examiner disagrees that simply teaching an embodiment wherein VFDs and motors/pumps are present on separate structures is an *explicit* teaching that these components must be separated; instead Morris teaches in paragraph 78 "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)…". This passage at least contemplates an embodiment wherein electric pump drives are constituted as part of the support structure 710 as integrated in control system 708. Therefore the examiner maintains that the combination of Morris and Broussard would not change the principle operation of Morris.

Regarding item 2 (Claims 1 and 9):

Applicant argues (see pages 10-11 of the response) that the proposed combination would change the principle of operation of Morris. The examiner respectfully disagrees. The proposed combination simply places one component (VFD) on a pump trailer rather than on a power trailer; the resulting operation would be a pump

supplied with power and control through a VFD. The examiner is unclear as to how the combination would result in an unworkable pumping system.

Applicant cites paragraph 52 and FIG. 2 and states "For example, Morris describes an advantageous position of the power transports 104 *(including the VFDs)* relative to other power equipment. However, this paragraph merely suggests that positing transports parallel rather than perpendicular to one another may be beneficial to reduce site footprint. There is no mention of particular transport components or benefits derived from the placement thereof. The following paragraph (paragraph 53) states "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.". Therefore the examiner maintains that Morris explicitly discloses that the layout and positioning of FIG. 1-2 and changes of that layout are not particularly consequential to the principle operation of the invention.

Applicant further argues "By way of example, the proposed modification would allegedly remove at least 3 trailers 104 (FIG. 2) and somehow combine these components with the 6 trailers 108 (FIG. 2).". However, this misconstrues the intent of the combination. The combination does not seek to remove the three transports 104 from the system, nor does the combination intend to position the entirety of the power transports onto the pump transports 108. The combination relies on Broussard to teach the positioning of VFDS next to and on a common structure of, the pumps; it is only the VFDs that are intended to be combined. Applicant further argues that the positioning of a VFD component on the pump transport requires more than

obvious design choice, applicant states "Morris acknowledges this limitation, nothing that height, length, and weight restrictions are present for various components. *See id.* at [0062].". However, paragraph 62 is not drawn to either a power transport or a pump transport, but a generator transport. There is no evidence that including a VFD on the pump transport would preclude a pump transport from use on roadways.

Regarding claim 20:

Applicant argues that the rejection fails to teach a single cable connection connects the switchgear and the pump assembly. Applicant argues that it is the configuration claimed by applicant that allows for a single cable to be used at all. Applicant cites paragraph 17 of the current application's disclosure which states in part "a single high voltage cable, for example a 13.8 kV cable, is run from the switchgear to the pumping unit *because the transformer is mounted on the same platform as the VFD, MCC, and frac pump*". However, the examiner notes that the pumping assembly of Morris includes a transformer on the same platform as the pump and motor, and as such teaches a configuration in which only a single cable would be necessary (as emphasized in the portion of paragraph 17 above). While Morris is silent as to a VFD, this limitation is addressed by the prior art to Broussard.

Allowable Subject Matter

Claim 21 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claim 21 recites that each of the pump, VFD, transformer, and switchgear are mounted on a common support structure. The combined limitations of claims 20-21 are not taught by the prior art, that is a fracturing system including a pump driven by an electric motor, a transformer, a VFD, and a switch gear on a common platform. Wherein the switchgear includes a common bus and front-aligned cable connections within an enclosure so that a single cable is needed to connect the switchgear and the transformer on the common transport.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to CHRISTOPHER S BOBISH whose telephone number is (571)270-5289. The examiner can normally be reached on Mon-Fri 9-5.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Devon Kramer can be reached on 571-272-7118. 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.

/CHRISTOPHER S BOBISH/
Examiner, Art Unit 3746

Notice of References Cited	Application/Control No. 16/597,014	Applicant(s)/Patent Under Reexamination Oehring et al.	
	Examiner CHRISTOPHER S BOBISH	Art Unit 3746	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-20180090914-A1	03-2018	Johnson; Bethel Idiculla	H02B1/565	1/1
	B					
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

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

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

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

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/597,014	Oehring et al.
	Examiner	**Art Unit**
	CHRISTOPHER S BOBISH	3746

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	12/20/2019	07/19/2020	01/28/2021						
	1	✓	✓	✓						
	2	✓	✓	✓						
	3	✓	✓	✓						
	4	✓	✓	✓						
	5	✓	✓	✓						
	6	✓	✓	✓						
	7	✓	✓	✓						
	8	✓	✓	✓						
	9	✓	✓	✓						
	10	✓	✓	✓						
	11	✓	✓	✓						
	12	✓	✓	✓						
	13	✓	✓	✓						
	14	✓	✓	✓						
	15	✓	✓	-						
	16	✓	✓	✓						
	17	✓	✓	✓						
	18	✓	✓	✓						
	19	✓	✓	✓						
	20	✓	✓	✓						
	21			O						

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/597,014	Oehring et al.
	Examiner	Art Unit
	CHRISTOPHER S BOBISH	3746

CPC - Searched*		
Symbol	Date	Examiner
F04B17/06	12/10/2019	CSB
F02B63/047, 06	12/10/2019	CSB

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
Inventor Name Search	12/10/2019	CSB
EAST Search	12/10/2019	CSB
Updated Search	07/08/2020	CSB
Updated Search	01/27/2021	CSB

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

/CHRISTOPHER S BOBISH/ Examiner, Art Unit 3746	

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	16597014
Filing Date	2019-10-09
First Named Inventor	Jared Oehring
Art Unit	3746
Examiner Name	Christopher S. Bobish
Attorney Docket Number	047158.100048

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
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	2	10415332		2019-09-17	Morris	
	3	10669804		2020-06-02	Kotrla	
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	8	6719900		2004-04-13	Hawkins	

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Examiner Name	Christopher S. Bobish
Attorney Docket Number	047158.100048

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	20	9051822		2015-06-09	Ayan	
	21	7170262		2007-01-30	Pettigrew	
	22	5025861		1991-06-25	Huber	

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	1	20160258267		2016-09-08	Payne	
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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	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	Office Action mailed June 29, 2020 in related U.S. Patent Application No. 16/728,359	☒
	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	☒
	9	Canadian Office Action mailed August 17, 2020 in related CA Patent Application No. 2,944,968	☒

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	Art Unit	3746
	Examiner Name	Christopher S. Bobish
	Attorney Docket Number	047158.100048

EXAMINER SIGNATURE			
Examiner Signature	/CHRISTOPHER S BOBISH/	Date Considered	01/27/2021

*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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Art Unit	3746
Examiner Name	Christopher S. Bobish
Attorney Docket Number	047158.100048

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.

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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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	16597014
Filing Date	2019-10-09
First Named Inventor	Jared OEHRING
Art Unit	3746
Examiner Name	Christopher S. BOBISH
Attorney Docket Number	047158-100048

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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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	1	3067854	CA	A1	2019-01-03	Morris et al.		

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	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.	T5
	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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	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

Examiner Signature	/CHRISTOPHER S BOBISH/	Date Considered	01/27/2021

*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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Examiner Name	Christopher S. BOBISH
Attorney Docket Number	047158-100048

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)	2020-11-19
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.

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