UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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APPLICATION NO.	ISSUE DATE	PATENT NO.
17/321,936	06-JUN-23	11668420

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

EGRANT NOTIFICATION

Your electronic patent grant (eGrant) is now available, which can be accessed via Patent Center at https://patentcenter.uspto.gov

The electronic patent grant is the official patent grant under 35 U.S.C. 153. For more information, please visit https://www.uspto.gov/electronicgrants

UNITED STATES PATENT AND TRADEMARK OFFICE

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P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/321,936	06/06/2023	11668420	047158.100090	4613

132858 7590 05/17/2023

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

ISSUE NOTIFICATION

The projected patent number and issue date are specified above. The patent will issue electronically. The electronically issued patent is the official patent grant pursuant to 35 U.S.C. § 153. The patent may be accessed on or after the issue date through Patent Center at https://patentcenter.uspto.gov/. The patent will be available in both the public and the private sides of Patent Center. Further assistance in electronically accessing the patent, or about Patent Center, is available by calling the Patent Electronic Business Center at 1-888-217-9197.

The USPTO is implementing electronic patent issuance with a transition period, during which period the USPTO will mail a ceremonial paper copy of the electronic patent grant to the correspondence address of record. Additional copies of the patent (i.e., certified and presentation copies) may be ordered for a fee from the USPTO's Certified Copy Center at https://certifiedcopycenter.uspto.gov/index.html. The Certified Copy Center may be reached at (800)972-6382.

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 Patents Stakeholder Experience (OPSE), Stakeholder Support Division (SSD) at (571)-272-4200.

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

Jared Oehring, Houston, TX;
Brandon Hinderliter, Houston, TX;
Lon Robinson, Houston, TX;
Alexander James Christinzio, 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.

Document Description: Issue Fee Payment (PTO-85B)

Issue Fee Transmittal Form

Application Number	Filing Date	First Named Inventor	Atty. Docket No.	Confirmation No.
17321936	17-May-2021	Jared Oehring	047158.100090	4613

TITLE OF INVENTION :

SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE

Entity Status	Application Type	Art Unit	Class - Subclass	EXAMINER
Regular Undiscounted	Utility under 35 USC 111(a)	3679	090100	AARON LEMBO

Issue Fee Due	Publication Due	Total Fee(s) Due	Date Due	Prev. Paid Fee
$1200	$0	$1200	25-Apr-2023	$0

1.Change of Correspondence Address and/or Indication Of Fee Address (37 CFR 1.33 & 1.363)

Current Correspondence Address:	Current Indicated Fee Address :
132858 Hogan Lovells US LLP 609 Main Street Suite 4200 Houston TX 77002 UNITED STATES 713-632-1400 hlusdocketing@hoganlovells.com	
☐ Change of correspondence address requested, system generated AIA/122-EFS form attached	☐ Fee Address indication requested, system generated SB/47-EFS form attached

2.Entity Status

Change in Entity Status

○ Applicant certifying micro entity status; system generated Micro Entity certification form attached. See 37 CFR 1.29.
Note: Absent a valid certification of micro entity status, issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment. If this box is checked, you will be prompted to choose a micro entity status on the gross income basis (37 CFR 1.29(a)) or the institution of higher education basis (37 CFR 1.29(d)), and make the applicable certification online.

○ Applicant asserting small entity status. See 37 CFR 1.27.
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.

◉ Applicant changing to regular undiscounted fee status.
Note: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

Document Description: Issue Fee Payment (PTO-85B)

3.The Following Fee(s) Are Submitted:

☒ Issue Fee

☐ I authorize USPTO to apply my previously paid issue fee to the current fees due

☐ Publication Fee

☐ The Director is hereby authorized to apply my previously paid issue fee to the current fee due and to charge deficient fees to Deposit Account Number _____

☒ If **in addition to** the payment of the issue fee amount submitted with this form, there are any discrepancies in any amount(s) due, the Director is authorized to charge any deficiency or credit any overpayment, to Deposit Account Number 501349 . The **issue fee must be submitted** with this form. **If payment of the issue fee does not accompany this form, checking this box and providing a deposit account number will NOT be effective to satisfy full payment of the fee(s) due.**

4.Firm and/or Attorney Names To Be Printed

NOTE: If no name is listed, no name will be printed
For printing on the patent front page, list to be displayed as entered

1. HOGAN LOVELLS US LLP
2.
3.

5.Assignee Name(s) and Residence Data To Be Printed

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

Name	City	State	Country	Category
U.S. Well Services, LLC	Houston	TEXAS	UNITED STATES	corporation

6.Signature

I certify, in accordance with 37 CFR 1.4(d)(4) that I am an attorney or agent registered to practice before the Patent and Trademark Office who has filed and has been granted power of attorney in this application. I also certify that this Fee(s) Transmittal form is being transmitted to the USPTO via EFS-WEB on the date indicated below.

Signature	/Taylor P. Evans/	**Date**	04-24-2023
Name	Taylor P. Evans	**Registration Number**	60506

Electronic Patent Application Fee Transmittal

Application Number:	17321936
Filing Date:	17-May-2021
Title of Invention:	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE
First Named Inventor/Applicant Name:	Jared Oehring
Filer:	Taylor P. Evans/Stephanie McDonough
Attorney Docket Number:	047158.100090

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY APPL ISSUE FEE	1501	1	1200	1200
PUBL. FEE- EARLY, VOLUNTARY, OR NORMAL	1504	1	0	0
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

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

Electronic Acknowledgement Receipt

EFS ID:	47890927
Application Number:	17321936
International Application Number:	
Confirmation Number:	4613
Title of Invention:	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE
First Named Inventor/Applicant Name:	Jared Oehring
Customer Number:	132858
Filer:	Taylor P. Evans/Stephanie McDonough
Filer Authorized By:	Taylor P. Evans
Attorney Docket Number:	047158.100090
Receipt Date:	24-APR-2023
Filing Date:	17-MAY-2021
Time Stamp:	16:14:06
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	E20234NG14055301
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 1.20 (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)	Web85b.pdf	60629 e28977dc6aeade6d5d69c642d1d7c623c02d21c9	no	2
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	40392 740687b740a4e0181d21f7176df30ca65bb28de4	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	101021		

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
COMMISSIONER FOR PATENTS
P.O.BOX 1450
ALEXANDRIA VA 22313-1451

PRESORTED
FIRST-CLASS MAIL
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POSTEDIGITAL
NNNNN

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

Courtesy Reminder for
Application Serial No: 17/321,936

Attorney Docket No: 047158.100090
Customer Number: 132858
Date of Electronic Notification: 01/25/2023

This is a courtesy reminder that new correspondence is available for this application. If you have not done so already, please review the correspondence. The official date of notification of the outgoing correspondence will be indicated on the form PTOL-90 accompanying the correspondence.

An email notification regarding the correspondence was sent to the following email address(es) associated with your customer number:
hlusdocketing@hoganlovells.com
stephanie.mcdonough@hoganlovells.com

To view your correspondence online or update your email addresses, please visit us anytime at **https://ppair-my.uspto.gov/pair/PrivatePair.**
If you have any questions, please email the Electronic Business Center (EBC) at EBC@uspto.gov or call 1-866-217-9197.

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
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www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

132858 7590 01/25/2023

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

EXAMINER
LEMBO, AARON LLOYD

ART UNIT	PAPER NUMBER
3679	

DATE MAILED: 01/25/2023

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/321,936	05/17/2021	Jared Oehring	047158.100090	4613

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

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	04/25/2023

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 40% the amount of undiscounted fees, and micro entity fees are 20% the amount of undiscounted 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. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PART B - FEE(S) TRANSMITTAL

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

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

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

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

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

132858 7590 01/25/2023

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.
17/321,936	05/17/2021	Jared Oehring	047158.100090	4613

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

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	04/25/2023

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

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

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

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 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
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/321,936	05/17/2021	Jared Oehring	047158.100090	4613

132858 7590 01/25/2023

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

EXAMINER	
LEMBO, AARON LLOYD	
ART UNIT	**PAPER NUMBER**
3679	

DATE MAILED: 01/25/2023

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 1003, Page 13

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. 17/321,936	Applicant(s) Oehring et al.	
	Examiner AARON L LEMBO	Art Unit 3679	AIA (FITF) Status Yes

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

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

1. ☑ This communication is responsive to Amendment filed 01/09/2023.
   ☐ 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 2-21 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

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

   Certified copies:

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

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

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

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

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

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

Attachment(s)

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

/AARON L LEMBO/
Primary Examiner, Art Unit 3679

Notice of Pre-AIA or AIA Status

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

Allowable Subject Matter

Claims 2-21 are allowed over the prior art of record.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to AARON L LEMBO whose telephone number is (571)270-3065. The examiner can normally be reached Monday-Friday, 7am-4pm.

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

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Troutman can be reached on 5712703654. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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

/AARON L LEMBO/
Primary Examiner
Art Unit 3679

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/321,936	Oehring et al.
	Examiner	Art Unit
	AARON L LEMBO	3679

CPC - Searched*		
Symbol	Date	Examiner
F16L33/02	10/24/2022	/all/
E21B43/26	10/24/2022	/all/
F04B1/00	10/24/2022	/all/
F04B15/02	10/24/2022	/all/
F04B17/03	10/24/2022	/all/

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

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

Search Notes		
Search Notes	Date	Examiner
SEARCH Text Search	10/24/2022	/all/
Assignee Search	10/24/2022	all/
Inventor Search	10/24/2022	all/
Similarity Search	10/24/2022	all/

/AARON L LEMBO/ Primary Examiner, Art Unit 3679	

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/321,936	Oehring et al.
	Examiner	Art Unit
	AARON L LEMBO	3679

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
F16L33	02	01/14/2023	/all/
E21B43	26	01/14/2023	/all/
F04B1	00	01/14/2023	/all/
F04B15	02	01/14/2023	/all/
F04B17	03	01/14/2023	/all/

/AARON L LEMBO/ Primary Examiner, Art Unit 3679	

LIBERTY EXHIBIT 1003, Page 18

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/321,936	Oehring et al.
	Examiner	**Art Unit**
	AARON L LEMBO	3679

CPC								
Symbol							**Type**	**Version**
F16L	/	33	/	02			F	2013-01-01
E21B	/	43	/	26			I	2013-01-01
F04B	/	17	/	03			I	2013-01-01
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F04B	/	1	/	00			I	2013-01-01

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

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/AARON L LEMBO/ Primary Examiner, Art Unit 3679	14 January 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	2	2B

U.S. Patent and Trademark Office

Part of Paper No.: 20230114

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/321,936	Oehring et al.
	Examiner	**Art Unit**
	AARON L LEMBO	3679

INTERNATIONAL CLASSIFICATION				
CLAIMED				
F16L	/	33	/	02
E21B	/	43	/	26
F04B	/	17	/	03
F04B	/	15	/	02
F04B	/	1	/	00

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

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

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	20	
/AARON L LEMBO/ Primary Examiner, Art Unit 3679	14 January 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	2	2B

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/321,936	Oehring et al.
	Examiner	**Art Unit**
	AARON L LEMBO	3679

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

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
-	1	9	10	18	19										
1	2	10	11	19	20										
2	3	11	12	20	21										
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7	8	16	17												
8	9	17	18												

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/AARON L LEMBO/ Primary Examiner, Art Unit 3679	14 January 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	2	2B

U.S. Patent and Trademark Office

Part of Paper No.: 20230114

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
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L5	105225	Oehring.in. Hinderliter.in. Robinson.in. Christinzio.in.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/24 12:04 PM
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		US-20140054965-$ or US-20140000899-$ or US-20130343858-$).did. or (US-20130341029-$ or US-20130306322-$ or US-20130233542-$ or US-20130175039-$ or US-20130175038-$ or US-20130009469-$ or US-20120247783-$ or US-20120232728-$ or US-20120222865-$ or US-20120205400-$ or US-20120205301-$ or US-20120127635-$ or US-20120085541-$ or US-20120049625-$ or US-20120018016-$ or US-20110272158-$ or US-20110247878-$ or US-20110166046-$ or US-20110085924-$ or US-20110061855-$ or US-20110017468-$ or US-20110005757-$ or US-20100322802-$ or US-20100303655-$ or US-20100293973-$ or US-20100250139-$ or US-20100172202-$).did. or (US-20100146981-$ or US-20100132949-$ or US-20100051272-$ or US-20100045109-$ or US-20100038907-$ or US-20100019574-$ or US-20090308602-$ or US-20090260826-$ or US-20090200035-$ or US-20090188181-$ or US-20090145611-$ or US-20090095482-$ or US-20090093317-$ or US-20090078410-$ or US-20090065299-$ or US-20090045782-$ or US-20080264649-$ or US-20080264625-$ or US-20080217024-$ or US-20080208478-$ or US-20080137266-$ or US-20080112802-$ or US-20080041596-$ or US-20080017369-$ or US-20070278140-$ or US-20070226089-$ or US-20070201305-					

		$).did. or (US-20070187163-$ or US-20070131410-$ or US-20060052903-$ or US-20050274508-$ or US-20050116541-$ or US-20050061548-$ or US-20040167738-$ or US-20040102109-$ or US-20040040746-$ or US-20040000077-$ or US-20020169523-$ or US-20030056514-$ or US-20030138327-$).did. or (US-10260327-$ or US-10246984-$ or US-10378326-$ or US-9915128-$ or US-10280724-$ or US-9103193-$ or US-9995218-$ or US-9970278-$ or US-9893500-$ or US-9745840-$ or US-9650879-$ or US-10020711-$ or US-9534473-$ or US-9840901-$ or US-9140110-$ or US-10119381-$ or US-10407990-$ or US-10232332-$ or US-9650871-$ or US-10393108-$ or US-10254732-$ or US-9410410-$ or US-10036238-$ or US-9587649-$ or US-10008880-$ or US-10227854-$).did. or (US-8997904-$ or US-9963961-$ or US-8789601-$ or US-9738461-$ or US-8534235-$ or US-8154419-$ or US-7845413-$ or US-1656861-$ or US-1671436-$ or US-2183364-$ or US-2220622-$ or US-2248051-$ or US-2407796-$ or US-2416848-$ or US-2753940-$ or US-3061039-$ or US-3066503-$ or US-3302069-$ or US-					

		3334495-$ or US- 3722595-$ or US- 3764233-$ or US- 3773140-$ or US- 3837179-$ or US- 3849662-$ or US- 3881551-$ or US- 4037431-$ or US- 4100822-$).did. or (US- 4151575-$ or US- 4226299-$ or US- 4265266-$ or US- 4432064-$ or US- 4442665-$ or US- 4456092-$ or US- 4506982-$ or US- 4512387-$ or US- 4529887-$ or US- 4538916-$ or US- 4676063-$ or US- 4759674-$ or US- 4793386-$ or US- 4845981-$ or US- 4922463-$ or US- 5006044-$ or US- 5025861-$ or US- 5050673-$ or US- 5130628-$ or US- 5131472-$ or US- 5172009-$ or US- 5189388-$ or US- 5366324-$ or US- 5422550-$ or US- 5548093-$ or US- 5590976-$ or US- 5655361-$).did. or (US- 5736838-$ or US- 5755096-$ or US- 5790972-$ or US- 5865247-$ or US- 5879137-$ or US- 5894888-$ or US- 5907970-$ or US- 6138764-$ or US- 6142878-$ or US- 6164910-$ or US- 6202702-$ or US- 6208098-$ or US- 6254462-$ or US- 6271637-$ or US- 6273193-$ or US- 6315523-$ or US- 6477852-$ or US- 6484490-$ or US- 6491098-$ or US- 6529135-$ or US- 6776227-$ or US- 6802690-$ or US-				

		6808303-$ or US- 6931310-$ or US- 6936947-$ or US- 7082993-$ or US- 7104233-$).did. or (US- 7170262-$ or US- 7173399-$ or US- 7308933-$ or US- 7312593-$ or US- 7336514-$ or US- 7445041-$ or US- 7494263-$ or US- 7500642-$ or US- 7525264-$ or US- 7563076-$ or US- 7581379-$ or US- 7675189-$ or US- 7683499-$ or US- 7717193-$ or US- 7755310-$ or US- 7807048-$ or US- 7835140-$ or US- 7894757-$ or US- 7977824-$ or US- 7984757-$ or US- 8037936-$ or US- 8054084-$ or US- 8083504-$ or US- 7926562-$ or US- 8096891-$ or US- 8139383-$ or US- 8146665-$).did. or (US- 8232892-$ or US- 8261528-$ or US- 8272439-$ or US- 8310272-$ or US- 8354817-$ or US- 8474521-$ or US- 8573303-$ or US- 8596056-$ or US- 8616005-$ or US- 8616274-$ or US- 8646521-$ or US- 8692408-$ or US- 8727068-$ or US- 8760657-$ or US- 8774972-$ or US- 8800652-$ or US- 8807960-$ or US- 8838341-$ or US- 8851860-$ or US- 8857506-$ or US- 8899940-$ or US- 8905056-$ or US- 8905138-$ or US- 9018881-$ or US- 9051822-$ or US- 9067182-$ or US-				

		9119326-$).did. or (US-9160168-$ or US-9322239-$ or US-9450385-$ or US-9611728-$ or US-9728354-$ or US-9863228-$ or US-9932799-$ or US-9976351-$ or US-10287873-$ or US-10309205-$ or US-10371012-$ or US-10436026-$).did.					
L18	320	(US-20190316447-$ or US-20190292866-$ or US-20190245348-$ or US-20190211661-$ or US-20190203567-$ or US-20190178235-$ or US-20190169971-$ or US-20190162061-$ or US-20190128080-$ or US-20190120024-$ or US-20190112910-$ or US-20190100989-$ or US-20190063309-$ or US-20190003329-$ or US-20180320483-$ or US-20180245428-$ or US-20180216455-$ or US-20180156210-$ or US-20180038216-$ or US-20180028992-$ or US-20130025706-$ or US-20170328179-$ or US-20170314979-$ or US-20170021318-$ or US-20170292513-$ or US-20170259227-$).did. or (US-20170241221-$ or US-20170234250-$ or US-20170226842-$ or US-20170159570-$ or US-20170146189-$ or US-20170145918-$ or US-20170114625-$ or US-20170051732-$ or US-20170036872-$ or US-20170022807-$ or US-20160348479-$ or US-20160341281-$ or US-20160319650-$ or US-20160312108-$ or US-20160290563-$ or US-20160290114-$ or US-20160281484-$ or US-20160265457-$ or US-	(US-PGPUB; USPAT)	OR	ON	ON	2020/06/20 10:50 AM

		20160230525-$ or US-20160230524-$ or US-20160221220-$ or US-20160208595-$ or US-20160186531-$ or US-20160160889-$ or US-20160105022-$ or US-20160102537-$ or US-20150330172-$).did. or (US-20150314225-$ or US-20150300336-$ or US-20150225113-$ or US-20150217672-$ or US-20150211512-$ or US-20150176386-$ or US-20150159911-$ or US-20150136043-$ or US-20150114652-$ or US-20150097504-$ or US-20150083426-$ or US-20150075778-$ or US-20150053426-$ or US-20150027712-$ or US-20140379300-$ or US-20140290768-$ or US-20140277772-$ or US-20140255214-$ or US-20140251623-$ or US-20140246211-$ or US-20140219824-$ or US-20140124162-$ or US-20140095114-$ or US-20140060658-$ or US-20140054965-$ or US-20140000899-$ or US-20130343858-$).did. or (US-20130341029-$ or US-20130306322-$ or US-20130233542-$ or US-20130175039-$ or US-20130175038-$ or US-20130009469-$ or US-20120247783-$ or US-20120232728-$ or US-20120222865-$ or US-20120205400-$ or US-20120205301-$ or US-20120127635-$ or US-20120085541-$ or US-20120049625-$ or US-20120018016-$ or US-20110272158-$ or US-20110247878-$ or US-20110166046-$ or US-20110085924-$ or US-20110061855-$ or US-20110017468-$ or US-					

		20110005757-$ or US-20100322802-$ or US-20100303655-$ or US-20100293973-$ or US-20100250139-$ or US-20100172202-$).did. or (US-20100146981-$ or US-20100132949-$ or US-20100051272-$ or US-20100045109-$ or US-20100038907-$ or US-20100019574-$ or US-20090308602-$ or US-20090260826-$ or US-20090200035-$ or US-20090188181-$ or US-20090145611-$ or US-20090095482-$ or US-20090093317-$ or US-20090078410-$ or US-20090065299-$ or US-20090045782-$ or US-20080264649-$ or US-20080264625-$ or US-20080217024-$ or US-20080208478-$ or US-20080137266-$ or US-20080112802-$ or US-20080041596-$ or US-20080017369-$ or US-20070278140-$ or US-20070226089-$ or US-20070201305-$).did. or (US-20070187163-$ or US-20070131410-$ or US-20060052903-$ or US-20050274508-$ or US-20050116541-$ or US-20050061548-$ or US-20040167738-$ or US-20040102109-$ or US-20040040746-$ or US-20040000077-$ or US-20020169523-$ or US-20030056514-$ or US-20030138327-$).did. or (US-10260327-$ or US-10246984-$ or US-10378326-$ or US-9915128-$ or US-10280724-$ or US-9103193-$ or US-9995218-$ or US-9970278-$ or US-9893500-$ or US-9745840-$ or US-9650879-$ or US-					

		10020711-$ or US-9534473-$ or US-9840901-$ or US-9140110-$ or US-10119381-$ or US-10407990-$ or US-10232332-$ or US-9650871-$ or US-10393108-$ or US-10254732-$ or US-9410410-$ or US-10036238-$ or US-9587649-$ or US-10008880-$ or US-10227854-$).did. or (US-8997904-$ or US-9963961-$ or US-8789601-$ or US-9738461-$ or US-8534235-$ or US-8154419-$ or US-7845413-$ or US-1656861-$ or US-1671436-$ or US-2183364-$ or US-2220622-$ or US-2248051-$ or US-2407796-$ or US-2416848-$ or US-2753940-$ or US-3061039-$ or US-3066503-$ or US-3302069-$ or US-3334495-$ or US-3722595-$ or US-3764233-$ or US-3773140-$ or US-3837179-$ or US-3849662-$ or US-3881551-$ or US-4037431-$ or US-4100822-$).did. or (US-4151575-$ or US-4226299-$ or US-4265266-$ or US-4432064-$ or US-4442665-$ or US-4456092-$ or US-4506982-$ or US-4512387-$ or US-4529887-$ or US-4538916-$ or US-4676063-$ or US-4759674-$ or US-4793386-$ or US-4845981-$ or US-4922463-$ or US-5006044-$ or US-					

		5025861-$ or US- 5050673-$ or US- 5130628-$ or US- 5131472-$ or US- 5172009-$ or US- 5189388-$ or US- 5366324-$ or US- 5422550-$ or US- 5548093-$ or US- 5590976-$ or US- 5655361-$).did. or (US- 5736838-$ or US- 5755096-$ or US- 5790972-$ or US- 5865247-$ or US- 5879137-$ or US- 5894888-$ or US- 5907970-$ or US- 6138764-$ or US- 6142878-$ or US- 6164910-$ or US- 6202702-$ or US- 6208098-$ or US- 6254462-$ or US- 6271637-$ or US- 6273193-$ or US- 6315523-$ or US- 6477852-$ or US- 6484490-$ or US- 6491098-$ or US- 6529135-$ or US- 6776227-$ or US- 6802690-$ or US- 6808303-$ or US- 6931310-$ or US- 6936947-$ or US- 7082993-$ or US- 7104233-$).did. or (US- 7170262-$ or US- 7173399-$ or US- 7308933-$ or US- 7312593-$ or US- 7336514-$ or US- 7445041-$ or US- 7494263-$ or US- 7500642-$ or US- 7525264-$ or US- 7563076-$ or US- 7581379-$ or US- 7675189-$ or US- 7683499-$ or US- 7717193-$ or US- 7755310-$ or US- 7807048-$ or US- 7835140-$ or US- 7894757-$ or US- 7977824-$ or US- 7984757-$ or US-				

		8037936-$ or US-8054084-$ or US-8083504-$ or US-7926562-$ or US-8096891-$ or US-8139383-$ or US-8146665-$).did. or (US-8232892-$ or US-8261528-$ or US-8272439-$ or US-8310272-$ or US-8354817-$ or US-8474521-$ or US-8573303-$ or US-8596056-$ or US-8616005-$ or US-8616274-$ or US-8646521-$ or US-8692408-$ or US-8727068-$ or US-8760657-$ or US-8774972-$ or US-8800652-$ or US-8807960-$ or US-8838341-$ or US-8851860-$ or US-8857506-$ or US-8899940-$ or US-8905056-$ or US-8905138-$ or US-9018881-$ or US-9051822-$ or US-9067182-$ or US-9119326-$).did. or (US-9160168-$ or US-9322239-$ or US-9450385-$ or US-9611728-$ or US-9728354-$ or US-9863228-$ or US-9932799-$ or US-9976351-$ or US-10287873-$ or US-10309205-$ or US-10371012-$ or US-10436026-$).did.					
L19	93	fitting and lembo.xa.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/20 10:50 AM
L20	22	("20020070014" | "20060159376" | "20090057026" | "20090315276" | "20110308815" | "20190056024" | "2937598" | "3055682" |	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/20 10:50 AM

		"3224817" | "3254908" | "4281726" | "4715526" | "5617879" | "6263982" | "6505649" | "6923476" | "8215645" | "9157293").PN. OR ("10669804").URPN.					
L21	5	L17 and fitting and electri$4 with pump$4 and union	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/20 10:51 AM
L22	221	("5" "5" adj inch) with (hose diameter) and fractur$4 and pump$4 same (electric$4 and plunger)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/20 10:55 AM
L23	476	(frac$4 frack$4 fractur$4) and (pump$4 with hose with fitting)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 09:38 PM
L24	44	(frac$4 frack$4 fractur$4) and (pump$4 with hose with fitting) and fitting with diameter and hose with diameter	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 09:41 PM
L25	59	(hydraulic$4 with fractur$4) and (pump$4 with hose with fitting)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 09:43 PM
L26	23	(US-20190323337-$ or US-20190248938-$ or US-20190137012-$ or US-20130284278-$ or US-20110272158-$ or US-20080264649-$).did. or (US-9052037-$ or US-9903192-$ or US-9513055-$ or US-10102471-$ or US-9400065-$ or US-10227430-$ or US-9284819-$ or US-9061223-$ or US-9050545-$ or US-8985202-$ or US-9341056-$ or US-9341055-$ or US-8162063-$ or US-10280724-$ or US-9840901-$ or US-8146665-$).did. or (US-2831551-$).did.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 09:45 PM
L27	23	L26 and (pump$4 with hose with fitting)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 09:45 PM
L28	14	("20060065319" | "20100018911" | "20130240042" | "2610741" | "2661096" |	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 09:55 PM

		"3748837" | "4051042" | "4836238" | "5230366" | "5433243" | "6390446" | "6719900").PN. OR ("9061223").URPN.					
L29	3	((US adj well adj services.as.) (oehring.in. hinderliter.in. robinson.in. christinzio.in.)) and fitting with hose with diameter$4 same pump$4	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 09:57 PM
L30	5	((US adj well adj services.as.) (oehring.in. hinderliter.in. robinson.in. christinzio.in.)) and fitting with hose with diameter$4	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 09:58 PM
L31	18	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and fitting with hose with diameter$4	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 10:05 PM
L32	8	fitting with hose with diameter$4 and (hose fitting) with pump$4 and union with pump$4	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 10:06 PM
L33	1	union same shank same reducer same fitting same hose	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 10:18 PM
L34	1	union same shank same reducer same fitting and fitting same hose	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 10:18 PM
L35	0	union with shank with reducer and fitting same hose	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 10:18 PM
L36	0	union with shank with reducer	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 10:18 PM
L37	1	union with shank with reducer	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/21 10:19 PM
L38	0	union same shank same reducer and fitting with hose	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/21 10:19 PM
L39	326	(US-20190316447-$ or	(US-PGPUB; USPAT)	OR	ON	ON	2020/06/21

		US-20190292866-$ or US-20190245348-$ or US-20190211661-$ or US-20190203567-$ or US-20190178235-$ or US-20190169971-$ or US-20190162061-$ or US-20190128080-$ or US-20190120024-$ or US-20190112910-$ or US-20190100989-$ or US-20190063309-$ or US-20190003329-$ or US-20180320483-$ or US-20180245428-$ or US-20180216455-$ or US-20180156210-$ or US-20180038216-$ or US-20180028992-$ or US-20130025706-$ or US-20170328179-$ or US-20170314979-$ or US-20170021318-$ or US-20170292513-$ or US-20170259227-$).did. or (US-20170241221-$ or US-20170234250-$ or US-20170226842-$ or US-20170159570-$ or US-20170146189-$ or US-20170145918-$ or US-20170114625-$ or US-20170051732-$ or US-20170036872-$ or US-20170022807-$ or US-20160348479-$ or US-20160341281-$ or US-20160319650-$ or US-20160312108-$ or US-20160290563-$ or US-20160290114-$ or US-20160281484-$ or US-20160265457-$ or US-20160230525-$ or US-20160230524-$ or US-20160221220-$ or US-20160208595-$ or US-20160186531-$ or US-20160160889-$ or US-20160105022-$ or US-20160102537-$ or US-20150330172-$).did. or (US-20150314225-$ or US-20150300336-$ or US-20150225113-$ or US-20150217672-$ or US-20150211512-$ or					10:20 PM

		US-20150176386-$ or US-20150159911-$ or US-20150136043-$ or US-20150114652-$ or US-20150097504-$ or US-20150083426-$ or US-20150075778-$ or US-20150053426-$ or US-20150027712-$ or US-20140379300-$ or US-20140290768-$ or US-20140277772-$ or US-20140255214-$ or US-20140251623-$ or US-20140246211-$ or US-20140219824-$ or US-20140124162-$ or US-20140095114-$ or US-20140060658-$ or US-20140054965-$ or US-20140000899-$ or US-20130343858-$).did. or (US-20130341029-$ or US-20130306322-$ or US-20130233542-$ or US-20130175039-$ or US-20130175038-$ or US-20130009469-$ or US-20120247783-$ or US-20120232728-$ or US-20120222865-$ or US-20120205400-$ or US-20120205301-$ or US-20120127635-$ or US-20120085541-$ or US-20120049625-$ or US-20120018016-$ or US-20110272158-$ or US-20110247878-$ or US-20110166046-$ or US-20110085924-$ or US-20110061855-$ or US-20110017468-$ or US-20110005757-$ or US-20100322802-$ or US-20100303655-$ or US-20100293973-$ or US-20100250139-$ or US-20100172202-$).did. or (US-20100146981-$ or US-20100132949-$ or US-20100051272-$ or US-20100045109-$ or US-20100038907-$ or US-20100019574-$ or US-20090308602-$ or US-20090260826-$ or					

		US-20090200035-$ or US-20090188181-$ or US-20090145611-$ or US-20090095482-$ or US-20090093317-$ or US-20090078410-$ or US-20090065299-$ or US-20090045782-$ or US-20080264649-$ or US-20080264625-$ or US-20080217024-$ or US-20080208478-$ or US-20080137266-$ or US-20080112802-$ or US-20080041596-$ or US-20080017369-$ or US-20070278140-$ or US-20070226089-$ or US-20070201305-$).did. or (US-20070187163-$ or US-20070131410-$ or US-20060052903-$ or US-20050274508-$ or US-20050116541-$ or US-20050061548-$ or US-20040167738-$ or US-20040102109-$ or US-20040040746-$ or US-20040000077-$ or US-20020169523-$ or US-20030056514-$ or US-20030138327-$ or US-20130284278-$).did. or (US-10260327-$ or US-10246984-$ or US-10378326-$ or US-9915128-$ or US-10280724-$ or US-9103193-$ or US-9995218-$ or US-9970278-$ or US-9893500-$ or US-9745840-$ or US-9650879-$ or US-10020711-$ or US-9534473-$ or US-9840901-$ or US-9140110-$ or US-10119381-$ or US-10407990-$ or US-10232332-$ or US-9650871-$ or US-10393108-$ or US-10254732-$ or US-9410410-$ or US-10036238-$ or US-9587649-$ or US-					

		10008880-$ or US-10227854-$).did. or (US-8997904-$ or US-9963961-$ or US-8789601-$ or US-9738461-$ or US-8534235-$ or US-8154419-$ or US-7845413-$ or US-1656861-$ or US-1671436-$ or US-2183364-$ or US-2220622-$ or US-2248051-$ or US-2407796-$ or US-2416848-$ or US-2753940-$ or US-3061039-$ or US-3066503-$ or US-3302069-$ or US-3334495-$ or US-3722595-$ or US-3764233-$ or US-3773140-$ or US-3837179-$ or US-3849662-$ or US-3881551-$ or US-4037431-$ or US-4100822-$).did. or (US-4151575-$ or US-4226299-$ or US-4265266-$ or US-4432064-$ or US-4442665-$ or US-4456092-$ or US-4506982-$ or US-4512387-$ or US-4529887-$ or US-4538916-$ or US-4676063-$ or US-4759674-$ or US-4793386-$ or US-4845981-$ or US-4922463-$ or US-5006044-$ or US-5025861-$ or US-5050673-$ or US-5130628-$ or US-5131472-$ or US-5172009-$ or US-5189388-$ or US-5366324-$ or US-5422550-$ or US-5548093-$ or US-5590976-$ or US-5655361-$).did. or (US-5736838-$ or US-5755096-$ or US-					

		5790972-$ or US- 5865247-$ or US- 5879137-$ or US- 5894888-$ or US- 5907970-$ or US- 6138764-$ or US- 6142878-$ or US- 6164910-$ or US- 6202702-$ or US- 6208098-$ or US- 6254462-$ or US- 6271637-$ or US- 6273193-$ or US- 6315523-$ or US- 6477852-$ or US- 6484490-$ or US- 6491098-$ or US- 6529135-$ or US- 6776227-$ or US- 6802690-$ or US- 6808303-$ or US- 6931310-$ or US- 6936947-$ or US- 7082993-$ or US- 7104233-$).did. or (US- 7170262-$ or US- 7173399-$ or US- 7308933-$ or US- 7312593-$ or US- 7336514-$ or US- 7445041-$ or US- 7494263-$ or US- 7500642-$ or US- 7525264-$ or US- 7563076-$ or US- 7581379-$ or US- 7675189-$ or US- 7683499-$ or US- 7717193-$ or US- 7755310-$ or US- 7807048-$ or US- 7835140-$ or US- 7894757-$ or US- 7977824-$ or US- 7984757-$ or US- 8037936-$ or US- 8054084-$ or US- 8083504-$ or US- 7926562-$ or US- 8096891-$ or US- 8139383-$ or US- 8146665-$).did. or (US- 8232892-$ or US- 8261528-$ or US- 8272439-$ or US- 8310272-$ or US- 8354817-$ or US- 8474521-$ or US-				

		8573303-$ or US-8596056-$ or US-8616005-$ or US-8616274-$ or US-8646521-$ or US-8692408-$ or US-8727068-$ or US-8760657-$ or US-8774972-$ or US-8800652-$ or US-8807960-$ or US-8838341-$ or US-8851860-$ or US-8857506-$ or US-8899940-$ or US-8905056-$ or US-8905138-$ or US-9018881-$ or US-9051822-$ or US-9067182-$ or US-9119326-$).did. or (US-9160168-$ or US-9322239-$ or US-9450385-$ or US-9611728-$ or US-9728354-$ or US-9863228-$ or US-9932799-$ or US-9976351-$ or US-10287873-$ or US-10309205-$ or US-10371012-$ or US-10436026-$ or US-10669804-$ or US-3055682-$ or US-9513055-$ or US-9061223-$ or US-8091928-$).did.					
L40	14	L39 and fitting with hose	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/21 10:20 PM
L41	2	hose with fracturing with inches	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/21 11:16 PM
L42	0	fracturing with pump with L28 adj inches	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/21 11:18 PM
L43	0	fracturing with pump with L28	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/21 11:18 PM
L44	322	fracturing with pump with "6"	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	ON	ON	2020/06/21 11:18 PM

			JPO; DERWENT; IBM_TDB)				
L45	0	fracturing with pump with "6" near2 (inch$4 diameter)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/21 11:19 PM
L46	2134	pump with "6" near2 (inch$4 diameter)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/21 11:19 PM
L47	21	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and pump with "6" near2 (inch$4 diameter)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 11:19 PM
L48	0	hose with drop adj out adj rate and fracturing	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/23 08:29 AM
L49	0	hose with drop adj out and fracturing	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/23 08:29 AM
L50	6	hose with dropout and fracturing	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/23 08:29 AM
L51	0	hose with pump with slurry with diameter and fracturing	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/23 08:30 AM
L52	109	(hose pump) with slurry with diameter and fracturing	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/23 08:30 AM
L53	0	(hose and pump) with slurry with diameter and fracturing	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/23 08:30 AM
L54	108	(pump) with slurry with diameter and fracturing	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/23 08:31 AM
L55	1	(hose) with slurry with diameter and fracturing	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/23 08:31 AM
L56	47	("10337308"|"10415332"|"10669804"|"20030079875"|"20060065319"|"20110052423"|"20130180722"|"20130284278"|	(US-PGPUB; USPAT)	OR	ON	ON	2020/10/19 01:01 PM

		"20130299167"|"20130306322"|"20130317750"|"20140138079"|"20140238683"|"20160258267"|"20160326854"|"20170096885"|"20170130743"|"20170175516"|"20170226838"|"20180045331"|"20180238147"|"20180266412"|"20180291713"|"20180343125"|"20190010793"|"20190112910"|"20190119096"|"20200232454"|"2610741"|"3055682"|"5004400"|"5025861"|"5230366"|"5433243"|"6719900"|"7170262"|"8091928"|"8774972"|"8997904"|"9051822"|"9061223"|"9260253"|"9324049"|"9340353"|"9499335"|"9513055"|"9909398").PN.				
L57	7	("10302079"|"20030079875"|"20110052423"|"20130180722"|"20130299167"|"20170159654"|"20170226838").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2020/10/19 03:42 PM
L58	47	("10337308"|"10415332"|"10669804"|"20030079875"|"20060065319"|"20110052423"|"20130180722"|"20130284278"|"20130299167"|"20130306322"|"20130317750"|"20140138079"|"20140238683"|"20160258267"|"20160326854"|"20170096885"|"20170130743"|"20170175516"|"20170226838"|"20180045331"|"20180238147"|"20180266412"|"20180291713"|"20180343125"|"20190010793"|"20190112910"|"20190119096"|"20200232454"|"2610741"|"3055682"|"5004400"|"5025861"|"5230366"|"5433243"|"6719900"|"7170262"|"8091928"|"8774972"|"8997904"|"9051822"|"9061223"|"9260253"|"9324049"|"9340353"|"9499335"|"9513055"|"9909398").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2020/10/19 03:42 PM
L59	25	("10184465"|"10627003	(US-PGPUB; USPAT)	OR	ON	ON	2021/01/07

		"|"10669471"|"10695950"|"10711576"|"20080095644"|"20120152716"|"20130189629"|"20130255271"|"20160273456"|"20170043280"|"20170074076"|"20170138171"|"20200047141"|"20200088152"|"5517822"|"6626646"|"6765304"|"8506267"|"8763387"|"8795525"|"9051923"|"9482086"|"9706185"|"9739546").PN.					02:15 PM
L60	3	"20170218727"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/07 02:29 PM
L61	1	(L59 L60) and pump$4 same fitting	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/07 02:32 PM
L62	0	(L59 L60) and pump$4 with plung$4	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/07 02:33 PM
L63	22	(L59 L60) and pump$4	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/07 02:33 PM
L64	1	(pump and reducer and union and shank) same fitting	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 09:05 PM
L65	0	(pump with fitting) and (reducer and union and shank) same fitting	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 09:05 PM
L66	272	(pump with fitting) and (reducer with fitting)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 09:05 PM
L67	5221	electric$4 with hydraulic$4 with pump and plunger	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 09:08 PM
L68	10	electric$4 with hydraulic$4 with pump and multi-plunger	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 09:08 PM
L69	6	electric$4 with hydraulic$4 with pump and (multi-plunger duplex triplex) with pump and pump with	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 09:12 PM

		fitting and hose with fitting					
L70	12	electric$4 with pump and (multi-plunger duplex triplex) with pump and pump with fitting and hose with fitting and pump with (hydraulic$4 fractur$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 09:30 PM
L71	11	electric$4 with pump and (multi-plunger duplex triplex) with pump and pump with fitting and pump with hose and hose with fitting and pump with (hydraulic$4 fractur$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 09:45 PM
L72	42111	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 09:54 PM
L73	8	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and pump and hose and fitting and reduc$4 with fitting and hose with fitting and hose with pump	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 09:55 PM
L74	5	(US-10563490-$ or US-10760557-$ or US-9316216-$ or US-8469108-$ or US-3652188-$).did.	(USPAT)	OR	ON	ON	2021/01/08 09:55 PM
L75	8	L73 and reduc$4 with fitting and hose with fitting and hose with pump	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 09:56 PM
L76	5	L74 and reduc$4 with fitting and hose with fitting and hose with pump	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 09:56 PM
L77	0	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and pump and hose and fitting and (union shank reduc$3) with fitting and hose with fitting and hose with pump and	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 10:09 PM

		(reduc$3 with (union shank))					
L78	15	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and pump and hose and fitting and ((reduc$3 with (union shank))(union shank reduc$3) with fitting) and hose with fitting and hose with pump	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 10:10 PM
L79	10	(US-20190055938-$ or US-20060021659-$).did. or (US-10102471-$ or US-9932981-$ or US-10563490-$ or US-10760557-$ or US-9316216-$ or US-8469108-$ or US-3652188-$).did. or (US-20150247497-$).did.	(US-PGPUB; USPAT; DERWENT)	OR	ON	ON	2021/01/08 10:14 PM
L80	10	L79 and ((reduc$3 with (union shank))(union shank reduc$3) with fitting) and hose with fitting and hose with pump	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 10:14 PM
L81	3	"20170218727"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 10:27 PM
L82	4	("20030000759"|"20140174691"|"20170302218"|"6560131").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2021/03/04 08:09 AM
L83	3	"20180183219"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/03/04 02:49 PM
L84	1	("20030000759"|"20140174691"|"20170302218"|"6560131").PN. and pump same (plunger hose fitting)	(US-PGPUB; USPAT)	OR	ON	ON	2021/03/04 02:51 PM
L85	25	("10221639"|"10408030"|"10408031"|"10740730"|"20080277120"|"20110110793"|"20130284455"|"20160326853"|"20170082033"|"20170212535"|"20170370639"|"20180090914"|"2018018	(US-PGPUB; USPAT)	OR	ON	ON	2021/03/23 09:26 PM

		1830"|"20180259080"|"20180266217"|"20180284817"|"20180298731"|"20180312738"|"20190154020"|"20190249527"|"3878884"|"5439066"|"6985750"|"9062545"|"9506333").PN.					
L86	1	L88 and fitting with hose	(US-PGPUB; USPAT)	OR	ON	ON	2021/03/23 09:29 PM
L90	415	((US-20170145918-A1 OR US-20080264625-A1 OR US-20130284278-A1 OR US-20060065319-A1 OR US-20190316447-A1 OR US-20190292866-A1 OR US-20190245348-A1 OR US-20190211661-A1 OR US-20190203567-A1 OR US-20190178235-A1 OR US-20190169971-A1 OR US-20190162061-A1 OR US-20190128080-A1 OR US-20190120024-A1 OR US-20190112910-A1 OR US-20190100989-A1 OR US-20190063309-A1 OR US-20190003329-A1 OR US-20180320483-A1 OR US-20180245428-A1 OR US-20180216455-A1 OR US-20180156210-A1 OR US-20180038216-A1 OR US-20180028992-A1 OR US-20130025706-A1 OR US-20170328179-A1 OR US-20170314979-A1 OR US-20170021318-A1 OR US-20170292513-A1 OR US-20170259227-A1 OR US-20170241221-A1 OR US-20170234250-A1 OR US-20170226842-A1 OR US-20170159570-A1 OR US-20170146189-A1 OR US-	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/01 04:56 PM

		20170114625-A1 OR US-20170051732-A1 OR US-20170036872-A1 OR US-20170022807-A1 OR US-20160348479-A1 OR US-20160341281-A1 OR US-20160319650-A1 OR US-20160312108-A1 OR US-20160290563-A1 OR US-20160290114-A1 OR US-20160281484-A1 OR US-20160265457-A1 OR US-20160230525-A1 OR US-20160230524-A1 OR US-20160221220-A1 OR US-20160208595-A1 OR US-20160186531-A1 OR US-20160160889-A1 OR US-20160105022-A1 OR US-20160102537-A1 OR US-20150330172-A1 OR US-20150314225-A1 OR US-20150300336-A1 OR US-20150225113-A1 OR US-20150217672-A1 OR US-20150211512-A1 OR US-20150176386-A1 OR US-20150159911-A1 OR US-20150136043-A1 OR US-20150114652-A1 OR US-20150097504-A1 OR US-20150083426-A1 OR US-20150075778-A1 OR US-20150053426-A1 OR US-20150027712-A1 OR US-20140379300-A1 OR US-20140290768-A1 OR US-20140277772-A1 OR US-20140255214-A1 OR US-20140251623-A1 OR US-20140246211-A1 OR US-20140219824-A1 OR US-20140124162-A1 OR US-20140095114-A1					

		OR US-20140060658-A1 OR US-20140054965-A1 OR US-20140000899-A1 OR US-20130343858-A1 OR US-20130341029-A1 OR US-20130306322-A1 OR US-20130233542-A1 OR US-20130175039-A1 OR US-20130175038-A1 OR US-20130009469-A1 OR US-20120247783-A1 OR US-20120232728-A1 OR US-20120222865-A1 OR US-20120205400-A1 OR US-20120205301-A1 OR US-20120127635-A1 OR US-20120085541-A1 OR US-20120049625-A1 OR US-20120018016-A1 OR US-20110272158-A1 OR US-20110247878-A1 OR US-20110166046-A1 OR US-20110085924-A1 OR US-20110061855-A1 OR US-20110017468-A1 OR US-20110005757-A1 OR US-20100322802-A1 OR US-20100303655-A1 OR US-20100293973-A1 OR US-20100250139-A1 OR US-20100172202-A1 OR US-20100146981-A1 OR US-20100132949-A1 OR US-20100051272-A1 OR US-20100045109-A1 OR US-20100038907-A1 OR US-20100019574-A1 OR US-20090308602-A1 OR US-20090260826-A1 OR US-20090200035-A1 OR US-20090188181-A1 OR US-20090145611-A1 OR US-20090095482-A1 OR US-					

		20090093317-A1 OR US-20090078410-A1 OR US-20090065299-A1 OR US-20090045782-A1 OR US-20080264649-A1 OR US-20080217024-A1 OR US-20080208478-A1 OR US-20080137266-A1 OR US-20080112802-A1 OR US-20080041596-A1 OR US-20080017369-A1 OR US-20070278140-A1 OR US-20070226089-A1 OR US-20070201305-A1 OR US-20070187163-A1 OR US-20070131410-A1 OR US-20060052903-A1 OR US-20050274508-A1 OR US-20050116541-A1 OR US-20050061548-A1 OR US-20040167738-A1 OR US-20040102109-A1 OR US-20040040746-A1 OR US-20040000077-A1 OR US-20020169523-A1 OR US-20030056514-A1 OR US-20030138327-A1 OR US-20200232454-A1 OR US-20190119096-A1 OR US-20170226838-A1 OR US-20130299167-A1 OR US-20130180722-A1 OR US-20110052423-A1 OR US-20030079875-A1 OR US-20190010793-A1 OR US-20180343125-A1 OR US-20180291713-A1 OR US-20180266412-A1 OR US-20180238147-A1 OR US-20180045331-A1 OR US-20170175516-A1 OR US-20170130743-A1 OR US-20170096885-A1 OR US-20160258267-A1					

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L91	0	F16L33/2076.cpc. AND F16L13/141.cpc. AND F16L25/14.cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/01 05:57 PM
L92	11	(F16L13/141.cpc. F16L33/2076.cpc.) AND F16L25/14.cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/01 05:58 PM
L93	2	(F16L13/141.cpc. F16L33/2076.cpc. F16L25/14.cpc.) AND hydraulic$4 ADJ fractur$3	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/01 05:59 PM
L94	170	(F16L13/141.cpc. F16L33/2076.cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP,	OR	ON	ON	2022/11/02 11:31 AM

		F16L25/14.cpc.) AND fractur$3	AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L95	27	(F16L13/141.cpc. F16L33/2076.cpc. F16L25/14.cpc.) AND fractur$3 AND pump$4	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 11:32 AM
L96	417	((US-20170145918-A1 OR US-20080264625-A1 OR US-20130284278-A1 OR US-20060065319-A1 OR US-20190316447-A1 OR US-20190292866-A1 OR US-20190245348-A1 OR US-20190211661-A1 OR US-20190203567-A1 OR US-20190178235-A1 OR US-20190169971-A1 OR US-20190162061-A1 OR US-20190128080-A1 OR US-20190120024-A1 OR US-20190112910-A1 OR US-20190100989-A1 OR US-20190063309-A1 OR US-20190003329-A1 OR US-20180320483-A1 OR US-20180245428-A1 OR US-20180216455-A1 OR US-20180156210-A1 OR US-20180038216-A1 OR US-20180028992-A1 OR US-20130025706-A1 OR US-20170328179-A1 OR US-20170314979-A1 OR US-20170021318-A1 OR US-20170292513-A1 OR US-20170259227-A1 OR US-20170241221-A1 OR US-20170234250-A1 OR US-	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 11:42 AM

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		10302079-B2 OR US-10337308-B2 OR US-10415332-B2 OR US-9909398-B2 OR US-9499335-B2 OR US-9340353-B2 OR US-9324049-B2 OR US-9260253-B2 OR US-5004400-A OR US-10711576-B2 OR US-10695950-B2 OR US-10669471-B2 OR US-10627003-B2 OR US-10184465-B2 OR US-9739546-B2 OR US-9706185-B2 OR US-9482086-B2 OR US-9051923-B2 OR US-8795525-B2 OR US-8763387-B2 OR US-8506267-B2 OR US-6765304-B2 OR US-6626646-B2 OR US-5517822-A OR US-6560131-B1 OR US-10740730-B2 OR US-10408031-B2 OR US-10408030-B2 OR US-10221639-B2 OR US-9506333-B2 OR US-9062545-B2 OR US-6985750-B1 OR US-5439066-A OR US-3878884-A).did. AND USPT.dbnm.) OR ((US-20170218727-A1).did. AND DWPI.dbnm.)					
L97	2	(F16L13/141.cpc. F16L33/2076.cpc. F16L25/14.cpc.) AND L96	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 11:43 AM
L98	41	(Artificial Intelligence) Similar to: 17/321,936 with 0 CPC Selections and 0 Text Selections Text: (US-20220107039-A1 OR US-11009162-B1 OR AR-120897-A1 OR US-10598258-B2 OR US-20220018232-A1 OR US-10914155-B2	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO))	OR	ON	ON	2022/11/02 12:12 PM

		OR CA-3115650-A1 OR US-20200109616-A1 OR WO-2020081313-A1 OR US-20210396222-A1 OR CA-3114499-A1 OR US-20210396119-A1 OR US-20210396223-A1 OR US-11208878-B2 OR US-20210156240-A1 OR US-20210041009-A1 OR US-20210079902-A1 OR WO-2020076902-A1 OR US-20200109617-A1 OR CA-3115669-A1 OR US-20200197883-A1 OR US-11009023-B2 OR US-20200325893-A1 OR US-11255173-B2 OR US-20210140295-A1 OR US-20220056794-A1 OR US-11415125-B2 OR CA-3114005-A1 OR US-11428218-B2 OR WO-2019113147-A1 OR US-20190249754-A1 OR CA-3139970-A1 OR US-20220290549-A1 OR US-10815978-B2 OR US-20190154020-A1 OR WO-2020231483-A1 OR AR-118923-A1 OR CA-3081681-C OR US-20200362681-A1 OR US-20210108631-A1 OR US-20210301815-A1 OR CA-3084596-A1 OR EP-2440784-B1 OR US-20210396121-A1 OR WO-2021262668-A1 OR AU-2017210621-B2 OR AU-2017210621-B9 OR CA-2765155-C OR WO-2021067410-A1 OR AU-2017210621-A1).did.					
L99	417	((US-20170145918-A1 OR US-20080264625-A1 OR US-20130284278-A1 OR US-20060065319-A1 OR US-20190316447-A1 OR US-	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT;	OR	ON	ON	2022/11/02 12:23 PM

		20190292866-A1 OR US-20190245348-A1 OR US-20190211661-A1 OR US-20190203567-A1 OR US-20190178235-A1 OR US-20190169971-A1 OR US-20190162061-A1 OR US-20190128080-A1 OR US-20190120024-A1 OR US-20190112910-A1 OR US-20190100989-A1 OR US-20190063309-A1 OR US-20190003329-A1 OR US-20180320483-A1 OR US-20180245428-A1 OR US-20180216455-A1 OR US-20180156210-A1 OR US-20180038216-A1 OR US-20180028992-A1 OR US-20130025706-A1 OR US-20170328179-A1 OR US-20170314979-A1 OR US-20170021318-A1 OR US-20170292513-A1 OR US-20170259227-A1 OR US-20170241221-A1 OR US-20170234250-A1 OR US-20170226842-A1 OR US-20170159570-A1 OR US-20170146189-A1 OR US-20170114625-A1 OR US-20170051732-A1 OR US-20170036872-A1 OR US-20170022807-A1 OR US-20160348479-A1 OR US-20160341281-A1 OR US-20160319650-A1 OR US-20160312108-A1 OR US-20160290563-A1 OR US-20160290114-A1 OR US-20160281484-A1 OR US-20160265457-A1 OR US-20160230525-A1 OR US-20160230524-A1	IBM_TDB)				

		OR US-20160221220-A1 OR US-20160208595-A1 OR US-20160186531-A1 OR US-20160160889-A1 OR US-20160105022-A1 OR US-20160102537-A1 OR US-20150330172-A1 OR US-20150314225-A1 OR US-20150300336-A1 OR US-20150225113-A1 OR US-20150217672-A1 OR US-20150211512-A1 OR US-20150176386-A1 OR US-20150159911-A1 OR US-20150136043-A1 OR US-20150114652-A1 OR US-20150097504-A1 OR US-20150083426-A1 OR US-20150075778-A1 OR US-20150053426-A1 OR US-20150027712-A1 OR US-20140379300-A1 OR US-20140290768-A1 OR US-20140277772-A1 OR US-20140255214-A1 OR US-20140251623-A1 OR US-20140246211-A1 OR US-20140219824-A1 OR US-20140124162-A1 OR US-20140095114-A1 OR US-20140060658-A1 OR US-20140054965-A1 OR US-20140000899-A1 OR US-20130343858-A1 OR US-20130341029-A1 OR US-20130306322-A1 OR US-20130233542-A1 OR US-20130175039-A1 OR US-20130175038-A1 OR US-20130009469-A1 OR US-20120247783-A1 OR US-20120232728-A1 OR US-20120222865-A1 OR US-					

		20120205400-A1 OR US-20120205301-A1 OR US-20120127635-A1 OR US-20120085541-A1 OR US-20120049625-A1 OR US-20120018016-A1 OR US-20110272158-A1 OR US-20110247878-A1 OR US-20110166046-A1 OR US-20110085924-A1 OR US-20110061855-A1 OR US-20110017468-A1 OR US-20110005757-A1 OR US-20100322802-A1 OR US-20100303655-A1 OR US-20100293973-A1 OR US-20100250139-A1 OR US-20100172202-A1 OR US-20100146981-A1 OR US-20100132949-A1 OR US-20100051272-A1 OR US-20100045109-A1 OR US-20100038907-A1 OR US-20100019574-A1 OR US-20090308602-A1 OR US-20090260826-A1 OR US-20090200035-A1 OR US-20090188181-A1 OR US-20090145611-A1 OR US-20090095482-A1 OR US-20090093317-A1 OR US-20090078410-A1 OR US-20090065299-A1 OR US-20090045782-A1 OR US-20080264649-A1 OR US-20080217024-A1 OR US-20080208478-A1 OR US-20080137266-A1 OR US-20080112802-A1 OR US-20080041596-A1 OR US-20080017369-A1 OR US-20070278140-A1 OR US-20070226089-A1 OR US-20070201305-A1						

		OR US-20070187163-A1 OR US-20070131410-A1 OR US-20060052903-A1 OR US-20050274508-A1 OR US-20050116541-A1 OR US-20050061548-A1 OR US-20040167738-A1 OR US-20040102109-A1 OR US-20040040746-A1 OR US-20040000077-A1 OR US-20020169523-A1 OR US-20030056514-A1 OR US-20030138327-A1 OR US-20200232454-A1 OR US-20190119096-A1 OR US-20170226838-A1 OR US-20130299167-A1 OR US-20130180722-A1 OR US-20110052423-A1 OR US-20030079875-A1 OR US-20190010793-A1 OR US-20180343125-A1 OR US-20180291713-A1 OR US-20180266412-A1 OR US-20180238147-A1 OR US-20180045331-A1 OR US-20170175516-A1 OR US-20170130743-A1 OR US-20170096885-A1 OR US-20160258267-A1 OR US-20140238683-A1 OR US-20130317750-A1 OR US-20200088152-A1 OR US-20200047141-A1 OR US-20170138171-A1 OR US-20170074076-A1 OR US-20170043280-A1 OR US-20160273456-A1 OR US-20130255271-A1 OR US-20130189629-A1 OR US-20120152716-A1 OR US-20080095644-A1 OR US-20170302218-A1 OR US-					

		20140174691-A1 OR US-20030000759-A1 OR US-20190249527-A1 OR US-20190154020-A1 OR US-20180312738-A1 OR US-20180298731-A1 OR US-20180284817-A1 OR US-20180266217-A1 OR US-20180259080-A1 OR US-20180181830-A1 OR US-20180090914-A1 OR US-20170370639-A1 OR US-20170212535-A1 OR US-20170082033-A1 OR US-20160326853-A1 OR US-20130284455-A1 OR US-20110110793-A1 OR US-20080277120-A1).did. AND PGPB.dbnm.) OR ((US-10669804-B2 OR US-3055682-A OR US-9513055-B1 OR US-9061223-B2 OR US-8091928-B2 OR US-6719900-B2 OR US-5433243-A OR US-5230366-A OR US-2610741-A OR US-5472049-A OR US-11009162-B1 OR US-11090709-B1 OR US-10260327-B2 OR US-10246984-B2 OR US-10378326-B2 OR US-9915128-B2 OR US-10280724-B2 OR US-9103193-B2 OR US-9995218-B2 OR US-9970278-B2 OR US-9893500-B2 OR US-9745840-B2 OR US-9650879-B2 OR US-10020711-B2 OR US-9534473-B2 OR US-9840901-B2 OR US-9140110-B2 OR US-10119381-B2 OR US-10407990-B2 OR US-10232332-B2 OR US-9650871-B2 OR US-10393108-B2 OR US-10254732-B2 OR US-					

		9410410-B2 OR US- 10036238-B2 OR US- 9587649-B2 OR US- 10008880-B2 OR US- 10227854-B2 OR US- 8997904-B2 OR US- 9963961-B2 OR US- 8789601-B2 OR US- 9738461-B2 OR US- 8534235-B2 OR US- 8154419-B2 OR US- 7845413-B2 OR US- 1656861-A OR US- 1671436-A OR US- 2183364-A OR US- 2220622-A OR US- 2248051-A OR US- 2407796-A OR US- 2416848-A OR US- 2753940-A OR US- 3061039-A OR US- 3066503-A OR US- 3302069-A OR US- 3334495-A OR US- 3722595-A OR US- 3764233-A OR US- 3773140-A OR US- 3837179-A OR US- 3849662-A OR US- 3881551-A OR US- 4037431-A OR US- 4100822-A OR US- 4151575-A OR US- 4226299-A OR US- 4265266-A OR US- 4432064-A OR US- 4442665-A OR US- 4456092-A OR US- 4506982-A OR US- 4512387-A OR US- 4529887-A OR US- 4538916-A OR US- 4676063-A OR US- 4759674-A OR US- 4793386-A OR US- 4845981-A OR US- 4922463-A OR US- 5006044-A OR US- 5025861-A OR US- 5050673-A OR US- 5130628-A OR US- 5131472-A OR US- 5172009-A OR US- 5189388-A OR US- 5366324-A OR US- 5422550-A OR US- 5548093-A OR US- 5590976-A OR US-				

		5655361-A OR US- 5736838-A OR US- 5755096-A OR US- 5790972-A OR US- 5865247-A OR US- 5879137-A OR US- 5894888-A OR US- 5907970-A OR US- 6138764-A OR US- 6142878-A OR US- 6164910-A OR US- 6202702-B1 OR US- 6208098-B1 OR US- 6254462-B1 OR US- 6271637-B1 OR US- 6273193-B1 OR US- 6315523-B1 OR US- 6477852-B2 OR US- 6484490-B1 OR US- 6491098-B1 OR US- 6529135-B1 OR US- 6776227-B2 OR US- 6802690-B2 OR US- 6808303-B2 OR US- 6931310-B2 OR US- 6936947-B1 OR US- 7082993-B2 OR US- 7104233-B2 OR US- 7170262-B2 OR US- 7173399-B2 OR US- 7308933-B1 OR US- 7312593-B1 OR US- 7336514-B2 OR US- 7445041-B2 OR US- 7494263-B2 OR US- 7500642-B2 OR US- 7525264-B2 OR US- 7563076-B2 OR US- 7581379-B2 OR US- 7675189-B2 OR US- 7683499-B2 OR US- 7717193-B2 OR US- 7755310-B2 OR US- 7807048-B2 OR US- 7835140-B2 OR US- 7894757-B2 OR US- 7977824-B2 OR US- 7984757-B1 OR US- 8037936-B2 OR US- 8054084-B2 OR US- 8083504-B2 OR US- 7926562-B2 OR US- 8096891-B2 OR US- 8139383-B2 OR US- 8146665-B2 OR US- 8232892-B2 OR US- 8261528-B2 OR US- 8272439-B2 OR US-				

		8310272-B2 OR US- 8354817-B2 OR US- 8474521-B2 OR US- 8573303-B2 OR US- 8596056-B2 OR US- 8616005-B1 OR US- 8616274-B2 OR US- 8646521-B2 OR US- 8692408-B2 OR US- 8727068-B2 OR US- 8760657-B2 OR US- 8774972-B2 OR US- 8800652-B2 OR US- 8807960-B2 OR US- 8838341-B2 OR US- 8851860-B1 OR US- 8857506-B2 OR US- 8899940-B2 OR US- 8905056-B2 OR US- 8905138-B2 OR US- 9018881-B2 OR US- 9051822-B2 OR US- 9067182-B2 OR US- 9119326-B2 OR US- 9160168-B2 OR US- 9322239-B2 OR US- 9450385-B2 OR US- 9611728-B2 OR US- 9728354-B2 OR US- 9863228-B2 OR US- 9932799-B2 OR US- 9976351-B2 OR US- 10287873-B2 OR US- 10309205-B2 OR US- 10371012-B2 OR US- 10436026-B2 OR US- 10302079-B2 OR US- 10337308-B2 OR US- 10415332-B2 OR US- 9909398-B2 OR US- 9499335-B2 OR US- 9340353-B2 OR US- 9324049-B2 OR US- 9260253-B2 OR US- 5004400-A OR US- 10711576-B2 OR US- 10695950-B2 OR US- 10669471-B2 OR US- 10627003-B2 OR US- 10184465-B2 OR US- 9739546-B2 OR US- 9706185-B2 OR US- 9482086-B2 OR US- 9051923-B2 OR US- 8795525-B2 OR US- 8763387-B2 OR US- 8506267-B2 OR US- 6765304-B2 OR US-				

		6626646-B2 OR US-5517822-A OR US-6560131-B1 OR US-10740730-B2 OR US-10408031-B2 OR US-10408030-B2 OR US-10221639-B2 OR US-9506333-B2 OR US-9062545-B2 OR US-6985750-B1 OR US-5439066-A OR US-3878884-A).did. AND USPT.dbnm.) OR ((US-20170218727-A1).did. AND DWPI.dbnm.)					
L100	7	((US-9840901-B2 OR US-9061223-B2 OR US-8474521-B2 OR US-5472049-A OR US-10669804-B2).did. AND USPT.dbnm.) OR ((US-20170218727-A1).did. AND DWPI.dbnm.) OR ((US-20130284278-A1).did. AND PGPB.dbnm.)	(USPAT; DERWENT; US-PGPUB)	OR	ON	ON	2022/11/02 12:23 PM
L101	412	(F16L13/141.cpc. F16L33/2076.cpc. F16L25/14.cpc.) AND hose WITH fitting$4 AND fitting$4 WITH diameter	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 12:26 PM
L102	98	(F16L13/141.cpc. F16L33/2076.cpc. F16L25/14.cpc.) AND hose WITH fitting$4 AND fitting$4 WITH diameter AND different$4 WITH diameter$4	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 12:26 PM
L103	0	(F16L13/141.cpc. F16L33/2076.cpc. F16L25/14.cpc.) AND hose WITH fitting$4 AND fitting$4 WITH diameter AND different$4 WITH diameter$4 AND pump$4 AND slurry	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 12:27 PM
L104	8	(F16L13/141.cpc. F16L33/2076.cpc. F16L25/14.cpc.) AND hose WITH fitting$4 AND fitting$4 WITH	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU,	OR	ON	ON	2022/11/02 12:27 PM

		diameter AND different$4 WITH diameter$4 AND pump$4 WITH hose	SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L105	5	(F16L13/141.cpc. F16L33/2076.cpc. F16L25/14.cpc.) AND fracturing AND hose AND pump$4	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 12:32 PM
L106	7	fracturing WITH (conduit hose) WITH pump$4 AND hose WITH fitting$4 AND hose WITH fitting$4 WITH diameter	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 12:34 PM
L107	59	fracturing WITH (conduit hose) WITH pump$4 AND hose WITH (fitting$4 end) WITH diameter	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 12:36 PM
L108	11	(F16L33/2076.cpc. F16L13/141.cpc.) AND F16L25/14.cpc.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 01:08 PM
L109	11751	(F16L33/2076.cpc. F16L13/141.cpc. F16L25/14.cpc.)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 01:09 PM
L110	288	(F16L33/2076.cpc. F16L13/141.cpc. F16L24/14.cpc.) AND E21B$/$.cpc.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 01:09 PM
L111	51	(F16L33/2076.cpc. F16L13/141.cpc. F16L24/14.cpc.) AND	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD,	OR	ON	ON	2022/11/02 01:09 PM

		E21B$/$.cpc. AND hose	DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L112	32	(Artificial Intelligence) More like doc: US-20220107039-A1 Text: (US-11009162-B1 OR CA-3115669-A1 OR US-11208878-B2 OR US-20170037717-A1 OR US-20220018233-A1 OR US-10934824-B2 OR US-20190040727-A1 OR AR-120897-A1 OR CA-3097051-A1 OR US-11035207-B2 OR US-20210262321-A1 OR WO-2019204242-A1 OR US-20190316447-A1 OR US-10036238-B2 OR US-20160273328-A1 OR US-20220034210-A1 OR US-10947829-B2 OR US-9650879-B2 OR US-20220178234-A1 OR US-11066912-B2).did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 01:11 PM
L113	261	hydraulic$4 ADJ fractur$4 AND reduc$4 WITH diameter$1 WITH pressur$4 WITH pump$4	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 01:12 PM
L114	101	hydraulic$4 ADJ fractur$4 AND reduc$4 near5 diameter$1 WITH (hose conduit) AND pressur$4 WITH pump$4	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO,	OR	ON	ON	2022/11/02 01:13 PM

			MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L115	16	(F16L33/2076.cpc. F16L13/141.cpc. F16L24/14.cpc.) AND L5 AND diameter WITH hose	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 01:33 PM
L116	0	(F16L33/2076.cpc. F16L13/141.cpc. F16L24/14.cpc.) AND "4" ADJ inch ADJ diameter near4 hose AND (5 "6") ADJ inch ADJ diameter near4 fitting	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 01:56 PM
L117	0	"4" ADJ inch ADJ diameter near4 hose AND (5 "6") ADJ inch ADJ diameter near4 fitting	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 01:57 PM
L118	0	"4" ADJ inch ADJ diameter near4 hose AND ("5" "6") ADJ inch ADJ diameter near4 fitting	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 01:57 PM
L119	1	"4" ADJ inch near4 hose AND ("5" "6") ADJ inch near4 fitting	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 01:57 PM
L120	13	"4" near2 diameter near4 hose AND ("5" "6") near2 diameter near4 fitting	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 01:57 PM
L121	3594	(F16L33/2076.cpc.)	(US-PGPUB; USPAT;	OR	ON	ON	2022/11/02

			USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				02:14 PM
L122	1405	(F16L33/2076.cpc.) AND diameter	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 02:15 PM
L123	1097	(F16L33/2076.cpc.) AND diameter AND (hose conduit)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 02:15 PM
L124	92	(F16L33/2076.cpc.) AND diameter AND (hose conduit) AND pump$4	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 02:15 PM
L125	104	e21B43/2607.cpc. AND robinson.in.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 02:17 PM
L126	2	"20210198153"	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 02:18 PM
L127	3	"202198953"	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 02:19 PM
L128	535	e21B43/2607.cpc. AND	(US-PGPUB; USPAT;	OR	ON	ON	2022/11/02

		flexibl$3	USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				02:21 PM
L129	3	((US-20200109617-A1 OR US-20160273328-A1 OR US-20190316447-A1).did. AND DWPI.dbnm.)	(DERWENT)	OR	ON	ON	2022/11/02 02:23 PM
L130	3	"17321936"	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 02:23 PM
L131	41	(Artificial Intelligence) Similar to: 17/321,936 with 0 CPC Selections and 0 Text Selections Text: (US-20220107039-A1 OR US-11009162-B1 OR AR-120897-A1 OR US-10598258-B2 OR US-20220018232-A1 OR US-10914155-B2 OR CA-3115650-A1 OR US-20200109616-A1 OR WO-2020081313-A1 OR US-20210396222-A1 OR CA-3114499-A1 OR US-20210396119-A1 OR US-20210396223-A1 OR US-11208878-B2 OR US-20210156240-A1 OR US-20210041009-A1 OR US-20210079902-A1 OR WO-2020076902-A1 OR US-20200109617-A1 OR CA-3115669-A1 OR	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO))	OR	ON	ON	2022/11/02 02:24 PM

		US-20200197883-A1 OR US-11009023-B2 OR US-20200325893-A1 OR US-11255173-B2 OR US-20210140295-A1 OR US-20220056794-A1 OR US-11415125-B2 OR CA-3114005-A1 OR US-11428218-B2 OR WO-2019113147-A1 OR US-20190249754-A1 OR CA-3139970-A1 OR US-20220290549-A1 OR US-10815978-B2 OR US-20190154020-A1 OR WO-2020231483-A1 OR AR-118923-A1 OR CA-3081681-C OR US-20200362681-A1 OR US-20210108631-A1 OR US-20210301815-A1 OR CA-3084596-A1 OR EP-2440784-B1 OR US-20210396121-A1 OR WO-2021262668-A1 OR AU-2017210621-B2 OR AU-2017210621-B9 OR CA-2765155-C OR WO-2021067410-A1 OR AU-2017210621-A1).did.					
L132	42	(Artificial Intelligence) Similar to: 17/321,936 with 0 CPC Selections and 2 Text Selections Text: (US-20220107039-A1 OR US-20210156240-A1 OR US-11009162-B1 OR US-20210140423-A1 OR US-20180156210-A1 OR CA-2987665-A1 OR CA-2987665-C OR US-11181107-B2 OR US-20190154020-A1 OR US-10815978-B2 OR WO-2021138462-A1 OR CA-3162983-A1 OR US-20190234171-A1 OR US-11208878-B2 OR US-20210198989-A1 OR BR-	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO))	OR	ON	ON	2022/11/02 02:28 PM

		122020025350-A2 OR BR-122020025339-A2 OR CA-3115669-A1 OR WO-2020076902-A1 OR US-20210381929-A1 OR US-11125217-B2 OR US-20200109617-A1 OR US-20210017830-A1 OR US-6869274-B2 OR BR-122020025357-A2 OR WO-2020081313-A1 OR CA-3115650-A1 OR US-20200109616-A1 OR US-20170259267-A1 OR US-20190178234-A1 OR CA-3030549-A1 OR WO-2018052398-A1 OR CA-3030549-C OR BR-122020025342-A2 OR US-11421504-B2 OR US-10895138-B2 OR US-10688493-B2 OR CA-2905976-A1 OR US-20160108939-A1 OR US-20200362681-A1 OR US-7090473-B2 OR BR-112013025880-A2 OR CA-2917673-C OR CA-3139970-A1 OR WO-2020231483-A1 OR US-20180080439-A1 OR US-10526862-B2 OR US-8021130-B2 OR US-9297245-B2 OR US-9945374-B2).did.					
L133	140	("1051046" | "1329760" | "1615536" | "2556544" | "2934095" | "3118691" | "3233668" | "3306637" | "3393267" | "3508768" | "3581775" | "3934902" | "3993100" | "4355961" | "4366864" | "4383554" | "4385018" | "4405016" | "4437691" | "4452312" | "4559716" | "4566168" | "4570673" | "4603887" | "4632432" | "4749047" | "4767136" | "4805430" | "4998756" | "5135698" | "5158326" | "5195589" | "5244045" | "5524710" | "5636691" | "5927344" | "6003604" | "6004639" | "6006788" | "6102445" | "6192941" | "6234030"	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/11/02 02:33 PM

		| "6364024" | "6609734" | "6691743" | "6899172" | "7481239" | "7934546" | "8100182" | "8110741" | "8241453" | "8398122" | "8485262" | "8528585" | "8770277" | "8839867" | "8905056" | "8960307" | "8978763" | "9068450" | "9175556" | "9222345" | "9255469" | "9518430" | "9631469" | "9670745" | "9903190" | "9915132" | "9932800" | "10094195" | "10132146" | "10161210" | "10323475" | "10385643" | "10385645" | "10385662" | "10400538" | "10443763" | "10480300" | "10487637" | "20030205378" | "20030205385" | "20040251020" | "20060207763" | "20070125544" | "20070227722" | "20080083539" | "20080277120" | "20090014184" | "20090090515" | "20090145597" | "20090261575" | "20100032031" | "20100051261" | "20100230114" | "20100300672" | "20110030963" | "20110079399" | "20110108275" | "20110114320" | "20110132596" | "20110259584" | "20120152564" | "20120155813" | "20120181015" | "20120181016" | "20120181030" | "20120242081" | "20130284455" | "20140007970" | "20140238683" | "20150083426" | "20150159458" |					

		"20150211342" | "20150275629" | "20150345272" | "20150354313" | "20160186506" | "20160305515" | "20160363242" | "20170175905" | "20170298700" | "20180264604" | "20180291718" | "20190360624" | "20200088021" | "20200131877" | "20200131889" | "20200277845" | "20210010358").pn. OR ("11319757").urpn. AND (PGPB | USPT | USOC).dbnm.					
L134	438	((US-20170145918-A1 OR US-20080264625-A1 OR US-20130284278-A1 OR US-20060065319-A1 OR US-20120181015-A1 OR US-20190316447-A1 OR US-20190292866-A1 OR US-20190245348-A1 OR US-20190211661-A1 OR US-20190203567-A1 OR US-20190178235-A1 OR US-20190169971-A1 OR US-20190162061-A1 OR US-20190128080-A1 OR US-20190120024-A1 OR US-20190112910-A1 OR US-20190100989-A1 OR US-20190063309-A1 OR US-20190003329-A1 OR US-20180320483-A1 OR US-20180245428-A1 OR US-20180216455-A1 OR US-20180156210-A1 OR US-20180038216-A1 OR US-20180028992-A1 OR US-20130025706-A1 OR US-20170328179-A1 OR US-20170314979-A1 OR US-20170021318-	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 02:39 PM

		A1 OR US-20170292513-A1 OR US-20170259227-A1 OR US-20170241221-A1 OR US-20170234250-A1 OR US-20170226842-A1 OR US-20170159570-A1 OR US-20170146189-A1 OR US-20170114625-A1 OR US-20170051732-A1 OR US-20170036872-A1 OR US-20170022807-A1 OR US-20160348479-A1 OR US-20160341281-A1 OR US-20160319650-A1 OR US-20160312108-A1 OR US-20160290563-A1 OR US-20160290114-A1 OR US-20160281484-A1 OR US-20160265457-A1 OR US-20160230525-A1 OR US-20160230524-A1 OR US-20160221220-A1 OR US-20160208595-A1 OR US-20160186531-A1 OR US-20160160889-A1 OR US-20160105022-A1 OR US-20160102537-A1 OR US-20150330172-A1 OR US-20150314225-A1 OR US-20150300336-A1 OR US-20150225113-A1 OR US-20150217672-A1 OR US-20150211512-A1 OR US-20150176386-A1 OR US-20150159911-A1 OR US-20150136043-A1 OR US-20150114652-A1 OR US-20150097504-A1 OR US-20150083426-A1 OR US-20150075778-A1 OR US-20150053426-A1 OR US-20150027712-A1 OR US-20140379300-A1 OR					

		US-20140290768-A1 OR US-20140277772-A1 OR US-20140255214-A1 OR US-20140251623-A1 OR US-20140246211-A1 OR US-20140219824-A1 OR US-20140124162-A1 OR US-20140095114-A1 OR US-20140060658-A1 OR US-20140054965-A1 OR US-20140000899-A1 OR US-20130343858-A1 OR US-20130341029-A1 OR US-20130306322-A1 OR US-20130233542-A1 OR US-20130175039-A1 OR US-20130175038-A1 OR US-20130009469-A1 OR US-20120247783-A1 OR US-20120232728-A1 OR US-20120222865-A1 OR US-20120205400-A1 OR US-20120205301-A1 OR US-20120127635-A1 OR US-20120085541-A1 OR US-20120049625-A1 OR US-20120018016-A1 OR US-20110272158-A1 OR US-20110247878-A1 OR US-20110166046-A1 OR US-20110085924-A1 OR US-20110061855-A1 OR US-20110017468-A1 OR US-20110005757-A1 OR US-20100322802-A1 OR US-20100303655-A1 OR US-20100293973-A1 OR US-20100250139-A1 OR US-20100172202-A1 OR US-20100146981-A1 OR US-20100132949-A1 OR US-20100051272-A1 OR US-20100045109-A1 OR US-20100038907-					

		A1 OR US-20100019574-A1 OR US-20090308602-A1 OR US-20090260826-A1 OR US-20090200035-A1 OR US-20090188181-A1 OR US-20090145611-A1 OR US-20090095482-A1 OR US-20090093317-A1 OR US-20090078410-A1 OR US-20090065299-A1 OR US-20090045782-A1 OR US-20080264649-A1 OR US-20080217024-A1 OR US-20080208478-A1 OR US-20080137266-A1 OR US-20080112802-A1 OR US-20080041596-A1 OR US-20080017369-A1 OR US-20070278140-A1 OR US-20070226089-A1 OR US-20070201305-A1 OR US-20070187163-A1 OR US-20070131410-A1 OR US-20060052903-A1 OR US-20050274508-A1 OR US-20050116541-A1 OR US-20050061548-A1 OR US-20040167738-A1 OR US-20040102109-A1 OR US-20040040746-A1 OR US-20040000077-A1 OR US-20020169523-A1 OR US-20030056514-A1 OR US-20030138327-A1 OR US-20200232454-A1 OR US-20190119096-A1 OR US-20170226838-A1 OR US-20130299167-A1 OR US-20130180722-A1 OR US-20110052423-A1 OR US-20030079875-A1 OR US-20190010793-A1 OR US-20180343125-A1 OR					

		US-20180291713-A1 OR US-20180266412-A1 OR US-20180238147-A1 OR US-20180045331-A1 OR US-20170175516-A1 OR US-20170130743-A1 OR US-20170096885-A1 OR US-20160258267-A1 OR US-20140238683-A1 OR US-20130317750-A1 OR US-20200088152-A1 OR US-20200047141-A1 OR US-20170138171-A1 OR US-20170074076-A1 OR US-20170043280-A1 OR US-20160273456-A1 OR US-20130255271-A1 OR US-20130189629-A1 OR US-20120152716-A1 OR US-20080095644-A1 OR US-20170302218-A1 OR US-20140174691-A1 OR US-20030000759-A1 OR US-20190249527-A1 OR US-20190154020-A1 OR US-20180312738-A1 OR US-20180298731-A1 OR US-20180284817-A1 OR US-20180266217-A1 OR US-20180259080-A1 OR US-20180181830-A1 OR US-20180090914-A1 OR US-20170370639-A1 OR US-20170212535-A1 OR US-20170082033-A1 OR US-20160326853-A1 OR US-20130284455-A1 OR US-20110110793-A1 OR US-20080277120-A1).did. AND PGPB.dbnm.) OR ((US-10669804-B2 OR US-3055682-A OR US-9513055-B1 OR US-9061223-B2 OR US-8091928-B2 OR US-					

		6719900-B2 OR US- 5433243-A OR US- 5230366-A OR US- 2610741-A OR US- 5472049-A OR US- 11009162-B1 OR US- 11090709-B1 OR US- 8752666-B2 OR US- 11090708-B1 OR US- 10132434-B2 OR US- 11319757-B2 OR US- 9068450-B2 OR US- 4603887-A OR US- 8839867-B2 OR US- 4998756-A OR US- 10323475-B2 OR US- 10480300-B2 OR US- 4570673-A OR US- 8978763-B2 OR US- 10260327-B2 OR US- 10246984-B2 OR US- 10378326-B2 OR US- 9915128-B2 OR US- 10280724-B2 OR US- 9103193-B2 OR US- 9995218-B2 OR US- 9970278-B2 OR US- 9893500-B2 OR US- 9745840-B2 OR US- 9650879-B2 OR US- 10020711-B2 OR US- 9534473-B2 OR US- 9840901-B2 OR US- 9140110-B2 OR US- 10119381-B2 OR US- 10407990-B2 OR US- 10232332-B2 OR US- 9650871-B2 OR US- 10393108-B2 OR US- 10254732-B2 OR US- 9410410-B2 OR US- 10036238-B2 OR US- 9587649-B2 OR US- 10008880-B2 OR US- 10227854-B2 OR US- 8997904-B2 OR US- 9963961-B2 OR US- 8789601-B2 OR US- 9738461-B2 OR US- 8534235-B2 OR US- 8154419-B2 OR US- 7845413-B2 OR US- 1656861-A OR US- 1671436-A OR US- 2183364-A OR US- 2220622-A OR US- 2248051-A OR US- 2407796-A OR US-				

		2416848-A OR US- 2753940-A OR US- 3061039-A OR US- 3066503-A OR US- 3302069-A OR US- 3334495-A OR US- 3722595-A OR US- 3764233-A OR US- 3773140-A OR US- 3837179-A OR US- 3849662-A OR US- 3881551-A OR US- 4037431-A OR US- 4100822-A OR US- 4151575-A OR US- 4226299-A OR US- 4265266-A OR US- 4432064-A OR US- 4442665-A OR US- 4456092-A OR US- 4506982-A OR US- 4512387-A OR US- 4529887-A OR US- 4538916-A OR US- 4676063-A OR US- 4759674-A OR US- 4793386-A OR US- 4845981-A OR US- 4922463-A OR US- 5006044-A OR US- 5025861-A OR US- 5050673-A OR US- 5130628-A OR US- 5131472-A OR US- 5172009-A OR US- 5189388-A OR US- 5366324-A OR US- 5422550-A OR US- 5548093-A OR US- 5590976-A OR US- 5655361-A OR US- 5736838-A OR US- 5755096-A OR US- 5790972-A OR US- 5865247-A OR US- 5879137-A OR US- 5894888-A OR US- 5907970-A OR US- 6138764-A OR US- 6142878-A OR US- 6164910-A OR US- 6202702-B1 OR US- 6208098-B1 OR US- 6254462-B1 OR US- 6271637-B1 OR US- 6273193-B1 OR US- 6315523-B1 OR US- 6477852-B2 OR US-					

		6484490-B1 OR US- 6491098-B1 OR US- 6529135-B1 OR US- 6776227-B2 OR US- 6802690-B2 OR US- 6808303-B2 OR US- 6931310-B2 OR US- 6936947-B1 OR US- 7082993-B2 OR US- 7104233-B2 OR US- 7170262-B2 OR US- 7173399-B2 OR US- 7308933-B1 OR US- 7312593-B1 OR US- 7336514-B2 OR US- 7445041-B2 OR US- 7494263-B2 OR US- 7500642-B2 OR US- 7525264-B2 OR US- 7563076-B2 OR US- 7581379-B2 OR US- 7675189-B2 OR US- 7683499-B2 OR US- 7717193-B2 OR US- 7755310-B2 OR US- 7807048-B2 OR US- 7835140-B2 OR US- 7894757-B2 OR US- 7977824-B2 OR US- 7984757-B1 OR US- 8037936-B2 OR US- 8054084-B2 OR US- 8083504-B2 OR US- 7926562-B2 OR US- 8096891-B2 OR US- 8139383-B2 OR US- 8146665-B2 OR US- 8232892-B2 OR US- 8261528-B2 OR US- 8272439-B2 OR US- 8310272-B2 OR US- 8354817-B2 OR US- 8474521-B2 OR US- 8573303-B2 OR US- 8596056-B2 OR US- 8616005-B1 OR US- 8616274-B2 OR US- 8646521-B2 OR US- 8692408-B2 OR US- 8727068-B2 OR US- 8760657-B2 OR US- 8774972-B2 OR US- 8800652-B2 OR US- 8807960-B2 OR US- 8838341-B2 OR US- 8851860-B1 OR US- 8857506-B2 OR US- 8899940-B2 OR US-				

		8905056-B2 OR US-8905138-B2 OR US-9018881-B2 OR US-9051822-B2 OR US-9067182-B2 OR US-9119326-B2 OR US-9160168-B2 OR US-9322239-B2 OR US-9450385-B2 OR US-9611728-B2 OR US-9728354-B2 OR US-9863228-B2 OR US-9932799-B2 OR US-9976351-B2 OR US-10287873-B2 OR US-10309205-B2 OR US-10371012-B2 OR US-10436026-B2 OR US-10302079-B2 OR US-10337308-B2 OR US-10415332-B2 OR US-9909398-B2 OR US-9499335-B2 OR US-9340353-B2 OR US-9324049-B2 OR US-9260253-B2 OR US-5004400-A OR US-10711576-B2 OR US-10695950-B2 OR US-10669471-B2 OR US-10627003-B2 OR US-10184465-B2 OR US-9739546-B2 OR US-9706185-B2 OR US-9482086-B2 OR US-9051923-B2 OR US-8795525-B2 OR US-8763387-B2 OR US-8506267-B2 OR US-6765304-B2 OR US-6626646-B2 OR US-5517822-A OR US-6560131-B1 OR US-10740730-B2 OR US-10408031-B2 OR US-10408030-B2 OR US-10221639-B2 OR US-9506333-B2 OR US-9062545-B2 OR US-6985750-B1 OR US-5439066-A OR US-3878884-A).did. AND USPT.dbnm.) OR ((US-20170218727-A1 OR US-20220107039-A1 OR WO-2012006326-A1 OR US-20210198953-A1 OR					

		US-20190316447-A1 OR US-20160273328-A1 OR US-20200109617-A1).did. AND DWPI.dbnm.) OR ((EP-1262703-A1).did. AND FTDB.dbnm.) OR ((US-3433505-A).did. AND USOC.dbnm.)					
L135	103	L134 AND pump AND (frac$4 ADJ fluid fluid ADJ source)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 02:40 PM
L136	5	L134 AND pump SAME (frac$4 ADJ fluid fluid ADJ source) WITH (hose flexible)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 02:40 PM
L137	15	L134 AND pump SAME (frac$4 ADJ fluid fluid ADJ source) SAME (hose flexible)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 02:40 PM

L138	6	L134 AND pump SAME (frac$4 ADJ fluid fluid ADJ source) SAME (hose flexible) AND diameter$4	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 02:43 PM
L139	144	E21B43/$.cpc. AND pump SAME (frac$4 ADJ fluid fluid ADJ source) SAME (hose flexible) AND diameter$4	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 02:48 PM
L140	13	E21B43/$.cpc. AND pump SAME (frac$4 ADJ fluid fluid ADJ source) SAME (hose flexible) WITH diameter$4	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 02:48 PM
L141	20	E21B43/$.cpc. AND pump SAME ((frack$4 fractur$4 frac$4) ADJ fluid fluid ADJ source) SAME (hose flexible) WITH diameter$4	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL,	OR	ON	ON	2022/11/02 02:48 PM

			NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L142	15	((US-9840901-B2 OR US-9061223-B2 OR US-8474521-B2 OR US-5472049-A OR US-10132434-B2 OR US-9068450-B2 OR US-4603887-A OR US-8839867-B2 OR US-4998756-A OR US-10323475-B2 OR US-10480300-B2 OR US-10669804-B2).did. AND USPT.dbnm.) OR ((US-20170218727-A1 OR WO-2012006326-A1).did. AND DWPI.dbnm.) OR ((US-20130284278-A1).did. AND PGPB.dbnm.)	(USPAT; DERWENT; US-PGPUB)	OR	ON	ON	2022/11/02 02:55 PM
L143	5512	electric$4 WITH (fractur$4 frack$4 hydraulic$4) WITH pump$4 AND (hose flexible ADJ conduit) AND (slurry fluid)	(US-PGPUB; USPAT; DERWENT)	OR	ON	ON	2022/11/02 03:04 PM
L144	816	electric$4 near4 (fractur$4 frack$4 hydraulic$4) near4 pump$4 AND pump$4 WITH (hose flexible ADJ conduit) WITH (slurry fluid)	(US-PGPUB; USPAT; DERWENT)	OR	ON	ON	2022/11/02 03:04 PM
L145	38	electric$4 near4 (fractur$4 frack$4 hydraulic$4) near4 pump$4 AND pump$4 WITH (hose flexible ADJ conduit) WITH (slurry fluid) AND diameter WITH (hose flexible ADJ conduit)	(US-PGPUB; USPAT; DERWENT)	OR	ON	ON	2022/11/02 03:04 PM
L146	6	(fractur$4 frack$4) AND electric$4 near4 (hydraulic$4) near4 pump$4 AND pump$4 WITH (hose flexible ADJ conduit) WITH (slurry fluid) AND diameter WITH (hose	(US-PGPUB; USPAT; DERWENT)	OR	ON	ON	2022/11/02 03:06 PM

		flexible ADJ conduit)					
L147	6	((US-9840901-B2 OR US-8474521-B2 OR US-4603887-A OR US-10480300-B2 OR US-10669804-B2).did. AND USPT.dbnm.) OR ((US-20130284278-A1).did. AND PGPB.dbnm.)	(USPAT; US-PGPUB)	OR	ON	ON	2022/11/02 03:09 PM
L148	1	multi-plunger near3 pump WITH hose WITH fitting	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/02 05:13 PM
L149	1	multi ADJ plunger near3 pump WITH hose WITH fitting	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/02 05:14 PM
L150	2	multi ADJ plunger near3 pump AND hose WITH fitting	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/02 05:14 PM
L151	2	(multiplunger multi-plunger multi ADJ plunger) near3 pump AND hose WITH fitting	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/02 05:14 PM
L152	95	(multiplunger multi-plunger multi ADJ plunger) near3 pump	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/02 05:14 PM
L153	14	(multiplunger multi-plunger multi ADJ plunger) near3 pump AND hose	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/02 05:14 PM
L154	22	(multiplunger multi-plunger multi ADJ plunger) near3 pump AND (fracturing fracking)	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/02 05:15 PM
L155	440	((US-20170145918-A1 OR US-20080264625-A1 OR US-20130284278-A1 OR US-20060065319-A1 OR US-20120181015-A1 OR US-20210102451-A1 OR US-20190316447-A1 OR US-20190292866-A1 OR US-20190245348-A1 OR US-20190211661-A1 OR US-20190203567-A1 OR US-20190178235-A1 OR US-20190169971-A1 OR US-20190162061-A1 OR US-20190128080-A1 OR US-20190120024-A1	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 05:27 PM

		OR US-20190112910-A1 OR US-20190100989-A1 OR US-20190063309-A1 OR US-20190003329-A1 OR US-20180320483-A1 OR US-20180245428-A1 OR US-20180216455-A1 OR US-20180156210-A1 OR US-20180038216-A1 OR US-20180028992-A1 OR US-20130025706-A1 OR US-20170328179-A1 OR US-20170314979-A1 OR US-20170021318-A1 OR US-20170292513-A1 OR US-20170259227-A1 OR US-20170241221-A1 OR US-20170234250-A1 OR US-20170226842-A1 OR US-20170159570-A1 OR US-20170146189-A1 OR US-20170114625-A1 OR US-20170051732-A1 OR US-20170036872-A1 OR US-20170022807-A1 OR US-20160348479-A1 OR US-20160341281-A1 OR US-20160319650-A1 OR US-20160312108-A1 OR US-20160290563-A1 OR US-20160290114-A1 OR US-20160281484-A1 OR US-20160265457-A1 OR US-20160230525-A1 OR US-20160230524-A1 OR US-20160221220-A1 OR US-20160208595-A1 OR US-20160186531-A1 OR US-20160160889-A1 OR US-20160105022-A1 OR US-20160102537-A1 OR US-20150330172-A1 OR US-20150314225-A1 OR US-					

		20150300336-A1 OR US-20150225113-A1 OR US-20150217672-A1 OR US-20150211512-A1 OR US-20150176386-A1 OR US-20150159911-A1 OR US-20150136043-A1 OR US-20150114652-A1 OR US-20150097504-A1 OR US-20150083426-A1 OR US-20150075778-A1 OR US-20150053426-A1 OR US-20150027712-A1 OR US-20140379300-A1 OR US-20140290768-A1 OR US-20140277772-A1 OR US-20140255214-A1 OR US-20140251623-A1 OR US-20140246211-A1 OR US-20140219824-A1 OR US-20140124162-A1 OR US-20140095114-A1 OR US-20140060658-A1 OR US-20140054965-A1 OR US-20140000899-A1 OR US-20130343858-A1 OR US-20130341029-A1 OR US-20130306322-A1 OR US-20130233542-A1 OR US-20130175039-A1 OR US-20130175038-A1 OR US-20130009469-A1 OR US-20120247783-A1 OR US-20120232728-A1 OR US-20120222865-A1 OR US-20120205400-A1 OR US-20120205301-A1 OR US-20120127635-A1 OR US-20120085541-A1 OR US-20120049625-A1 OR US-20120018016-A1 OR US-20110272158-A1 OR US-20110247878-A1 OR US-20110166046-A1					

		OR US-20110085924-A1 OR US-20110061855-A1 OR US-20110017468-A1 OR US-20110005757-A1 OR US-20100322802-A1 OR US-20100303655-A1 OR US-20100293973-A1 OR US-20100250139-A1 OR US-20100172202-A1 OR US-20100146981-A1 OR US-20100132949-A1 OR US-20100051272-A1 OR US-20100045109-A1 OR US-20100038907-A1 OR US-20100019574-A1 OR US-20090308602-A1 OR US-20090260826-A1 OR US-20090200035-A1 OR US-20090188181-A1 OR US-20090145611-A1 OR US-20090095482-A1 OR US-20090093317-A1 OR US-20090078410-A1 OR US-20090065299-A1 OR US-20090045782-A1 OR US-20080264649-A1 OR US-20080217024-A1 OR US-20080208478-A1 OR US-20080137266-A1 OR US-20080112802-A1 OR US-20080041596-A1 OR US-20080017369-A1 OR US-20070278140-A1 OR US-20070226089-A1 OR US-20070201305-A1 OR US-20070187163-A1 OR US-20070131410-A1 OR US-20060052903-A1 OR US-20050274508-A1 OR US-20050116541-A1 OR US-20050061548-A1 OR US-20040167738-A1 OR US-20040102109-A1 OR US-					

		20040040746-A1 OR US-20040000077-A1 OR US-20020169523-A1 OR US-20030056514-A1 OR US-20030138327-A1 OR US-20200232454-A1 OR US-20190119096-A1 OR US-20170226838-A1 OR US-20130299167-A1 OR US-20130180722-A1 OR US-20110052423-A1 OR US-20030079875-A1 OR US-20190010793-A1 OR US-20180343125-A1 OR US-20180291713-A1 OR US-20180266412-A1 OR US-20180238147-A1 OR US-20180045331-A1 OR US-20170175516-A1 OR US-20170130743-A1 OR US-20170096885-A1 OR US-20160258267-A1 OR US-20140238683-A1 OR US-20130317750-A1 OR US-20200088152-A1 OR US-20200047141-A1 OR US-20170138171-A1 OR US-20170074076-A1 OR US-20170043280-A1 OR US-20160273456-A1 OR US-20130255271-A1 OR US-20130189629-A1 OR US-20120152716-A1 OR US-20080095644-A1 OR US-20170302218-A1 OR US-20140174691-A1 OR US-20030000759-A1 OR US-20190249527-A1 OR US-20190154020-A1 OR US-20180312738-A1 OR US-20180298731-A1 OR US-20180284817-A1 OR US-20180266217-A1 OR US-20180259080-A1					

		OR US-20180181830-A1 OR US-20180090914-A1 OR US-20170370639-A1 OR US-20170212535-A1 OR US-20170082033-A1 OR US-20160326853-A1 OR US-20130284455-A1 OR US-20110110793-A1 OR US-20080277120-A1).did. AND PGPB.dbnm.) OR ((US-10669804-B2 OR US-3055682-A OR US-9513055-B1 OR US-9061223-B2 OR US-8091928-B2 OR US-6719900-B2 OR US-5433243-A OR US-5230366-A OR US-2610741-A OR US-5472049-A OR US-11009162-B1 OR US-11090709-B1 OR US-8752666-B2 OR US-11090708-B1 OR US-10132434-B2 OR US-11319757-B2 OR US-9068450-B2 OR US-4603887-A OR US-8839867-B2 OR US-4998756-A OR US-10323475-B2 OR US-10480300-B2 OR US-4570673-A OR US-8978763-B2 OR US-10260327-B2 OR US-10246984-B2 OR US-10378326-B2 OR US-9915128-B2 OR US-10280724-B2 OR US-9103193-B2 OR US-9995218-B2 OR US-9970278-B2 OR US-9893500-B2 OR US-9745840-B2 OR US-9650879-B2 OR US-10020711-B2 OR US-9534473-B2 OR US-9840901-B2 OR US-9140110-B2 OR US-10119381-B2 OR US-10407990-B2 OR US-10232332-B2 OR US-9650871-B2 OR US-10393108-B2 OR US-					

		10254732-B2 OR US- 9410410-B2 OR US- 10036238-B2 OR US- 9587649-B2 OR US- 10008880-B2 OR US- 10227854-B2 OR US- 8997904-B2 OR US- 9963961-B2 OR US- 8789601-B2 OR US- 9738461-B2 OR US- 8534235-B2 OR US- 8154419-B2 OR US- 7845413-B2 OR US- 1656861-A OR US- 1671436-A OR US- 2183364-A OR US- 2220622-A OR US- 2248051-A OR US- 2407796-A OR US- 2416848-A OR US- 2753940-A OR US- 3061039-A OR US- 3066503-A OR US- 3302069-A OR US- 3334495-A OR US- 3722595-A OR US- 3764233-A OR US- 3773140-A OR US- 3837179-A OR US- 3849662-A OR US- 3881551-A OR US- 4037431-A OR US- 4100822-A OR US- 4151575-A OR US- 4226299-A OR US- 4265266-A OR US- 4432064-A OR US- 4442665-A OR US- 4456092-A OR US- 4506982-A OR US- 4512387-A OR US- 4529887-A OR US- 4538916-A OR US- 4676063-A OR US- 4759674-A OR US- 4793386-A OR US- 4845981-A OR US- 4922463-A OR US- 5006044-A OR US- 5025861-A OR US- 5050673-A OR US- 5130628-A OR US- 5131472-A OR US- 5172009-A OR US- 5189388-A OR US- 5366324-A OR US- 5422550-A OR US- 5548093-A OR US-				

		5590976-A OR US- 5655361-A OR US- 5736838-A OR US- 5755096-A OR US- 5790972-A OR US- 5865247-A OR US- 5879137-A OR US- 5894888-A OR US- 5907970-A OR US- 6138764-A OR US- 6142878-A OR US- 6164910-A OR US- 6202702-B1 OR US- 6208098-B1 OR US- 6254462-B1 OR US- 6271637-B1 OR US- 6273193-B1 OR US- 6315523-B1 OR US- 6477852-B2 OR US- 6484490-B1 OR US- 6491098-B1 OR US- 6529135-B1 OR US- 6776227-B2 OR US- 6802690-B2 OR US- 6808303-B2 OR US- 6931310-B2 OR US- 6936947-B1 OR US- 7082993-B2 OR US- 7104233-B2 OR US- 7170262-B2 OR US- 7173399-B2 OR US- 7308933-B1 OR US- 7312593-B1 OR US- 7336514-B2 OR US- 7445041-B2 OR US- 7494263-B2 OR US- 7500642-B2 OR US- 7525264-B2 OR US- 7563076-B2 OR US- 7581379-B2 OR US- 7675189-B2 OR US- 7683499-B2 OR US- 7717193-B2 OR US- 7755310-B2 OR US- 7807048-B2 OR US- 7835140-B2 OR US- 7894757-B2 OR US- 7977824-B2 OR US- 7984757-B1 OR US- 8037936-B2 OR US- 8054084-B2 OR US- 8083504-B2 OR US- 7926562-B2 OR US- 8096891-B2 OR US- 8139383-B2 OR US- 8146665-B2 OR US- 8232892-B2 OR US- 8261528-B2 OR US-				

		8272439-B2 OR US- 8310272-B2 OR US- 8354817-B2 OR US- 8474521-B2 OR US- 8573303-B2 OR US- 8596056-B2 OR US- 8616005-B1 OR US- 8616274-B2 OR US- 8646521-B2 OR US- 8692408-B2 OR US- 8727068-B2 OR US- 8760657-B2 OR US- 8774972-B2 OR US- 8800652-B2 OR US- 8807960-B2 OR US- 8838341-B2 OR US- 8851860-B1 OR US- 8857506-B2 OR US- 8899940-B2 OR US- 8905056-B2 OR US- 8905138-B2 OR US- 9018881-B2 OR US- 9051822-B2 OR US- 9067182-B2 OR US- 9119326-B2 OR US- 9160168-B2 OR US- 9322239-B2 OR US- 9450385-B2 OR US- 9611728-B2 OR US- 9728354-B2 OR US- 9863228-B2 OR US- 9932799-B2 OR US- 9976351-B2 OR US- 10287873-B2 OR US- 10309205-B2 OR US- 10371012-B2 OR US- 10436026-B2 OR US- 10302079-B2 OR US- 10337308-B2 OR US- 10415332-B2 OR US- 9909398-B2 OR US- 9499335-B2 OR US- 9340353-B2 OR US- 9324049-B2 OR US- 9260253-B2 OR US- 5004400-A OR US- 10711576-B2 OR US- 10695950-B2 OR US- 10669471-B2 OR US- 10627003-B2 OR US- 10184465-B2 OR US- 9739546-B2 OR US- 9706185-B2 OR US- 9482086-B2 OR US- 9051923-B2 OR US- 8795525-B2 OR US- 8763387-B2 OR US- 8506267-B2 OR US-				

		6765304-B2 OR US-6626646-B2 OR US-5517822-A OR US-6560131-B1 OR US-10740730-B2 OR US-10408031-B2 OR US-10408030-B2 OR US-10221639-B2 OR US-9506333-B2 OR US-9062545-B2 OR US-6985750-B1 OR US-5439066-A OR US-3878884-A).did. AND USPT.dbnm.) OR ((US-20170218727-A1 OR US-20220107039-A1 OR WO-2012006326-A1 OR US-20210198953-A1 OR US-20190316447-A1 OR US-20160273328-A1 OR US-20200109617-A1 OR US-11009162-B1).did. AND DWPI.dbnm.) OR ((EP-1262703-A1).did. AND FTDB.dbnm.) OR ((US-3433505-A).did. AND USOC.dbnm.)					

PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N1	7	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and pump and hose and fitting and reduc$4 with fitting and hose with fitting and hose with pump	(USPAT)	OR	ON	ON	2021/01/08 09:58 PM
N2	23674	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and pump and hose and fitting and (union shank reduc$3) with fitting and hose with fitting and hose with pump reduc$3 with fitting	(USPAT)	OR	ON	ON	2021/01/08 10:09 PM
N3	0	(F16L33/02.cpc. E21B43/26.cpc.	(USPAT)	OR	ON	ON	2021/01/08 10:09 PM

		F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and pump and hose and fitting and (union shank reduc$3) with fitting and hose with fitting and hose with pump and (reduc$3 with (union shank))					
N74	2	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) AND pump AND hose AND fitting AND (union shank reduc$3) WITH fitting AND hose WITH fitting AND hose WITH pump AND (reduc$3 WITH (union shank))	(US-PGPUB; USPAT)	OR	ON	ON	2023/01/14 08:10 AM

PE2E SEARCH - Search History (Similarity Search)

Ref #	Application Number	Text Selections	CPC Selections
L11	17/321,936	No selections	No selections
L98	17/321,936	No selections	No selections
L131	17/321,936	No selections	No selections
L132	17/321,936	(Specification) Embodiments of the present disclosure present an improvement over existing systems by removing the standard 4" (0.1016 m) supply hoses while maintaining standard 6" connection types by utilizing a particularly designed ferrule. The standard 4" supply hose provides an insufficient volume of fracturing fluid to a pump utilizing in hydraulic fracturing operation. These problems may be compounded when 4" connections are also used. Using a 5" diameter hose supplies more volume, reduces pressure drop, and reduces cavitation and other poor conditions pumps can experience when not supplied adequately. (Specification) Embodiments of the present disclosure include specialty-sized hoses developed in order to allow greater flow/supply to frac pumps (e.g., positive displacement, multi plunger pumps). This increased flow capability reduces cavitation events and prolongs equipment life. Specially selecting a 5" (0.127 m) diameter hose allows for fluid velocity to be maintained above a threshold at which sand particles would begin to fall out and eventually cause a blockage	No selections

		(sand off) the hose itself. In order to utilize this diameter/size hose in a large-scale function, a connection point was developed to enable use of standard 6" (0.1524 m) components, such as but not limited to hammer unions, butterfly valves, and other 6" steel pipe components. Embodiments include a hybrid of 5" hose and 6" end connectors. This then results in an improvement to existing methods of supplying fluid to a positive displacement pump.	

Bibliographic Data

Application No: 17/321,936

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /AARON L LEMBO/ Examiner's Signature | Initials

Title: SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
05/17/2021	166	3679	047158.100090
RULE			

APPLICANTS

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

INVENTORS

Jared Oehring, Houston, TX, UNITED STATES

Brandon Hinderliter, Houston, TX, UNITED STATES

Lon Robinson, Houston, TX, UNITED STATES

Alexander James Christinzio, Houston, TX, UNITED STATES

CONTINUING DATA

This application is a CON of 16728359 12/27/2019 PAT 11009162

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

05/24/2021

STATE OR COUNTRY

UNITED STATES

ADDRESS

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

FILING FEE RECEIVED

$5,140

Amendments to the Specification

Applicant hereby submits a Replacement Specification including a Clean Specification and a Marked Up Specification.

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings of claims in the application:

Listing of Claims:

1. (Cancelled)

2. (Previously Presented) A hydraulic fracturing system for fracturing a subterranean formation, comprising:

an electric powered multi-plunger hydraulic fracturing pump having an inlet and an outlet, the outlet coupled to a well associated with the subterranean formation and powered by at least one electric motor;

a fluid source, coupled to the inlet of the electric powered multi-plunger hydraulic fracturing pump, the fluid source providing a slurry for injection into the subterranean formation;

a hose extending between the fluid source and the electric powered multi-plunger hydraulic fracturing pump, the hose comprising:

a first end, for coupling to the fluid source, having a first diameter;

a second end, for coupling to the inlet of the electric powered multi-plunger hydraulic fracturing pump, having a second diameter; and

a body between the first end and the second end having a third diameter, the third diameter being less than both the first diameter and the second diameter; and

a pair of fittings, a first fitting forming the first end and a second fitting forming the second end, each fitting of the pair of fittings having a shank end for receiving at least a portion of the body and a union for engaging the respective fluid source and electric powered multi-plunger hydraulic fracturing pump.

3. (Previously Presented) The system of claim 2, wherein the third diameter is approximately 5 inches and the second diameter is approximately 6 inches.

4. (Previously Presented) The system of claim 2, wherein each fitting of the pair of fittings further comprises:

a reducer between the union and the shank end.

5. (Previously Presented) The system of claim 4, wherein at least a portion of the reducer extends into a groove formed in the union, the union extending farther laterally than the reducer.

6. (Previously Presented) The system of claim 4, wherein each fitting of the pair of fittings is formed as an integral piece with at least one rigid coupling between at least one of the union, the shank end, and the reducer.

7. (Previously Presented) The system of claim 2, wherein the third diameter is particularly selected based at least in part on a threshold, the threshold corresponding to a drop out rate for the slurry.

8. (Previously Presented) The system of claim 2, wherein the third diameter is particularly selected based at least in part on a pressure drop rate, a damage accumulation rate, or a suggested flow rate.

9. (Previously Presented) The system of claim 2, wherein the third diameter is associated with a second threshold, corresponding to a maximum suggested flow rate, an operating window for the electric powered multi-plunger hydraulic fracturing pump exceeding the maximum suggested flow rate.

10. (Previously Presented) The system of claim 2, further comprising:

a plurality of electric powered multi-plunger hydraulic fracturing pumps, each electric powered multi-plunger hydraulic fracturing pump receiving fluid from the fluid source;

a plurality of hoses having the third diameter; and

a plurality of fittings between respective hoses of the plurality of the hoses and respective electric powered multi-plunger hydraulic fracturing pumps of the plurality of electric powered multi-plunger hydraulic fracturing pumps, each of the electric powered multi-plunger hydraulic fracturing pumps having a connection having the second diameter.

11. (Previously Presented) The system of claim 2, further comprising:

a distribution system, positioned between the well and the electric powered multi-plunger hydraulic fracturing pump, the distribution system collecting the slurry from electric powered multi-plunger hydraulic fracturing pump for injection into the subterranean formation.

12. (Previously Presented) A hydraulic fracturing system for fracturing a subterranean formation, comprising:

an electric powered multi-plunger hydraulic fracturing pump having an inlet and an outlet, the outlet coupled to a well associated with the subterranean formation and powered by at least one electric motor;

a fluid source, coupled to the inlet of the electric powered multi-plunger hydraulic fracturing pump, the fluid source providing a slurry for injection into the subterranean formation;

a hose extending between the fluid source and the electric powered multi-plunger hydraulic fracturing pump, the hose comprising:

a first end, for coupling to the fluid source, having a first diameter;

a second end, for coupling to the inlet of the electric powered multi-plunger hydraulic fracturing pump, having a second diameter; and

a body between the first end and the second end having a third diameter, the third diameter being less than both the first diameter and the second diameter; and

a pair of fittings, wherein a first fitting of the pair of fittings is at the first end and a second fitting of the pair of fittings is at the second end, each fitting of the pair of fittings comprising:

a union arranged at a first fitting end, the union having a union diameter, larger than the first diameter;

a shank end at a second fitting end, the shank end configured to receive at least a portion of the hose, the shank end being securable to at least the portion of the hose, the shank end including an opening to receive the hose; and

a reducer positioned between the union and the shank end, the reducer being welded to the respective union and shank end at each end, the reducer having an

increasing diameter along its axial length, the reducer extending at least partially into the union.

13. (Previously Presented) The system of claim 12, wherein the third diameter is approximately 5 inches and the second diameter is approximately 6 inches.

14. (Previously Presented) The system of claim 12, wherein at least a portion of the reducer extends into a groove formed in the union, the union extending farther laterally than the reducer.

15. (Previously Presented) The system of claim 12, wherein each fitting of the pair of fittings is formed as an integral piece with at least one rigid coupling between at least one of the union, the shank end, and the reducer.

16. (Previously Presented) The system of claim 12, wherein the third diameter is particularly selected based at least in part on a threshold, the threshold corresponding to a drop out rate for the slurry.

17. (Previously Presented) The system of claim 12, wherein the third diameter is particularly selected based at least in part on a pressure drop rate, a damage accumulation rate, or a suggested flow rate.

18. (Previously Presented) The system of claim 12, wherein the third diameter is associated with a second threshold, corresponding to a maximum suggested flow rate, an operating window for the electric powered multi-plunger hydraulic fracturing pump exceeding the maximum suggested flow rate.

19. (Previously Presented) The system of claim 12, further comprising:

a plurality of electric powered multi-plunger hydraulic fracturing pumps, each electric powered multi-plunger hydraulic fracturing pump receiving fluid from the fluid source;

a plurality of hoses having the third diameter; and

a plurality of fittings between respective hoses of the plurality of the hoses and respective electric powered multi-plunger hydraulic fracturing pumps of the plurality of electric powered multi-plunger hydraulic fracturing pumps, each of the electric powered multi-plunger hydraulic fracturing pumps having a connection having the second diameter.

20. (Previously Presented) The system of claim 12, further comprising:

a distribution system, positioned between the well and the electric powered multi-plunger hydraulic fracturing pump, the distribution system collecting the slurry from electric powered multi-plunger hydraulic fracturing pump for injection into the subterranean formation.

21. (Previously Presented) The system of claim 12, further comprising:

a third fitting positioned on a third end of the hose for coupling to a second electric powered multi-plunger hydraulic fracturing pump, having the second diameter.

Remarks

This paper is responsive to the Office Action mailed November 7, 2022. Claims 2-21 were pending before submission of this paper. Claims 1 and 12 are in independent form. The drawings are objected to. Claims 2-21 are allowed.

Reconsideration of the claims in view of the amendments and the following remarks is respectfully requested.

I. Allowable Subject Matter

Applicant thanks the Examiner for indicating claims 2-21 are allowed.

II. Amendments to the Specification

Applicant hereby submits amendments to the specification with Replacement Specifications, including both Clean and Marked Up versions. The amendments add no new matter and are fully supported by the originally filed specification in at least original paragraphs 25-30 and FIGS. 2 and 3. Applicant respectfully requests entry of the amendments.

Specifically, the amendments to the specification are directed toward describing New Figure 2B, which embodies the features of previously submitted FIG. 2 (now FIG. 2A). New paragraphs 28 and 29 describe the fitting 200 previously disclosed in FIG. 2 and the accompanying paragraphs. New reference numerals have been included to identify features such as first and second ends and diameters, among other features. New paragraphs 28 and 29 make reference to specific diameters that were previously disclosed and discussed in the specification as filed. Moreover, new paragraphs 28 and 29 describe a specific embodiment of FIG. 2 in which one or more components are duplicated with the inclusion of a body between the two fittings 200, which was noted in paragraph 25 and shown in FIG. 2.

Additional amendments are directed toward paragraph 11 for modifying the description of the figures in view of new FIG. 2B and also to correct a typographical error in paragraph 31 (previously paragraph 29).

Applicant respectfully submits the amendments add no new matter and requests entry of the amendments.

III. Amendments to the Figures

Applicant hereby submits New Sheet 3/4 and Replacement Sheet 2/4. No new matter is added by way of the amendments. Applicant respectfully requests entry of the amendments.

New Sheet 3/4 (illustrating new FIG. 2B) incorporates features of originally-filed FIG. 2 directed toward the fittings 200. New Sheet 3/4 adds additional reference characters and duplicates the fitting 200 from FIG. 2 to illustrate the connection by a body 222, which was described in paragraph 25 of the original specification.

Replacement Sheet 2/4 adds character "A" to FIG. 2.

Sheets 1/4 and 4/4 have not been modified but for updating the total number of pages for the drawings from 3 to 4.

IV. Objection to the Drawings

The Office Action objects to the drawings as allegedly not showing each features of the claims. Office Action, 2. Specifically, the Office Action contends that "the first end, second end, and body having different diameters, as well as the pair of fittings" is not shown in the drawings. *Id.* Applicant respectfully disagrees at least due to the disclosure of original FIG. 2, but for the sake of advancing prosecution and without acquiescing to the objection, Applicant has submitted new FIG. 2B along with accompanying new paragraphs 28 and 29 to address the objection. As noted, these amendments add no new matter. Applicant respectfully requests entry of the amendments and withdrawal of the objection.

V. Amendment to the claims

Unless otherwise specified or addressed in the remarks section, amendments to the claims are made for purposes of clarity, and are not intended to alter the scope of the claims or limit any equivalents thereof. The amendments are supported by the specification and do not add new matter. In addition, by focusing on specific claims and claim elements in the discussion above, Applicant does not imply that other claim elements are disclosed or suggested by the references.

In addition, any characterizations of claims and/or cited art are being made to facilitate expeditious prosecution of this application. Applicant reserves the right to pursue at a later date any other broader or narrower claims that capture any subject matter supported by the present disclosure, including subject matter found to be specifically disclaimed herein or by another prosecution. Accordingly, reviewers of this or any child or related prosecution history shall not reasonably infer that Applicant has made any disclaimers or disavowals of any subject matter supported by the present disclosure.

VI. Conclusion

In view of the foregoing, Applicant believes all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

Further, the Commissioner is hereby authorized to charge any additional fees or credit any overpayment in connection with this paper to Deposit Account No. 50-1349.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 713-632-1413.

Respectfully submitted,

/Joe Grdinovac/
Joe Grdinovac
Registration No. 72,224

HOGAN LOVELLS US LLP
609 Main Street, Suite 4200
Houston, TX 77002
Tel: 713-632-1400

SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application is a continuation of U.S. Patent Application No. 16/728,359 filed December 27, 2019, titled SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE, the entirety of the disclosure of which is incorporated by reference herein.

BACKGROUND

1. Technical Field

[0002] This disclosure relates generally to hydraulic fracturing and more particularly to systems and methods for fluid supply lines utilized in hydraulic fracturing.

2. Background

[0003] With advancements in technology over the past few decades, the ability to reach unconventional sources of hydrocarbons has tremendously increased. Horizontal drilling and hydraulic fracturing are two such ways that new developments in technology have led to hydrocarbon production from previously unreachable shale formations. Hydraulic fracturing (fracturing) operations typically require powering numerous components in order to recover oil and gas resources from the ground. For example, hydraulic fracturing usually includes pumps that inject fracturing fluid down the wellbore, blenders that mix proppant into the fluid, cranes, wireline units, and many other components that all must perform different functions to carry out fracturing operations.

[0004] Hydraulic fracturing operations often try to increase flow rates through fracturing pumps in order to reduce operational times and save costs. However, typical fracturing systems have established component sizes and non-standard components are challenging to incorporate and may

lead to errors, as operators may be unfamiliar with the new components. One such instance is in fluid flow lines (e.g., hoses) utilize to supply fracturing fluid to the pumps. Many flow lines utilized in the industry have a 4 inch diameter. However, this flow diameter limits fluid inlet into the pumps, which may be undesirable, because pumps operating at lower flow rates and/or pressures than desired may experience premature wear and failures. Moreover, merely increasing hose sizes is not practical because of component fittings on the pump and potential problems with flow rates, as flow rates that drop below a threshold may experience drop out of particulates, leading to blockages and other problems at the well site.

SUMMARY

[0005] Applicant recognized the problems noted above herein and conceived and developed embodiments of systems and methods, according to the present disclosure, for operating electric fracturing pumps.

[0006] In an embodiment, a hydraulic fracturing system for fracturing a subterranean formation includes an electric powered, multi-plunger pump having an inlet and an outlet, the outlet coupled to a well associated with the subterranean formation and powered by at least one electric motor, the electric powered pump configured to pump fluid into a wellbore associated with the well at a high pressure so that the fluid passes from the wellbore into the subterranean formation and fractures the subterranean formation. The system also includes a fluid source, coupled to the inlet of the electric powered pump, the fluid source providing a slurry for injection into the subterranean formation. The system further includes a hose extending between the fluid source and the electric powered pump, the hose being flexible and having a first diameter. The system includes a fitting between the hose and the electric powered pump, the fitting having a first end for receiving the hose at the first diameter and a second end for coupling to the electric powered pump at a second diameter, the second diameter being larger than the first diameter. The system also includes a distribution system,

positioned between the wellbore and the electric powered pump, the distribution system collecting the slurry from electric powered pumps for injection into the subterranean formation.

[0007] In an embodiment, a hydraulic fracturing system for fracturing a subterranean formation includes an electric powered, multi-plunger pump having an inlet and an outlet, the outlet coupled to a well associated with the subterranean formation and powered by at least one electric motor, the electric powered pump configured to pump fluid into a wellbore associated with the well at a high pressure so that the fluid passes from the wellbore into the subterranean formation and fractures the subterranean formation. The system also includes a fluid source, coupled to the inlet of the electric powered pump, the fluid source providing a slurry for injection into the subterranean formation. The system includes a hose extending between the fluid source and the electric powered pump, the hose including a first end, for coupling to the fluid source, having a first diameter, a second end, for coupling to the inlet of the electric powered pump, having a second diameter, and a body between the first end and the second end having a third diameter, the third diameter being less than both the first diameter and the second diameter. The system further includes a pair of fittings, a first fitting forming the first end and a second fitting forming the second end, each fitting of the pair of fittings having a shank end for receiving at least a portion of the body and a union for engaging the respective fluid source and electric powered pump.

[0008] In an embodiment, a method for selecting a hose diameter for a flow line utilized in fracturing operations includes determining a first end connection size is a first diameter. The method also includes determining a second end connection size is a second diameter. The method further includes determining a first flow rate, associated with a first hose diameter, is below a threshold. The method includes determining a second flow rate, associated with a second hose diameter, exceeds the threshold. The method also includes forming the flow line using the second hose diameter.

BRIEF DESCRIPTION OF DRAWINGS

[0009] Some of the features and benefits of the present disclosure having been stated, others will become apparent as the description proceeds when taken in conjunction with the accompanying drawings, in which:

[0010] FIG. 1 is a schematic plan view of an embodiment of a fracturing operation, in accordance with embodiments of the present disclosure;

[0011] FIGS. 2A and 2B are side views ~~is a side view~~ of an embodiment of a fitting, in accordance with embodiments of the present disclosure;

[0012] FIG. 3 is a schematic perspective view of an embodiment of a flow line, in accordance with embodiments of the present disclosure; and

[0013] FIG. 4 is a graphical representation of suction pipe flow rates, in accordance with embodiments of the present disclosure.

[0014] While the disclosure will be described in connection with the preferred embodiments, it will be understood that it is not intended to limit the disclosure to that embodiment. On the contrary, it is intended to cover all alternatives, modifications, and equivalents, as may be included within the spirit and scope of the disclosure as defined by the appended claims.

DETAILED DESCRIPTION

[0015] The method and system of the present disclosure will now be described more fully hereinafter with reference to the accompanying drawings in which embodiments are shown. The method and system of the present disclosure may be in many different forms and should not be construed as limited to the illustrated embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey its scope to those skilled in the art. Like numbers refer to like elements throughout. In an embodiment, usage of

the term "about" includes +/- 5% of the cited magnitude. In an embodiment, usage of the term "substantially" includes +/- 5% of the cited magnitude.

[0016] It is to be further understood that the scope of the present disclosure is not limited to the exact details of construction, operation, exact materials, or embodiments shown and described, as modifications and equivalents will be apparent to one skilled in the art. In the drawings and specification, there have been disclosed illustrative embodiments and, although specific terms are employed, they are used in a generic and descriptive sense only and not for the purpose of limitation.

[0017] When introducing elements of various embodiments of the present disclosure, the articles "a", "an", "the", and "said" are intended to mean that there are one or more of the elements. The terms "comprising", "including", and "having" are intended to be inclusive and mean that there may be additional elements other than the listed elements. Any examples of operating parameters and/or environmental conditions are not exclusive of other parameters/conditions of the disclosed embodiments. Additionally, it should be understood that references to "one embodiment", "an embodiment", “certain embodiments”, or “other embodiments” of the present disclosure are not intended to be interpreted as excluding the existence of additional embodiments that also incorporate the recited features. Furthermore, reference to terms such as “above”, “below”, “upper”, “lower”, “side”, “front”, “back”, or other terms regarding orientation or direction are made with reference to the illustrated embodiments and are not intended to be limiting or exclude other orientations or directions. Additionally, recitations of steps of a method should be understood as being capable of being performed in any order unless specifically stated otherwise. Furthermore, the steps may be performed in series or in parallel unless specifically stated otherwise. Particular dimensions may be referred to herein along with their accompanying abbreviations, including but not limited to: inches (in, ”), meters (m), centimeters (cm), pounds per square inch (PSI), pascals (Pa), feet per second (ft/s), barrels per minute (BPM), and the like.

[0018] Embodiments of the present disclosure include specialty-sized hoses developed in order to allow greater flow/supply to frac pumps (e.g., positive displacement, multi plunger pumps). This increased flow capability reduces cavitation events and prolongs equipment life. Specially selecting a 5" (0.127 m) diameter hose allows for fluid velocity to be maintained above a threshold at which sand particles would begin to fall out and eventually cause a blockage (sand off) the hose itself. In order to utilize this diameter/size hose in a large-scale function, a connection point was developed to enable use of standard 6" (0.1524 m) components, such as but not limited to hammer unions, butterfly valves, and other 6" steel pipe components. Embodiments include a hybrid of 5" hose and 6" end connectors. This then results in an improvement to existing methods of supplying fluid to a positive displacement pump.

[0019] Embodiments of the present disclosure present an improvement over existing systems by removing the standard 4" (0.1016 m) supply hoses while maintaining standard 6" connection types by utilizing a particularly designed ferrule. The standard 4" supply hose provides an insufficient volume of fracturing fluid to a pump utilizing in hydraulic fracturing operation. These problems may be compounded when 4" connections are also used. Using a 5" diameter hose supplies more volume, reduces pressure drop, and reduces cavitation and other poor conditions pumps can experience when not supplied adequately.

[0020] FIG. 1 is a plan schematic view of an embodiment of a hydraulic fracturing system 10 positioned at a well site 12. In the illustrated embodiment, pump units 14, which make up a pumping system 16, are used to pressurize a slurry solution for injection into a wellhead 18. An optional hydration unit 20 receives fluid from a fluid source 22 via a line, such as a tubular, and also receives additives from an additive source 24. In an embodiment, the fluid is water and the additives are mixed together and transferred to a blender unit 26 where proppant from a proppant source 28 may be added to form the slurry solution (e.g., fracturing slurry) which is transferred to the pumping

system 16. The pump units 14 may receive the slurry solution at a first pressure (e.g., 80 psi to 160 psi) and boost the pressure to around 15,000 psi for injection into the wellhead 18. In certain embodiments, the pump units 14 are powered by electric motors.

[0021] After being discharged from the pump system 16, a distribution system 30, such as a missile, receives the slurry solution for injection into the wellhead 18. The distribution system 30 consolidates the slurry solution from each of the pump units 14 and includes discharge piping 32 coupled to the wellhead 18. In this manner, pressurized solution for hydraulic fracturing may be injected into the wellhead 18.

[0022] In the illustrated embodiment, one or more sensors 34, 36 are arranged throughout the hydraulic fracturing system 10 to measure various properties related to fluid flow, vibration, and the like.

[0023] It should be appreciated that while various embodiments of the present disclosure may describe electric motors powering the pump units 14, in embodiments, electrical generation can be supplied by various different options, as well as hybrid options. Hybrid options may include two or more of the following electric generation options: Gas turbine generators with fuel supplied by field gas, CNG, and/or LNG, diesel turbine generators, diesel engine generators, natural gas engine generators, batteries, electrical grids, and the like. Moreover, these electric sources may include a single source type unit or multiple units. For example, there may be one gas turbine generator, two gas turbines generators, two gas turbine generators coupled with one diesel engine generator, and various other configurations.

[0024] In various embodiments, equipment at the well site may utilize 3-phase, 60 Hz, 690V electrical power. However, it should be appreciated that in other embodiments different power specifications may be utilized, such as 4160V or at different frequencies, such as 50 Hz. Accordingly, discussions herein with a particular type of power specification should not be

interpreted as limited only the particularly discussed specification unless otherwise explicitly stated. Furthermore, systems described herein are designed for use in outdoor, oilfield conditions with fluctuations in temperature and weather, such as intense sunlight, wind, rain, snow, dust, and the like. In embodiments, the components are designed in accordance with various industry standards, such as NEMA, ANSI, and NFPA.

[0025] FIG. 2A is a side view of an embodiment of a fitting 200 (e.g., ferrule) that may be utilized with embodiments of the present disclosure to incorporate 5" hoses into systems using 4" hoses and 6" fittings. In the illustrated embodiment, the fitting 200 includes a cutaway region 202 illustrating a coupling location 204 between a union 206 and a stem assembly 208. In the illustrated embodiment, the union 206 is configured to couple to a 6" coupling, for example on a pump. However, as illustrated, the stem assembly 208 includes a reducer 210 and a shank end 212 to receive a 5" hose (not pictured). For example, an end of the hose may be inserted into the shank end 212 and crimped, thereby joining the hose to the fitting 200. As a result, 5" hoses may be utilized in embodiments that include 6" fittings without significantly overhauling and/or modifying existing equipment. As discussed herein, 5" hoses provide numerous advantages including reduced pressure drop, greater capacity, and flow velocities greater than a threshold level corresponding to particulate drop out.

[0026] In the illustrated embodiment, various rigid couplings 214 are included along the fitting 200, for example, as welds utilizing to secure one or more components together. For example, there is a rigid coupling 214 between the union 206 and the reducer 210, as well as a rigid coupling 214 between the reducer 210 and the shank end 214. Accordingly, the components forming the fitting 200 may be particularly selected, based on one or more properties, for use with fracturing operations. For example, different fittings 200 may include different components. By way of example only, the union 206 may be replaced with a flanged end connection or the like.

[0027] Embodiments of the present disclosure that utilize the fitting 200 provide improved operations at a well site at least because greater volumes of fluid may be provided to fracturing pumps while maintaining flow rates above a threshold amount where particulates begin to drop out of the flow. For example, a 5" hose may meet rate demands while maintaining flow velocities at sufficient levels to reduce the likelihood of drop out. In contrast, a 4" hose may not meet rate demands and a 6" hose may not maintain flow velocities above the threshold for drop out. Moreover, the fitting 200 provides easy integration into existing systems without overhauling expensive equipment. For example, it may be costly to overhaul inlet piping on a fracturing pump, so much so, that it may be cost prohibitive to do so. Additionally, existing field equipment may be configured with certain specifications and include sunk costs, leading producers and operators to be reluctant to change. However, utilizing the fitting 200 enables existing equipment to remain in operation while providing improved operations.

[0028] FIG. 2B is a side view of an embodiment of a hose assembly 220 (e.g., hose) that may incorporate one or more features of FIGS. 1 and 2A. By way of example, the hose assembly 220 may form at least a portion of a flow line, such as a flow line between a source and a pump, a pump and a manifold, or the like. This example illustrates fittings 200 from FIG. 2A and further includes a body 222 (e.g., hose, hose portion), which is noted in FIG. 2A as not being shown but contemplated extending from the shank end 212, extending between a first fitting 200A and a second fitting 200B, which may be referred to as a pair of fittings on each end of the body 222. In at least one embodiment, the first fitting 200A is coupled at and/or at least partially forms a first end 224 and the second fitting 200B is coupled at and/or at least partially forms a second end 226. As described herein, diameters associated with portions of the fittings 200A, 200B may be different from diameters associated with portions of the body 222.

~~[0027]~~**[0029]** In at least one embodiment, the first fitting 200A at the first end 224 includes a first diameter 228 and the second fitting 200B at the second end 226 includes a second diameter 230. The first diameter 228 and the second diameter 230 may be equal in various embodiments. As noted herein, the first diameter 228 and/or the second diameter 230 may be approximately 6". In at least one embodiment, the first diameter 228 is greater than the second diameter 230. In at least one embodiment, the first diameter 228 is less than the second diameter 230. As shown in FIG. 2B, as discussed herein, a third diameter 232 is associated with the body 222. In this embodiment, the third diameter 232 is smaller than the first diameter 228 and the second diameter 230. For example, as noted herein, the third diameter 232 may be approximately 5" while the first diameter 228 and/or the second diameter 230 is approximately 6". In at least one embodiment, the third diameter 232 may be equal to and/or greater than the first diameter 228. In at least one embodiment, the third diameter 232 may be equal to and/or greater than the second diameter 230.

~~[0028]~~**[0030]** FIG. 3 is a schematic perspective view of an embodiment of a portion of a flow line 300 including the fitting 200. In the illustrated embodiment, the flow line 300 includes connections 302 for coupling to mating 6" connections. However, due to the inclusion of the fitting 200, a 5" flow line may be incorporated into the design. The fitting 200, as noted above includes a transition from the 5" line to a 6" connection, thereby enabling use with the illustrated flow line 300. Advantageously, the flow line 300 may continue to be used in wellbore operations without modifications, which may reduce costs to operators with respect to obtaining new equipment for jobs.

~~[0029]~~**[0031]** As noted above, embodiments of the present disclosure provide advantages over existing systems that either utilize flow lines having diameters that are too small to provide sufficient capacity or are too large to maintain fluid velocities above threshold levels. Embodiments of the present disclosure overcome these problems by providing more volume, reducing drop in pressure,

and reducing a likelihood of cavitation and other ~~unhealthly~~ unhealthy pump conditions, such as starving. By way of example, frac slurry often consists of sand media also known as proppant, at low fluid velocities this proppant can begin to fall out of suspension. Some industry data notes that sand fall out begins at 2.21ft/sec, which equates to 3.2 BPM in a 5" hose. Sand fall out is substantial at 1.72 ft/sec, which equates to 2.2 BPM in a 5" hoses. As a result, systems may be deployed to ensure that flow rates are maintained above these levels (which may be set as the thresholds) during operation.

~~[0030]~~[0032] Furthermore, embodiments of the present disclosure improve existing systems by reducing damage accumulation rates due to the improved flow characteristics associated with the 5" hose when compared to the 4" hose of existing systems. For example, a damage accumulate rate associated with the 5" hose may be less than the 4" hose and may increase at a lower rate as flow rate increases. Damage accumulation may be a factor, at least in part, on flow velocities, where a small diameter pipe will have greater velocities than a larger diameter pipe.

~~[0031]~~[0033] FIG. 4 is a graphical representation 400 illustrating pump flow rates and respective suction piping sizes. The x-axis 402 corresponds to suction pipe diameter (in inches) and the y-axis 404 corresponds to flow rate (in BPM). An operational window 406 is provided indicative of typical ranges where fracturing operations may occur. In this embodiment, the operational widow 406 extends from approximately 1 BPM to approximately 7 BPM.

~~[0032]~~[0034] Each respective suction pipe diameter includes a threshold flow rate, which may be obtained through experimental procedures and/or reference materials. For example, a 4" suction pipe illustrated at 408 has a threshold 410 of approximately 4.3 BPM, a 5" suction pipe illustrated at 412 has a threshold 414 of approximately 5.5 BPM, and a 6" suction pipe illustrated at 416 has a threshold 418 of approximately 6.5 BPM. The operational window 406 includes a portion that exceeds each of the illustrated thresholds 410, 414, 418.

~~[0033]~~[0035] Operations using the 4" suction pipe 408 include an operating range that is approximately 40% larger than the threshold 410. As a result, there is a high likelihood that operations will exceed the threshold due to demands to supply additional fluid for fracturing operations. Similarly, operations using the 5" suction pipe 412 and the 6" suction pipe 416 also exceed threshold 414, 418 by approximately 22% and 7%, respectively. The instant application has identified that while the 6" suction pipe 416 enables the largest flow rate, that problems associated with fluid velocities and drop out make the 6" suction pipe 416 undesirable. Accordingly, embodiments may incorporate the 5" suction pipe 412, which provides significant improvements over the 4" suction pipe 408 while also reducing the likelihood of drop out. The 5" suction pipe 412 also has less pressure drop, when compared to the 4" suction pipe 408, providing an additional improvement over existing configurations.

~~[0034]~~[0036] The present disclosure described herein, therefore, is well adapted to carry out the objects and attain the ends and advantages mentioned, as well as others inherent therein. While a presently preferred embodiment of the disclosure has been given for purposes of disclosure, numerous changes exist in the details of procedures for accomplishing the desired results. These and other similar modifications will readily suggest themselves to those skilled in the art, and are intended to be encompassed within the spirit of the present disclosure disclosed herein and the scope of the appended claims.

SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application is a continuation of U.S. Patent Application No. 16/728,359 filed December 27, 2019, titled SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE, the entirety of the disclosure of which is incorporated by reference herein.

BACKGROUND

1. Technical Field

[0002] This disclosure relates generally to hydraulic fracturing and more particularly to systems and methods for fluid supply lines utilized in hydraulic fracturing.

2. Background

[0003] With advancements in technology over the past few decades, the ability to reach unconventional sources of hydrocarbons has tremendously increased. Horizontal drilling and hydraulic fracturing are two such ways that new developments in technology have led to hydrocarbon production from previously unreachable shale formations. Hydraulic fracturing (fracturing) operations typically require powering numerous components in order to recover oil and gas resources from the ground. For example, hydraulic fracturing usually includes pumps that inject fracturing fluid down the wellbore, blenders that mix proppant into the fluid, cranes, wireline units, and many other components that all must perform different functions to carry out fracturing operations.

[0004] Hydraulic fracturing operations often try to increase flow rates through fracturing pumps in order to reduce operational times and save costs. However, typical fracturing systems have established component sizes and non-standard components are challenging to incorporate and may

lead to errors, as operators may be unfamiliar with the new components. One such instance is in fluid flow lines (e.g., hoses) utilize to supply fracturing fluid to the pumps. Many flow lines utilized in the industry have a 4 inch diameter. However, this flow diameter limits fluid inlet into the pumps, which may be undesirable, because pumps operating at lower flow rates and/or pressures than desired may experience premature wear and failures. Moreover, merely increasing hose sizes is not practical because of component fittings on the pump and potential problems with flow rates, as flow rates that drop below a threshold may experience drop out of particulates, leading to blockages and other problems at the well site.

SUMMARY

[0005] Applicant recognized the problems noted above herein and conceived and developed embodiments of systems and methods, according to the present disclosure, for operating electric fracturing pumps.

[0006] In an embodiment, a hydraulic fracturing system for fracturing a subterranean formation includes an electric powered, multi-plunger pump having an inlet and an outlet, the outlet coupled to a well associated with the subterranean formation and powered by at least one electric motor, the electric powered pump configured to pump fluid into a wellbore associated with the well at a high pressure so that the fluid passes from the wellbore into the subterranean formation and fractures the subterranean formation. The system also includes a fluid source, coupled to the inlet of the electric powered pump, the fluid source providing a slurry for injection into the subterranean formation. The system further includes a hose extending between the fluid source and the electric powered pump, the hose being flexible and having a first diameter. The system includes a fitting between the hose and the electric powered pump, the fitting having a first end for receiving the hose at the first diameter and a second end for coupling to the electric powered pump at a second diameter, the second diameter being larger than the first diameter. The system also includes a

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distribution system, positioned between the wellbore and the electric powered pump, the distribution system collecting the slurry from electric powered pumps for injection into the subterranean formation.

[0007] In an embodiment, a hydraulic fracturing system for fracturing a subterranean formation includes an electric powered, multi-plunger pump having an inlet and an outlet, the outlet coupled to a well associated with the subterranean formation and powered by at least one electric motor, the electric powered pump configured to pump fluid into a wellbore associated with the well at a high pressure so that the fluid passes from the wellbore into the subterranean formation and fractures the subterranean formation. The system also includes a fluid source, coupled to the inlet of the electric powered pump, the fluid source providing a slurry for injection into the subterranean formation. The system includes a hose extending between the fluid source and the electric powered pump, the hose including a first end, for coupling to the fluid source, having a first diameter, a second end, for coupling to the inlet of the electric powered pump, having a second diameter, and a body between the first end and the second end having a third diameter, the third diameter being less than both the first diameter and the second diameter. The system further includes a pair of fittings, a first fitting forming the first end and a second fitting forming the second end, each fitting of the pair of fittings having a shank end for receiving at least a portion of the body and a union for engaging the respective fluid source and electric powered pump.

[0008] In an embodiment, a method for selecting a hose diameter for a flow line utilized in fracturing operations includes determining a first end connection size is a first diameter. The method also includes determining a second end connection size is a second diameter. The method further includes determining a first flow rate, associated with a first hose diameter, is below a threshold. The method includes determining a second flow rate, associated with a second hose

diameter, exceeds the threshold. The method also includes forming the flow line using the second hose diameter.

BRIEF DESCRIPTION OF DRAWINGS

[0009] Some of the features and benefits of the present disclosure having been stated, others will become apparent as the description proceeds when taken in conjunction with the accompanying drawings, in which:

[0010] FIG. 1 is a schematic plan view of an embodiment of a fracturing operation, in accordance with embodiments of the present disclosure;

[0011] FIGS. 2A and 2B are side views of an embodiment of a fitting, in accordance with embodiments of the present disclosure;

[0012] FIG. 3 is a schematic perspective view of an embodiment of a flow line, in accordance with embodiments of the present disclosure; and

[0013] FIG. 4 is a graphical representation of suction pipe flow rates, in accordance with embodiments of the present disclosure.

[0014] While the disclosure will be described in connection with the preferred embodiments, it will be understood that it is not intended to limit the disclosure to that embodiment. On the contrary, it is intended to cover all alternatives, modifications, and equivalents, as may be included within the spirit and scope of the disclosure as defined by the appended claims.

DETAILED DESCRIPTION

[0015] The method and system of the present disclosure will now be described more fully hereinafter with reference to the accompanying drawings in which embodiments are shown. The method and system of the present disclosure may be in many different forms and should not be construed as limited to the illustrated embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey its scope to

those skilled in the art. Like numbers refer to like elements throughout. In an embodiment, usage of the term "about" includes +/- 5% of the cited magnitude. In an embodiment, usage of the term "substantially" includes +/- 5% of the cited magnitude.

[0016] It is to be further understood that the scope of the present disclosure is not limited to the exact details of construction, operation, exact materials, or embodiments shown and described, as modifications and equivalents will be apparent to one skilled in the art. In the drawings and specification, there have been disclosed illustrative embodiments and, although specific terms are employed, they are used in a generic and descriptive sense only and not for the purpose of limitation.

[0017] When introducing elements of various embodiments of the present disclosure, the articles "a", "an", "the", and "said" are intended to mean that there are one or more of the elements. The terms "comprising", "including", and "having" are intended to be inclusive and mean that there may be additional elements other than the listed elements. Any examples of operating parameters and/or environmental conditions are not exclusive of other parameters/conditions of the disclosed embodiments. Additionally, it should be understood that references to "one embodiment", "an embodiment", “certain embodiments”, or “other embodiments” of the present disclosure are not intended to be interpreted as excluding the existence of additional embodiments that also incorporate the recited features. Furthermore, reference to terms such as “above”, “below”, “upper”, “lower”, “side”, “front”, “back”, or other terms regarding orientation or direction are made with reference to the illustrated embodiments and are not intended to be limiting or exclude other orientations or directions. Additionally, recitations of steps of a method should be understood as being capable of being performed in any order unless specifically stated otherwise. Furthermore, the steps may be performed in series or in parallel unless specifically stated otherwise. Particular dimensions may be referred to herein along with their accompanying

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abbreviations, including but not limited to: inches (in, ”), meters (m), centimeters (cm), pounds per square inch (PSI), pascals (Pa), feet per second (ft/s), barrels per minute (BPM), and the like.

[0018] Embodiments of the present disclosure include specialty-sized hoses developed in order to allow greater flow/supply to frac pumps (e.g., positive displacement, multi plunger pumps). This increased flow capability reduces cavitation events and prolongs equipment life. Specially selecting a 5” (0.127 m) diameter hose allows for fluid velocity to be maintained above a threshold at which sand particles would begin to fall out and eventually cause a blockage (sand off) the hose itself. In order to utilize this diameter/size hose in a large-scale function, a connection point was developed to enable use of standard 6” (0.1524 m) components, such as but not limited to hammer unions, butterfly valves, and other 6” steel pipe components. Embodiments include a hybrid of 5” hose and 6” end connectors. This then results in an improvement to existing methods of supplying fluid to a positive displacement pump.

[0019] Embodiments of the present disclosure present an improvement over existing systems by removing the standard 4” (0.1016 m) supply hoses while maintaining standard 6” connection types by utilizing a particularly designed ferrule. The standard 4” supply hose provides an insufficient volume of fracturing fluid to a pump utilizing in hydraulic fracturing operation. These problems may be compounded when 4” connections are also used. Using a 5” diameter hose supplies more volume, reduces pressure drop, and reduces cavitation and other poor conditions pumps can experience when not supplied adequately.

[0020] FIG. 1 is a plan schematic view of an embodiment of a hydraulic fracturing system 10 positioned at a well site 12. In the illustrated embodiment, pump units 14, which make up a pumping system 16, are used to pressurize a slurry solution for injection into a wellhead 18. An optional hydration unit 20 receives fluid from a fluid source 22 via a line, such as a tubular, and also receives additives from an additive source 24. In an embodiment, the fluid is water and the

additives are mixed together and transferred to a blender unit 26 where proppant from a proppant source 28 may be added to form the slurry solution (e.g., fracturing slurry) which is transferred to the pumping system 16. The pump units 14 may receive the slurry solution at a first pressure (e.g., 80 psi to 160 psi) and boost the pressure to around 15,000 psi for injection into the wellhead 18. In certain embodiments, the pump units 14 are powered by electric motors.

[0021] After being discharged from the pump system 16, a distribution system 30, such as a missile, receives the slurry solution for injection into the wellhead 18. The distribution system 30 consolidates the slurry solution from each of the pump units 14 and includes discharge piping 32 coupled to the wellhead 18. In this manner, pressurized solution for hydraulic fracturing may be injected into the wellhead 18.

[0022] In the illustrated embodiment, one or more sensors 34, 36 are arranged throughout the hydraulic fracturing system 10 to measure various properties related to fluid flow, vibration, and the like.

[0023] It should be appreciated that while various embodiments of the present disclosure may describe electric motors powering the pump units 14, in embodiments, electrical generation can be supplied by various different options, as well as hybrid options. Hybrid options may include two or more of the following electric generation options: Gas turbine generators with fuel supplied by field gas, CNG, and/or LNG, diesel turbine generators, diesel engine generators, natural gas engine generators, batteries, electrical grids, and the like. Moreover, these electric sources may include a single source type unit or multiple units. For example, there may be one gas turbine generator, two gas turbines generators, two gas turbine generators coupled with one diesel engine generator, and various other configurations.

[0024] In various embodiments, equipment at the well site may utilize 3-phase, 60 Hz, 690V electrical power. However, it should be appreciated that in other embodiments different power

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specifications may be utilized, such as 4160V or at different frequencies, such as 50 Hz. Accordingly, discussions herein with a particular type of power specification should not be interpreted as limited only the particularly discussed specification unless otherwise explicitly stated. Furthermore, systems described herein are designed for use in outdoor, oilfield conditions with fluctuations in temperature and weather, such as intense sunlight, wind, rain, snow, dust, and the like. In embodiments, the components are designed in accordance with various industry standards, such as NEMA, ANSI, and NFPA.

[0025] FIG. 2A is a side view of an embodiment of a fitting 200 (e.g., ferrule) that may be utilized with embodiments of the present disclosure to incorporate 5" hoses into systems using 4" hoses and 6" fittings. In the illustrated embodiment, the fitting 200 includes a cutaway region 202 illustrating a coupling location 204 between a union 206 and a stem assembly 208. In the illustrated embodiment, the union 206 is configured to couple to a 6" coupling, for example on a pump. However, as illustrated, the stem assembly 208 includes a reducer 210 and a shank end 212 to receive a 5" hose (not pictured). For example, an end of the hose may be inserted into the shank end 212 and crimped, thereby joining the hose to the fitting 200. As a result, 5" hoses may be utilized in embodiments that include 6" fittings without significantly overhauling and/or modifying existing equipment. As discussed herein, 5" hoses provide numerous advantages including reduced pressure drop, greater capacity, and flow velocities greater than a threshold level corresponding to particulate drop out.

[0026] In the illustrated embodiment, various rigid couplings 214 are included along the fitting 200, for example, as welds utilizing to secure one or more components together. For example, there is a rigid coupling 214 between the union 206 and the reducer 210, as well as a rigid coupling 214 between the reducer 210 and the shank end 214. Accordingly, the components forming the fitting 200 may be particularly selected, based on one or more properties, for use with fracturing

operations. For example, different fittings 200 may include different components. By way of example only, the union 206 may be replaced with a flanged end connection or the like.

[0027] Embodiments of the present disclosure that utilize the fitting 200 provide improved operations at a well site at least because greater volumes of fluid may be provided to fracturing pumps while maintaining flow rates above a threshold amount where particulates begin to drop out of the flow. For example, a 5" hose may meet rate demands while maintaining flow velocities at sufficient levels to reduce the likelihood of drop out. In contrast, a 4" hose may not meet rate demands and a 6" hose may not maintain flow velocities above the threshold for drop out. Moreover, the fitting 200 provides easy integration into existing systems without overhauling expensive equipment. For example, it may be costly to overhaul inlet piping on a fracturing pump, so much so, that it may be cost prohibitive to do so. Additionally, existing field equipment may be configured with certain specifications and include sunk costs, leading producers and operators to be reluctant to change. However, utilizing the fitting 200 enables existing equipment to remain in operation while providing improved operations.

[0028] FIG. 2B is a side view of an embodiment of a hose assembly 220 (e.g., hose) that may incorporate one or more features of FIGS. 1 and 2A. By way of example, the hose assembly 220 may form at least a portion of a flow line, such as a flow line between a source and a pump, a pump and a manifold, or the like. This example illustrates fittings 200 from FIG. 2A and further includes a body 222 (e.g., hose, hose portion), which is noted in FIG. 2A as not being shown but contemplated extending from the shank end 212, extending between a first fitting 200A and a second fitting 200B, which may be referred to as a pair of fittings on each end of the body 222. In at least one embodiment, the first fitting 200A is coupled at and/or at least partially forms a first end 224 and the second fitting 200B is coupled at and/or at least partially forms a second end 226.

As described herein, diameters associated with portions of the fittings 200A, 200B may be different from diameters associated with portions of the body 222.

[0029] In at least one embodiment, the first fitting 200A at the first end 224 includes a first diameter 228 and the second fitting 200B at the second end 226 includes a second diameter 230. The first diameter 228 and the second diameter 230 may be equal in various embodiments. As noted herein, the first diameter 228 and/or the second diameter 230 may be approximately 6". In at least one embodiment, the first diameter 228 is greater than the second diameter 230. In at least one embodiment, the first diameter 228 is less than the second diameter 230. As shown in FIG. 2B, as discussed herein, a third diameter 232 is associated with the body 222. In this embodiment, the third diameter 232 is smaller than the first diameter 228 and the second diameter 230. For example, as noted herein, the third diameter 232 may be approximately 5" while the first diameter 228 and/or the second diameter 230 is approximately 6". In at least one embodiment, the third diameter 232 may be equal to and/or greater than the first diameter 228. In at least one embodiment, the third diameter 232 may be equal to and/or greater than the second diameter 230.

[0030] FIG. 3 is a schematic perspective view of an embodiment of a portion of a flow line 300 including the fitting 200. In the illustrated embodiment, the flow line 300 includes connections 302 for coupling to mating 6" connections. However, due to the inclusion of the fitting 200, a 5" flow line may be incorporated into the design. The fitting 200, as noted above includes a transition from the 5" line to a 6" connection, thereby enabling use with the illustrated flow line 300. Advantageously, the flow line 300 may continue to be used in wellbore operations without modifications, which may reduce costs to operators with respect to obtaining new equipment for jobs.

[0031] As noted above, embodiments of the present disclosure provide advantages over existing systems that either utilize flow lines having diameters that are too small to provide sufficient

capacity or are too large to maintain fluid velocities above threshold levels. Embodiments of the present disclosure overcome these problems by providing more volume, reducing drop in pressure, and reducing a likelihood of cavitation and other unhealthy pump conditions, such as starving. By way of example, frac slurry often consists of sand media also known as proppant, at low fluid velocities this proppant can begin to fall out of suspension. Some industry data notes that sand fall out begins at 2.21ft/sec, which equates to 3.2 BPM in a 5" hose. Sand fall out is substantial at 1.72 ft/sec, which equates to 2.2 BPM in a 5" hoses. As a result, systems may be deployed to ensure that flow rates are maintained above these levels (which may be set as the thresholds) during operation.

[0032] Furthermore, embodiments of the present disclosure improve existing systems by reducing damage accumulation rates due to the improved flow characteristics associated with the 5" hose when compared to the 4" hose of existing systems. For example, a damage accumulate rate associated with the 5" hose may be less than the 4" hose and may increase at a lower rate as flow rate increases. Damage accumulation may be a factor, at least in part, on flow velocities, where a small diameter pipe will have greater velocities than a larger diameter pipe.

[0033] FIG. 4 is a graphical representation 400 illustrating pump flow rates and respective suction piping sizes. The x-axis 402 corresponds to suction pipe diameter (in inches) and the y-axis 404 corresponds to flow rate (in BPM). An operational window 406 is provided indicative of typical ranges where fracturing operations may occur. In this embodiment, the operational widow 406 extends from approximately 1 BPM to approximately 7 BPM.

[0034] Each respective suction pipe diameter includes a threshold flow rate, which may be obtained through experimental procedures and/or reference materials. For example, a 4" suction pipe illustrated at 408 has a threshold 410 of approximately 4.3 BPM, a 5" suction pipe illustrated at 412 has a threshold 414 of approximately 5.5 BPM, and a 6" suction pipe illustrated at 416 has

a threshold 418 of approximately 6.5 BPM. The operational window 406 includes a portion that exceeds each of the illustrated thresholds 410, 414, 418.

[0035] Operations using the 4" suction pipe 408 include an operating range that is approximately 40% larger than the threshold 410. As a result, there is a high likelihood that operations will exceed the threshold due to demands to supply additional fluid for fracturing operations. Similarly, operations using the 5" suction pipe 412 and the 6" suction pipe 416 also exceed threshold 414, 418 by approximately 22% and 7%, respectively. The instant application has identified that while the 6" suction pipe 416 enables the largest flow rate, that problems associated with fluid velocities and drop out make the 6" suction pipe 416 undesirable. Accordingly, embodiments may incorporate the 5" suction pipe 412, which provides significant improvements over the 4" suction pipe 408 while also reducing the likelihood of drop out. The 5" suction pipe 412 also has less pressure drop, when compared to the 4" suction pipe 408, providing an additional improvement over existing configurations.

[0036] The present disclosure described herein, therefore, is well adapted to carry out the objects and attain the ends and advantages mentioned, as well as others inherent therein. While a presently preferred embodiment of the disclosure has been given for purposes of disclosure, numerous changes exist in the details of procedures for accomplishing the desired results. These and other similar modifications will readily suggest themselves to those skilled in the art, and are intended to be encompassed within the spirit of the present disclosure disclosed herein and the scope of the appended claims.

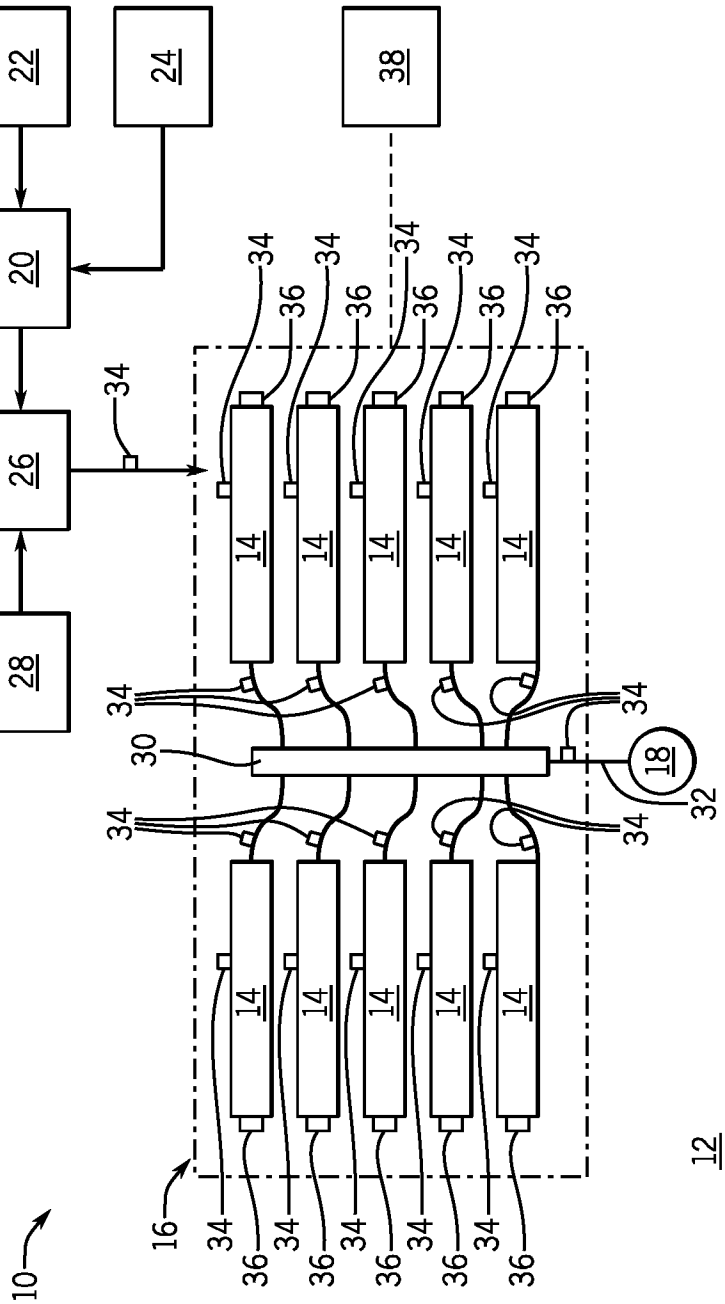


FIG. 1

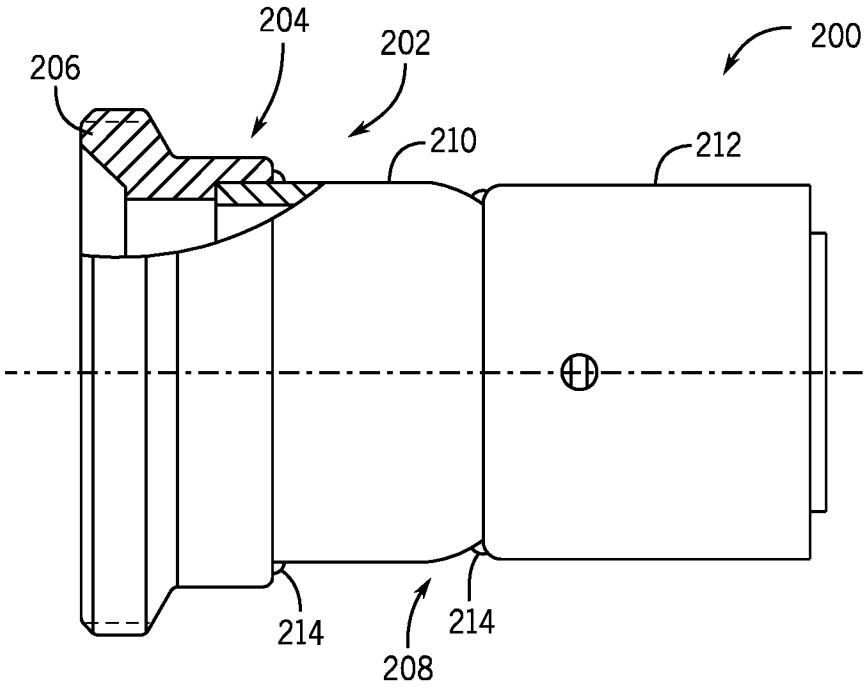


FIG. 2A

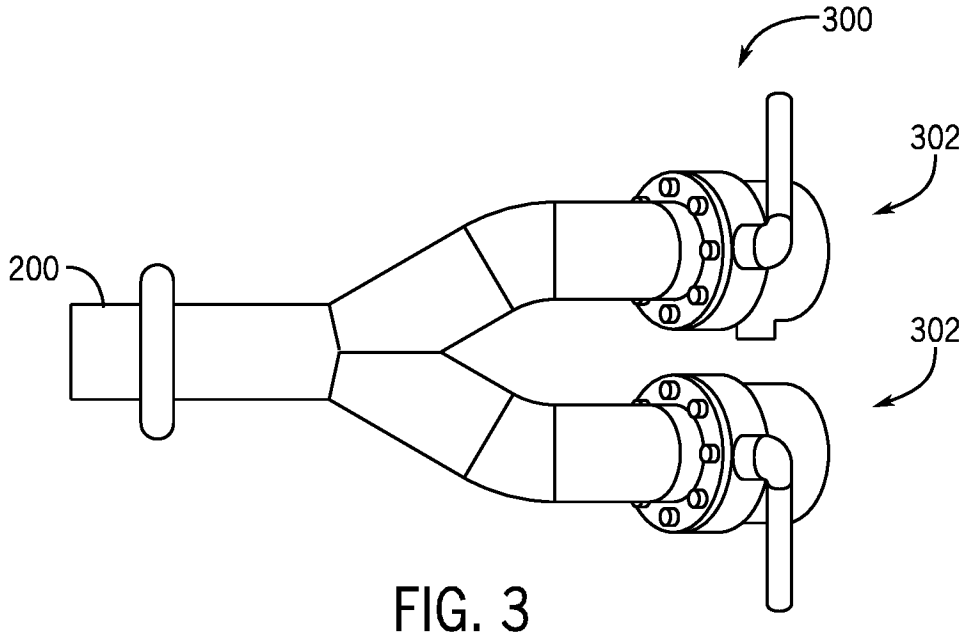


FIG. 3

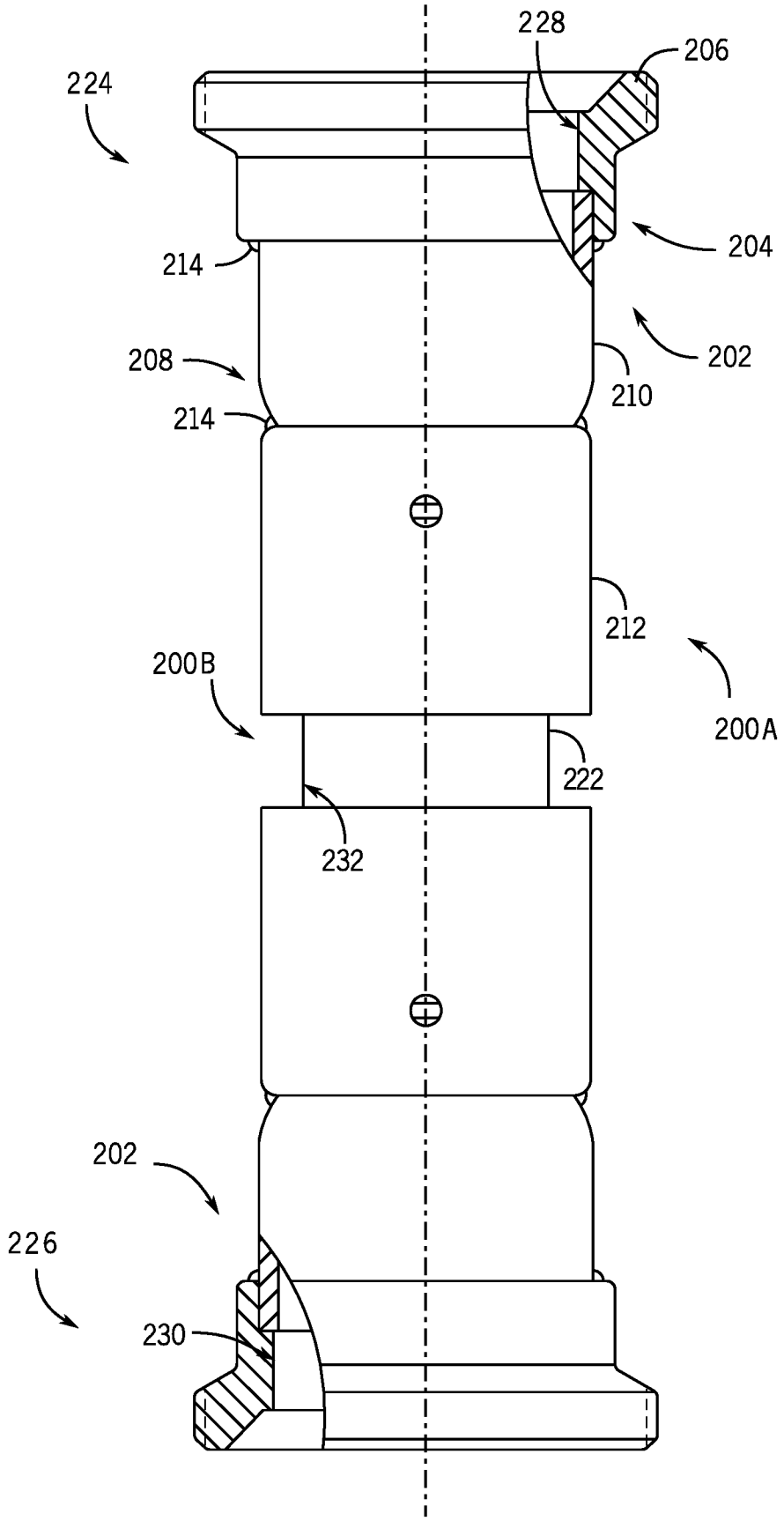

228
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FIG. 2B

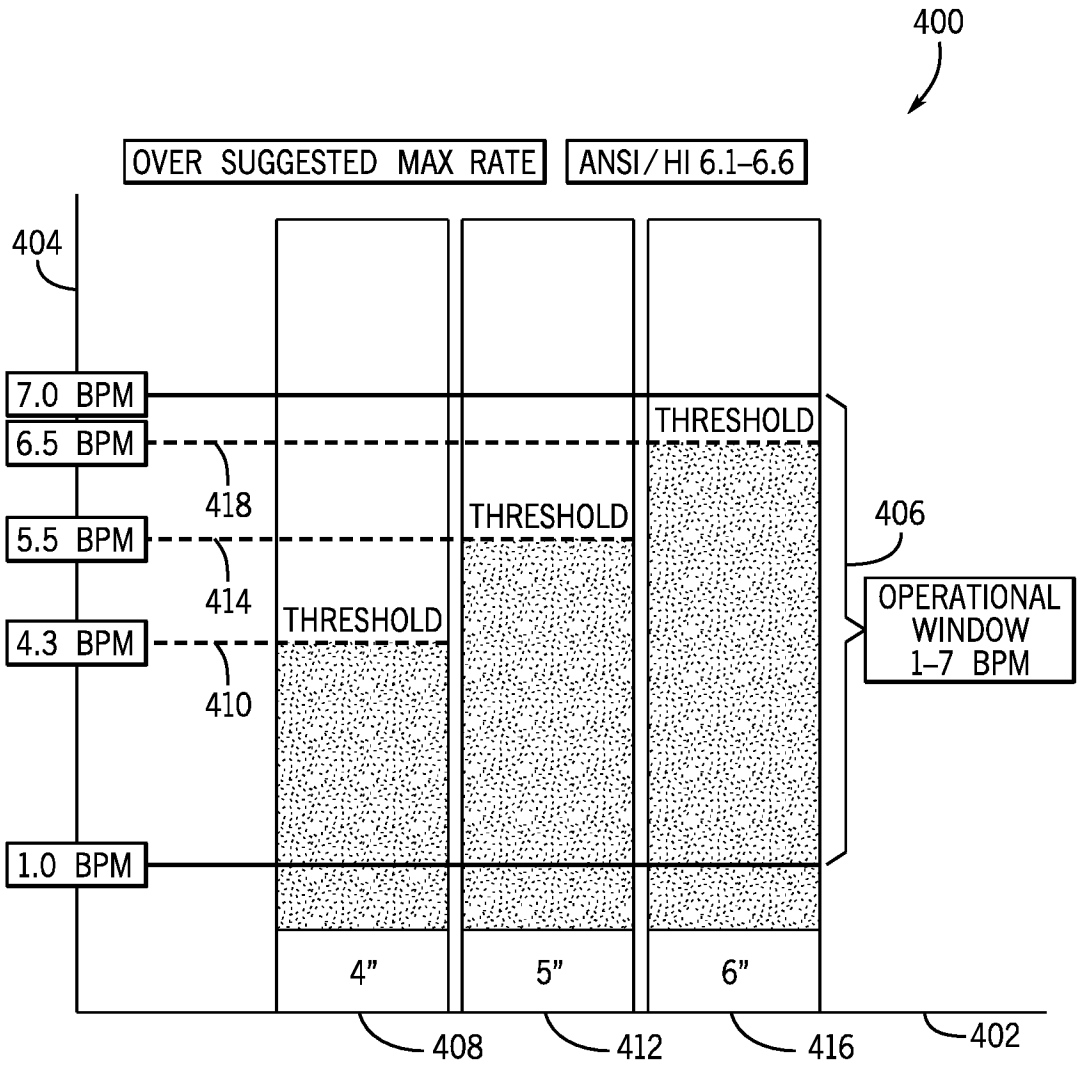

400
OVER SUGGESTED MAX RATE
ANSI/HI 6.1–6.6
404
7.0 BPM
6.5 BPM
5.5 BPM
4.3 BPM
1.0 BPM
418
414
410
THRESHOLD
THRESHOLD
THRESHOLD
406
OPERATIONAL WINDOW 1–7 BPM
4"
5"
6"
408
412
416
402

FIG. 4

Electronic Acknowledgement Receipt

EFS ID:	47339753
Application Number:	17321936
International Application Number:	
Confirmation Number:	4613
Title of Invention:	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE
First Named Inventor/Applicant Name:	Jared Oehring
Customer Number:	132858
Filer:	Taylor P. Evans/Stephanie McDonough
Filer Authorized By:	Taylor P. Evans
Attorney Docket Number:	047158.100090
Receipt Date:	09-JAN-2023
Filing Date:	17-MAY-2021
Time Stamp:	14:52:11
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		100090_Response.pdf	160890 a1efcf6b94981dca3963663a1c04b93e45df7840	yes	11

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Response after Ex Parte Quayle Action	1	1
	Specification	2	2
	Drawings-only black and white line drawings	3	3
	Claims	4	8
	Applicant Arguments/Remarks Made in an Amendment	9	11

Warnings:					
Information:					
2	Applicant Arguments/Remarks Made in an Amendment	100090_Substitute-Specification-Marked-up-Copy.pdf	146198 ee9b92995f546324c89ed210d4d7edd8f9772a3a	no	12
Warnings:					
Information:					
3	Specification	100090_Substitute-Specification-Clean-Copy.pdf	143555 727e9a3b1a2531c1d501ba170ebf438d8cbe7f45	no	12
Warnings:					
Information:					
4	Drawings-only black and white line drawings	100090_Replacement-Sheets-as-filed.pdf	123155 aa2fc52c07c727ec51834d33142f6c302270e1fe	no	4
Warnings:					
Information:					
		Total Files Size (in bytes):	573798		

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.

I hereby certify that this correspondence is being filed via EFS-Web with the United States Patent and Trademark Office on January 9, 2023.

HOGAN LOVELLS US LLP

By: /Stephanie McDonough/

PATENT
Attorney Docket No.: 047158.100090

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Jared Oehring	Confirmation No.: 4613
Application No.: 17/321,936	Examiner: Lembo, Aaron Lloyd
Filed: May 17, 2021	Art Unit: 3679
For: SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE	
Customer No.: 132858	

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

Commissioner:

In response to the Ex Parte Quayle Action mailed November 7, 2022, please enter the following amendments and remarks:

Amendments to the Specification begin on page 2 of this paper.

Amendments to the Figures begin on page 3 of this paper.

The Claims are reflected in the listing of claims which begins on page 4 of this paper.

Remarks/Arguments begin on page 9 of this paper.

Amendments to the Figures

Applicant hereby submits New Sheet 3/4.

Please replace Sheet 2/3 with Replacement Sheet 2/4.

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
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.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 17/321,936	Filing Date 05/17/2021	☐ 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 $480 =	
☐ 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	01/09/2023	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 2	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".	/LAJUAN D HICKSON/
*** 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.

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UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/321,936	05/17/2021	Jared Oehring	047158.100090	4613

132858 7590 11/07/2022

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

EXAMINER	
LEMBO, AARON LLOYD	

ART UNIT	PAPER NUMBER
3679	

NOTIFICATION DATE	DELIVERY MODE
11/07/2022	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. 17/321,936	Applicant(s) Oehring et al.	
	Examiner AARON L LEMBO	Art Unit 3679	AIA (FITF) Status Yes

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

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 2 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 12/23/2021.

☐ 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) 2-21 is/are pending in the application.

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

6) ☑ Claim(s) 2-21 is/are allowed.

7) ☐ Claim(s) _____ is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

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

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 05/17/2021 is/are: a)☐ accepted or b)☑ objected to by the Examiner.

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

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

Priority under 35 U.S.C. § 119

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

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

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

2.☐ Certified copies of the priority documents have been received in Application No. _____.

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

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

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

Notice of Pre-AIA or AIA Status

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

DETAILED ACTION

Drawings

The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the first end, second end, and body having different diameters, as well as the pair of fittings must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Allowable Subject Matter

Claims 2-21 are found to be allowable over the prior art of record.

The following is a statement of reasons for the indication of allowable subject matter:

Guidry (US 10,480,300), Winborn (US 2013/0284278) and Kotrla et al (US 10,669,804) were found to be the most applicable prior art references.

Guidry discloses wherein a connection is required to connect a fracturing fluid supply (28) to a pump (not shown) to be provided to a fracturing manifold (22).

Specifics as to the connection, or the particular use of an electric powered, multi-plunger hydraulic fracturing pump.

Neither Winborn nor Kotrla disclose such necessary specifics either.

Neither Guidry, nor any additionally cited art of record teaches or fairly suggests, alone or in combination, inter alia, wherein a system comprising an electric powered multi-plunger hydraulic fracturing pump, a fluid source, and a hose extended between the two, wherein the hose comprises a pair of fittings with diameters as claimed.

Conclusion

This application is in condition for allowance except for the following formal matters:

Drawing Objection presented above.

Prosecution on the merits is closed in accordance with the practice under Ex parte Quayle, 25 USPQ 74, 453 O.G. 213, (Comm'r Pat. 1935).

A shortened statutory period for reply to this action is set to expire TWO (2) MONTHS from the mailing date of this letter. Extensions of time may be granted under 37 CFR 1.136 but in no case can any

extension carry the date for reply to this Office action beyond the maximum period of SIX MONTHS set by statute (35 U.S.C. 133).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to AARON L LEMBO whose telephone number is (571)270-3065. The examiner can normally be reached Monday-Friday, 7am-4pm.

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

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Troutman can be reached on 5712703654. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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

/AARON L LEMBO/
Primary Examiner
Art Unit 3679

Notice of References Cited	Application/Control No. 17/321,936	Applicant(s)/Patent Under Reexamination Oehring et al.	
	Examiner AARON L LEMBO	Art Unit 3679	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-4603887-A	08-1986	Mayfield; Terry D.	E21B43/2607	285/298
*	B	US-10480300-B2	11-2019	Guidry; Kirk P.	E21B43/26	1/1
*	C	US-20170218727-A1	08-2017	Oehring; Jared	H02P21/00	1/1
	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.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/321,936	Oehring et al.
	Examiner	Art Unit
	AARON L LEMBO	3679

CPC - Searched*		
Symbol	Date	Examiner

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

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

LIBERTY EXHIBIT 1003, Page 162

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

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

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

Application Number	17321936
Filing Date	2021-05-17
First Named Inventor	Jared OEHRING
Art Unit	
Examiner Name	Not Yet Assigned
Attorney Docket Number	047158.100090

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. /A.L.L./

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17321936
	Filing Date	2021-05-17
	First Named Inventor	Jared OEHRING
	Art Unit	
	Examiner Name	Not Yet Assigned
	Attorney Docket Number	047158.100090

	9	5334899	A	1994-08-02	Skybyk	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	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. /A.L.L./

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17321936
	Filing Date	2021-05-17
	First Named Inventor	Jared OEHRING
	Art Unit	
	Examiner Name	Not Yet Assigned
	Attorney Docket Number	047158.100090

	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

Examiner Signature	/AARON L LEMBO/	Date Considered	10/24/2022

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	17321936
Filing Date	2021-05-17
First Named Inventor	Jared OEHRING
Art Unit	
Examiner Name	Not Yet Assigned
Attorney Docket Number	047158.100090

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

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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.

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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)	2021-09-30
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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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.

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

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Examiner Name	Unknown
Attorney Docket Number	047158.100090

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	

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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.	

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	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	☐

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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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	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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Signature	/Taylor P. Evans/	Date (YYYY-MM-DD)	2021-06-10
Name/Print	Taylor P. Evans	Registration Number	60506

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Doc code: IDS
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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	4601629	A	1986-07-22	Zimmerman	
	2	10648270	B2	2020-05-12	Brunty et al.	
	3	6585455	B1	2003-07-01	Petersen et al.	
	4	6273193	B1	2001-08-14	Hermann et al.	
	5	5813455	A	1998-09-29	Pratt et al.	
	6	6097310	A	2000-08-01	Harrell et al.	
	7	9353593	B1	2016-05-31	Lu et al.	
	8	4411313	A	1983-10-25	Johnson et al.	

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	9	9140105	B2	2015-09-22	Pattillo	
	10	10781752	B2	2020-09-22	Kikkawa et al.	
	11	10767561	B2	2020-09-08	Brady	
	12	9790858	B2	2017-10-17	Kanebako	
	13	10731561	B2	2020-08-04	Oehring et al.	
	14	6442942	B1	2002-09-03	Kopko	
	15	5486047	A	1996-01-23	Zimmerman	
	16	4768884	A	1988-09-06	Elkin	
	17	4538916	A	1985-09-03	Zimmerman	
	18	2976025	A	1961-03-21	Pro	
	19	9945365	B2	2018-04-17	Hernandez et al.	

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	20	10988998	B2	2021-04-27	Fischer et al.	
	21	10686301	B2	2020-06-16	Oehring et al.	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20040045703	A1	2004-03-11	Hooper et al.	
	2	20160230660	A1	2016-08-11	Zeitoun et al.	
	3	20130051971	A1	2013-02-28	Wyse et al.	
	4	20140174717	A1	2014-06-26	Broussard et al.	
	5	20120112757	A1	2012-05-10	Vrankovic et al.	
	6	20180366950	A1	2018-12-20	Pedersen et al.	
	7	20200350790		2020-11-05	Luft et al.	

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	8	20200325760	A1	2020-10-15	Markham	
	9	20200040878	A1	2020-02-06	Morris	

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	1	2014177346	WO		2014-11-06	Kaarstad		
	2	2009046280	WO		2009-04-09	Williams et al.		
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	1	Kroposki et al., Making Microgrids Work, 6 IEEE Power and Energy Mag. 40, 41 (2008).	
	2	Dan T. Ton & Merrill A. Smith, The U.S. Department of Energy's Microgrid Initiative, 25 The Electricity J. 84 (2012), pages 84-94.	

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	4	Non-Final Office Action issued in US Patent Application No.16/943,935 mailed October 21, 2021	
	5	Non-Final Office Action issued in US Patent Application No. 16/564,186, mailed October 15, 2021	
	6	Final Office Action issued in US Application No. 16/356,263 mailed October 7, 2021	
	7	Non-Final Office Action issued in US Application No. 17/060,647 mailed September 20, 2021	
	8	Non-Final Office Action issued in US Application No. 16/901,774 mailed September 14 2021	
	9	Canadian Office Action issued in Canadian Application No. 3,094,768 mailed October 28, 2021	

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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)	2021-12-29
Name/Print	Tayloy P. Evans	Registration Number	60506

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

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

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

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

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	63	("10648270" OR "10686301" OR "10731561" OR "10767561" OR "10781752" OR "10988998" OR "20040045703" OR "20120112757" OR "20130051971" OR "20140174717" OR "20160230660" OR "20180366950" OR "20200040878" OR "20200325760" OR "20200350790" OR "2976025" OR "4411313" OR "4538916" OR "4601629" OR "4768884" OR "5486047" OR "5813455" OR "6097310" OR "6273193" OR "6442942" OR "6585455" OR "9140105" OR "9353593" OR "9790858" OR "9945365" OR "10415332" OR "10648311" OR "10794165" OR "20090072645" OR "20160006311" OR "20180363640" OR "5334899" OR "5798596" OR "6035265" OR "6121705" OR "6788022" OR "7795830" OR "20010000996" OR "20050201197" OR "20060109141" OR "20080164023" OR "20080257449" OR "20110081268" OR "20110110793" OR "20120063936" OR "20120150455" OR "20150147194" OR "20150233530" OR	(US-PGPUB; USPAT)	OR	ON	ON	2022/10/24 12:02 PM

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L3	524	Well ADJ services ADJ LLC	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/24 12:03 PM
L5	105225	Oehring.in. Hinderliter.in. Robinson.in. Christinzio.in.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/24 12:04 PM
L11	41	(Artificial Intelligence) Similar to: 17/321,936 with 0 CPC Selections and 0 Text Selections Text: (US-20220107039-A1 OR US-11009162-B1 OR AR-120897-A1 OR US-10598258-B2 OR US-20220018232-A1 OR US-10914155-B2 OR CA-3115650-A1 OR US-20200109616-A1 OR WO-2020081313-A1 OR US-20210396222-A1 OR CA-3114499-A1 OR US-20210396119-A1 OR US-20210396223-A1 OR US-11208878-B2 OR US-20210156240-A1 OR US-20210041009-A1 OR US-20210079902-A1 OR WO-2020076902-A1 OR US-20200109617-A1 OR CA-3115669-A1 OR US-20200197883-A1 OR US-11009023-B2	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO))	OR	ON	ON	2022/11/01 04:53 PM

		OR US-20200325893-A1 OR US-11255173-B2 OR US-20210140295-A1 OR US-20220056794-A1 OR US-11415125-B2 OR CA-3114005-A1 OR US-11428218-B2 OR WO-2019113147-A1 OR US-20190249754-A1 OR CA-3139970-A1 OR US-20220290549-A1 OR US-10815978-B2 OR US-20190154020-A1 OR WO-2020231483-A1 OR AR-118923-A1 OR CA-3081681-C OR US-20200362681-A1 OR US-20210108631-A1 OR US-20210301815-A1 OR CA-3084596-A1 OR EP-2440784-B1 OR US-20210396121-A1 OR WO-2021262668-A1 OR AU-2017210621-B2 OR AU-2017210621-B9 OR CA-2765155-C OR WO-2021067410-A1 OR AU-2017210621-A1).did.					
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L16	383	L13 or L14	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/20 10:01 AM
L17	320	(US-20190316447-$ or US-20190292866-$ or US-20190245348-$ or US-20190211661-$ or US-20190203567-$ or US-20190178235-$ or US-20190169971-$ or US-20190162061-$ or US-20190128080-$ or US-20190120024-$ or US-20190112910-$ or US-20190100989-$ or US-20190063309-$ or US-20190003329-$ or US-20180320483-$ or US-20180245428-$ or US-20180216455-$ or US-20180156210-$ or US-20180038216-$ or US-20180028992-$ or	(US-PGPUB; USPAT)	OR	ON	ON	2020/06/20 10:49 AM

		US-20130025706-$ or US-20170328179-$ or US-20170314979-$ or US-20170021318-$ or US-20170292513-$ or US-20170259227-$).did. or (US-20170241221-$ or US-20170234250-$ or US-20170226842-$ or US-20170159570-$ or US-20170146189-$ or US-20170145918-$ or US-20170114625-$ or US-20170051732-$ or US-20170036872-$ or US-20170022807-$ or US-20160348479-$ or US-20160341281-$ or US-20160319650-$ or US-20160312108-$ or US-20160290563-$ or US-20160290114-$ or US-20160281484-$ or US-20160265457-$ or US-20160230525-$ or US-20160230524-$ or US-20160221220-$ or US-20160208595-$ or US-20160186531-$ or US-20160160889-$ or US-20160105022-$ or US-20160102537-$ or US-20150330172-$).did. or (US-20150314225-$ or US-20150300336-$ or US-20150225113-$ or US-20150217672-$ or US-20150211512-$ or US-20150176386-$ or US-20150159911-$ or US-20150136043-$ or US-20150114652-$ or US-20150097504-$ or US-20150083426-$ or US-20150075778-$ or US-20150053426-$ or US-20150027712-$ or US-20140379300-$ or US-20140290768-$ or US-20140277772-$ or US-20140255214-$ or US-20140251623-$ or US-20140246211-$ or US-20140219824-$ or US-20140124162-$ or US-20140095114-$ or US-20140060658-$ or						

		US-20140054965-$ or US-20140000899-$ or US-20130343858-$).did. or (US-20130341029-$ or US-20130306322-$ or US-20130233542-$ or US-20130175039-$ or US-20130175038-$ or US-20130009469-$ or US-20120247783-$ or US-20120232728-$ or US-20120222865-$ or US-20120205400-$ or US-20120205301-$ or US-20120127635-$ or US-20120085541-$ or US-20120049625-$ or US-20120018016-$ or US-20110272158-$ or US-20110247878-$ or US-20110166046-$ or US-20110085924-$ or US-20110061855-$ or US-20110017468-$ or US-20110005757-$ or US-20100322802-$ or US-20100303655-$ or US-20100293973-$ or US-20100250139-$ or US-20100172202-$).did. or (US-20100146981-$ or US-20100132949-$ or US-20100051272-$ or US-20100045109-$ or US-20100038907-$ or US-20100019574-$ or US-20090308602-$ or US-20090260826-$ or US-20090200035-$ or US-20090188181-$ or US-20090145611-$ or US-20090095482-$ or US-20090093317-$ or US-20090078410-$ or US-20090065299-$ or US-20090045782-$ or US-20080264649-$ or US-20080264625-$ or US-20080217024-$ or US-20080208478-$ or US-20080137266-$ or US-20080112802-$ or US-20080041596-$ or US-20080017369-$ or US-20070278140-$ or US-20070226089-$ or US-20070201305-					

		$).did. or (US-20070187163-$ or US-20070131410-$ or US-20060052903-$ or US-20050274508-$ or US-20050116541-$ or US-20050061548-$ or US-20040167738-$ or US-20040102109-$ or US-20040040746-$ or US-20040000077-$ or US-20020169523-$ or US-20030056514-$ or US-20030138327-$).did. or (US-10260327-$ or US-10246984-$ or US-10378326-$ or US-9915128-$ or US-10280724-$ or US-9103193-$ or US-9995218-$ or US-9970278-$ or US-9893500-$ or US-9745840-$ or US-9650879-$ or US-10020711-$ or US-9534473-$ or US-9840901-$ or US-9140110-$ or US-10119381-$ or US-10407990-$ or US-10232332-$ or US-9650871-$ or US-10393108-$ or US-10254732-$ or US-9410410-$ or US-10036238-$ or US-9587649-$ or US-10008880-$ or US-10227854-$).did. or (US-8997904-$ or US-9963961-$ or US-8789601-$ or US-9738461-$ or US-8534235-$ or US-8154419-$ or US-7845413-$ or US-1656861-$ or US-1671436-$ or US-2183364-$ or US-2220622-$ or US-2248051-$ or US-2407796-$ or US-2416848-$ or US-2753940-$ or US-3061039-$ or US-3066503-$ or US-3302069-$ or US-					

		3334495-$ or US- 3722595-$ or US- 3764233-$ or US- 3773140-$ or US- 3837179-$ or US- 3849662-$ or US- 3881551-$ or US- 4037431-$ or US- 4100822-$).did. or (US- 4151575-$ or US- 4226299-$ or US- 4265266-$ or US- 4432064-$ or US- 4442665-$ or US- 4456092-$ or US- 4506982-$ or US- 4512387-$ or US- 4529887-$ or US- 4538916-$ or US- 4676063-$ or US- 4759674-$ or US- 4793386-$ or US- 4845981-$ or US- 4922463-$ or US- 5006044-$ or US- 5025861-$ or US- 5050673-$ or US- 5130628-$ or US- 5131472-$ or US- 5172009-$ or US- 5189388-$ or US- 5366324-$ or US- 5422550-$ or US- 5548093-$ or US- 5590976-$ or US- 5655361-$).did. or (US- 5736838-$ or US- 5755096-$ or US- 5790972-$ or US- 5865247-$ or US- 5879137-$ or US- 5894888-$ or US- 5907970-$ or US- 6138764-$ or US- 6142878-$ or US- 6164910-$ or US- 6202702-$ or US- 6208098-$ or US- 6254462-$ or US- 6271637-$ or US- 6273193-$ or US- 6315523-$ or US- 6477852-$ or US- 6484490-$ or US- 6491098-$ or US- 6529135-$ or US- 6776227-$ or US- 6802690-$ or US-				

		6808303-$ or US- 6931310-$ or US- 6936947-$ or US- 7082993-$ or US- 7104233-$).did. or (US- 7170262-$ or US- 7173399-$ or US- 7308933-$ or US- 7312593-$ or US- 7336514-$ or US- 7445041-$ or US- 7494263-$ or US- 7500642-$ or US- 7525264-$ or US- 7563076-$ or US- 7581379-$ or US- 7675189-$ or US- 7683499-$ or US- 7717193-$ or US- 7755310-$ or US- 7807048-$ or US- 7835140-$ or US- 7894757-$ or US- 7977824-$ or US- 7984757-$ or US- 8037936-$ or US- 8054084-$ or US- 8083504-$ or US- 7926562-$ or US- 8096891-$ or US- 8139383-$ or US- 8146665-$).did. or (US- 8232892-$ or US- 8261528-$ or US- 8272439-$ or US- 8310272-$ or US- 8354817-$ or US- 8474521-$ or US- 8573303-$ or US- 8596056-$ or US- 8616005-$ or US- 8616274-$ or US- 8646521-$ or US- 8692408-$ or US- 8727068-$ or US- 8760657-$ or US- 8774972-$ or US- 8800652-$ or US- 8807960-$ or US- 8838341-$ or US- 8851860-$ or US- 8857506-$ or US- 8899940-$ or US- 8905056-$ or US- 8905138-$ or US- 9018881-$ or US- 9051822-$ or US- 9067182-$ or US-				

		9119326-$).did. or (US-9160168-$ or US-9322239-$ or US-9450385-$ or US-9611728-$ or US-9728354-$ or US-9863228-$ or US-9932799-$ or US-9976351-$ or US-10287873-$ or US-10309205-$ or US-10371012-$ or US-10436026-$).did.					
L18	320	(US-20190316447-$ or US-20190292866-$ or US-20190245348-$ or US-20190211661-$ or US-20190203567-$ or US-20190178235-$ or US-20190169971-$ or US-20190162061-$ or US-20190128080-$ or US-20190120024-$ or US-20190112910-$ or US-20190100989-$ or US-20190063309-$ or US-20190003329-$ or US-20180320483-$ or US-20180245428-$ or US-20180216455-$ or US-20180156210-$ or US-20180038216-$ or US-20180028992-$ or US-20130025706-$ or US-20170328179-$ or US-20170314979-$ or US-20170021318-$ or US-20170292513-$ or US-20170259227-$).did. or (US-20170241221-$ or US-20170234250-$ or US-20170226842-$ or US-20170159570-$ or US-20170146189-$ or US-20170145918-$ or US-20170114625-$ or US-20170051732-$ or US-20170036872-$ or US-20170022807-$ or US-20160348479-$ or US-20160341281-$ or US-20160319650-$ or US-20160312108-$ or US-20160290563-$ or US-20160290114-$ or US-20160281484-$ or US-20160265457-$ or US-	(US-PGPUB; USPAT)	OR	ON	ON	2020/06/20 10:50 AM

		20160230525-$ or US-20160230524-$ or US-20160221220-$ or US-20160208595-$ or US-20160186531-$ or US-20160160889-$ or US-20160105022-$ or US-20160102537-$ or US-20150330172-$).did. or (US-20150314225-$ or US-20150300336-$ or US-20150225113-$ or US-20150217672-$ or US-20150211512-$ or US-20150176386-$ or US-20150159911-$ or US-20150136043-$ or US-20150114652-$ or US-20150097504-$ or US-20150083426-$ or US-20150075778-$ or US-20150053426-$ or US-20150027712-$ or US-20140379300-$ or US-20140290768-$ or US-20140277772-$ or US-20140255214-$ or US-20140251623-$ or US-20140246211-$ or US-20140219824-$ or US-20140124162-$ or US-20140095114-$ or US-20140060658-$ or US-20140054965-$ or US-20140000899-$ or US-20130343858-$).did. or (US-20130341029-$ or US-20130306322-$ or US-20130233542-$ or US-20130175039-$ or US-20130175038-$ or US-20130009469-$ or US-20120247783-$ or US-20120232728-$ or US-20120222865-$ or US-20120205400-$ or US-20120205301-$ or US-20120127635-$ or US-20120085541-$ or US-20120049625-$ or US-20120018016-$ or US-20110272158-$ or US-20110247878-$ or US-20110166046-$ or US-20110085924-$ or US-20110061855-$ or US-20110017468-$ or US-					

		20110005757-$ or US-20100322802-$ or US-20100303655-$ or US-20100293973-$ or US-20100250139-$ or US-20100172202-$).did. or (US-20100146981-$ or US-20100132949-$ or US-20100051272-$ or US-20100045109-$ or US-20100038907-$ or US-20100019574-$ or US-20090308602-$ or US-20090260826-$ or US-20090200035-$ or US-20090188181-$ or US-20090145611-$ or US-20090095482-$ or US-20090093317-$ or US-20090078410-$ or US-20090065299-$ or US-20090045782-$ or US-20080264649-$ or US-20080264625-$ or US-20080217024-$ or US-20080208478-$ or US-20080137266-$ or US-20080112802-$ or US-20080041596-$ or US-20080017369-$ or US-20070278140-$ or US-20070226089-$ or US-20070201305-$).did. or (US-20070187163-$ or US-20070131410-$ or US-20060052903-$ or US-20050274508-$ or US-20050116541-$ or US-20050061548-$ or US-20040167738-$ or US-20040102109-$ or US-20040040746-$ or US-20040000077-$ or US-20020169523-$ or US-20030056514-$ or US-20030138327-$).did. or (US-10260327-$ or US-10246984-$ or US-10378326-$ or US-9915128-$ or US-10280724-$ or US-9103193-$ or US-9995218-$ or US-9970278-$ or US-9893500-$ or US-9745840-$ or US-9650879-$ or US-					

		10020711-$ or US-9534473-$ or US-9840901-$ or US-9140110-$ or US-10119381-$ or US-10407990-$ or US-10232332-$ or US-9650871-$ or US-10393108-$ or US-10254732-$ or US-9410410-$ or US-10036238-$ or US-9587649-$ or US-10008880-$ or US-10227854-$).did. or (US-8997904-$ or US-9963961-$ or US-8789601-$ or US-9738461-$ or US-8534235-$ or US-8154419-$ or US-7845413-$ or US-1656861-$ or US-1671436-$ or US-2183364-$ or US-2220622-$ or US-2248051-$ or US-2407796-$ or US-2416848-$ or US-2753940-$ or US-3061039-$ or US-3066503-$ or US-3302069-$ or US-3334495-$ or US-3722595-$ or US-3764233-$ or US-3773140-$ or US-3837179-$ or US-3849662-$ or US-3881551-$ or US-4037431-$ or US-4100822-$).did. or (US-4151575-$ or US-4226299-$ or US-4265266-$ or US-4432064-$ or US-4442665-$ or US-4456092-$ or US-4506982-$ or US-4512387-$ or US-4529887-$ or US-4538916-$ or US-4676063-$ or US-4759674-$ or US-4793386-$ or US-4845981-$ or US-4922463-$ or US-5006044-$ or US-					

		5025861-$ or US- 5050673-$ or US- 5130628-$ or US- 5131472-$ or US- 5172009-$ or US- 5189388-$ or US- 5366324-$ or US- 5422550-$ or US- 5548093-$ or US- 5590976-$ or US- 5655361-$).did. or (US- 5736838-$ or US- 5755096-$ or US- 5790972-$ or US- 5865247-$ or US- 5879137-$ or US- 5894888-$ or US- 5907970-$ or US- 6138764-$ or US- 6142878-$ or US- 6164910-$ or US- 6202702-$ or US- 6208098-$ or US- 6254462-$ or US- 6271637-$ or US- 6273193-$ or US- 6315523-$ or US- 6477852-$ or US- 6484490-$ or US- 6491098-$ or US- 6529135-$ or US- 6776227-$ or US- 6802690-$ or US- 6808303-$ or US- 6931310-$ or US- 6936947-$ or US- 7082993-$ or US- 7104233-$).did. or (US- 7170262-$ or US- 7173399-$ or US- 7308933-$ or US- 7312593-$ or US- 7336514-$ or US- 7445041-$ or US- 7494263-$ or US- 7500642-$ or US- 7525264-$ or US- 7563076-$ or US- 7581379-$ or US- 7675189-$ or US- 7683499-$ or US- 7717193-$ or US- 7755310-$ or US- 7807048-$ or US- 7835140-$ or US- 7894757-$ or US- 7977824-$ or US- 7984757-$ or US-					

		8037936-$ or US-8054084-$ or US-8083504-$ or US-7926562-$ or US-8096891-$ or US-8139383-$ or US-8146665-$).did. or (US-8232892-$ or US-8261528-$ or US-8272439-$ or US-8310272-$ or US-8354817-$ or US-8474521-$ or US-8573303-$ or US-8596056-$ or US-8616005-$ or US-8616274-$ or US-8646521-$ or US-8692408-$ or US-8727068-$ or US-8760657-$ or US-8774972-$ or US-8800652-$ or US-8807960-$ or US-8838341-$ or US-8851860-$ or US-8857506-$ or US-8899940-$ or US-8905056-$ or US-8905138-$ or US-9018881-$ or US-9051822-$ or US-9067182-$ or US-9119326-$).did. or (US-9160168-$ or US-9322239-$ or US-9450385-$ or US-9611728-$ or US-9728354-$ or US-9863228-$ or US-9932799-$ or US-9976351-$ or US-10287873-$ or US-10309205-$ or US-10371012-$ or US-10436026-$).did.					
L19	93	fitting and lembo.xa.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/20 10:50 AM
L20	22	("20020070014" | "20060159376" | "20090057026" | "20090315276" | "20110308815" | "20190056024" | "2937598" | "3055682" |	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/20 10:50 AM

		"3224817" | "3254908" | "4281726" | "4715526" | "5617879" | "6263982" | "6505649" | "6923476" | "8215645" | "9157293").PN. OR ("10669804").URPN.					
L21	5	L17 and fitting and electri$4 with pump$4 and union	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/20 10:51 AM
L22	221	("5" "5" adj inch) with (hose diameter) and fractur$4 and pump$4 same (electric$4 and plunger)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/20 10:55 AM
L23	476	(frac$4 frack$4 fractur$4) and (pump$4 with hose with fitting)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 09:38 PM
L24	44	(frac$4 frack$4 fractur$4) and (pump$4 with hose with fitting) and fitting with diameter and hose with diameter	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 09:41 PM
L25	59	(hydraulic$4 with fractur$4) and (pump$4 with hose with fitting)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 09:43 PM
L26	23	(US-20190323337-$ or US-20190248938-$ or US-20190137012-$ or US-20130284278-$ or US-20110272158-$ or US-20080264649-$).did. or (US-9052037-$ or US-9903192-$ or US-9513055-$ or US-10102471-$ or US-9400065-$ or US-10227430-$ or US-9284819-$ or US-9061223-$ or US-9050545-$ or US-8985202-$ or US-9341056-$ or US-9341055-$ or US-8162063-$ or US-10280724-$ or US-9840901-$ or US-8146665-$).did. or (US-2831551-$).did.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 09:45 PM
L27	23	L26 and (pump$4 with hose with fitting)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 09:45 PM
L28	14	("20060065319" | "20100018911" | "20130240042" | "2610741" | "2661096" |	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 09:55 PM

		"3748837" | "4051042" | "4836238" | "5230366" | "5433243" | "6390446" | "6719900").PN. OR ("9061223").URPN.					
L29	3	((US adj well adj services.as.) (oehring.in. hinderliter.in. robinson.in. christinzio.in.)) and fitting with hose with diameter$4 same pump$4	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 09:57 PM
L30	5	((US adj well adj services.as.) (oehring.in. hinderliter.in. robinson.in. christinzio.in.)) and fitting with hose with diameter$4	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 09:58 PM
L31	18	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and fitting with hose with diameter$4	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 10:05 PM
L32	8	fitting with hose with diameter$4 and (hose fitting) with pump$4 and union with pump$4	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 10:06 PM
L33	1	union same shank same reducer same fitting same hose	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 10:18 PM
L34	1	union same shank same reducer same fitting and fitting same hose	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 10:18 PM
L35	0	union with shank with reducer and fitting same hose	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 10:18 PM
L36	0	union with shank with reducer	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 10:18 PM
L37	1	union with shank with reducer	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/21 10:19 PM
L38	0	union same shank same reducer and fitting with hose	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/21 10:19 PM
L39	326	(US-20190316447-$ or	(US-PGPUB; USPAT)	OR	ON	ON	2020/06/21

		US-20190292866-$ or US-20190245348-$ or US-20190211661-$ or US-20190203567-$ or US-20190178235-$ or US-20190169971-$ or US-20190162061-$ or US-20190128080-$ or US-20190120024-$ or US-20190112910-$ or US-20190100989-$ or US-20190063309-$ or US-20190003329-$ or US-20180320483-$ or US-20180245428-$ or US-20180216455-$ or US-20180156210-$ or US-20180038216-$ or US-20180028992-$ or US-20130025706-$ or US-20170328179-$ or US-20170314979-$ or US-20170021318-$ or US-20170292513-$ or US-20170259227-$).did. or (US-20170241221-$ or US-20170234250-$ or US-20170226842-$ or US-20170159570-$ or US-20170146189-$ or US-20170145918-$ or US-20170114625-$ or US-20170051732-$ or US-20170036872-$ or US-20170022807-$ or US-20160348479-$ or US-20160341281-$ or US-20160319650-$ or US-20160312108-$ or US-20160290563-$ or US-20160290114-$ or US-20160281484-$ or US-20160265457-$ or US-20160230525-$ or US-20160230524-$ or US-20160221220-$ or US-20160208595-$ or US-20160186531-$ or US-20160160889-$ or US-20160105022-$ or US-20160102537-$ or US-20150330172-$).did. or (US-20150314225-$ or US-20150300336-$ or US-20150225113-$ or US-20150217672-$ or US-20150211512-$ or					10:20 PM

		US-20150176386-$ or US-20150159911-$ or US-20150136043-$ or US-20150114652-$ or US-20150097504-$ or US-20150083426-$ or US-20150075778-$ or US-20150053426-$ or US-20150027712-$ or US-20140379300-$ or US-20140290768-$ or US-20140277772-$ or US-20140255214-$ or US-20140251623-$ or US-20140246211-$ or US-20140219824-$ or US-20140124162-$ or US-20140095114-$ or US-20140060658-$ or US-20140054965-$ or US-20140000899-$ or US-20130343858-$).did. or (US-20130341029-$ or US-20130306322-$ or US-20130233542-$ or US-20130175039-$ or US-20130175038-$ or US-20130009469-$ or US-20120247783-$ or US-20120232728-$ or US-20120222865-$ or US-20120205400-$ or US-20120205301-$ or US-20120127635-$ or US-20120085541-$ or US-20120049625-$ or US-20120018016-$ or US-20110272158-$ or US-20110247878-$ or US-20110166046-$ or US-20110085924-$ or US-20110061855-$ or US-20110017468-$ or US-20110005757-$ or US-20100322802-$ or US-20100303655-$ or US-20100293973-$ or US-20100250139-$ or US-20100172202-$).did. or (US-20100146981-$ or US-20100132949-$ or US-20100051272-$ or US-20100045109-$ or US-20100038907-$ or US-20100019574-$ or US-20090308602-$ or US-20090260826-$ or						

		US-20090200035-$ or US-20090188181-$ or US-20090145611-$ or US-20090095482-$ or US-20090093317-$ or US-20090078410-$ or US-20090065299-$ or US-20090045782-$ or US-20080264649-$ or US-20080264625-$ or US-20080217024-$ or US-20080208478-$ or US-20080137266-$ or US-20080112802-$ or US-20080041596-$ or US-20080017369-$ or US-20070278140-$ or US-20070226089-$ or US-20070201305-$).did. or (US-20070187163-$ or US-20070131410-$ or US-20060052903-$ or US-20050274508-$ or US-20050116541-$ or US-20050061548-$ or US-20040167738-$ or US-20040102109-$ or US-20040040746-$ or US-20040000077-$ or US-20020169523-$ or US-20030056514-$ or US-20030138327-$ or US-20130284278-$).did. or (US-10260327-$ or US-10246984-$ or US-10378326-$ or US-9915128-$ or US-10280724-$ or US-9103193-$ or US-9995218-$ or US-9970278-$ or US-9893500-$ or US-9745840-$ or US-9650879-$ or US-10020711-$ or US-9534473-$ or US-9840901-$ or US-9140110-$ or US-10119381-$ or US-10407990-$ or US-10232332-$ or US-9650871-$ or US-10393108-$ or US-10254732-$ or US-9410410-$ or US-10036238-$ or US-9587649-$ or US-					

		10008880-$ or US-10227854-$).did. or (US-8997904-$ or US-9963961-$ or US-8789601-$ or US-9738461-$ or US-8534235-$ or US-8154419-$ or US-7845413-$ or US-1656861-$ or US-1671436-$ or US-2183364-$ or US-2220622-$ or US-2248051-$ or US-2407796-$ or US-2416848-$ or US-2753940-$ or US-3061039-$ or US-3066503-$ or US-3302069-$ or US-3334495-$ or US-3722595-$ or US-3764233-$ or US-3773140-$ or US-3837179-$ or US-3849662-$ or US-3881551-$ or US-4037431-$ or US-4100822-$).did. or (US-4151575-$ or US-4226299-$ or US-4265266-$ or US-4432064-$ or US-4442665-$ or US-4456092-$ or US-4506982-$ or US-4512387-$ or US-4529887-$ or US-4538916-$ or US-4676063-$ or US-4759674-$ or US-4793386-$ or US-4845981-$ or US-4922463-$ or US-5006044-$ or US-5025861-$ or US-5050673-$ or US-5130628-$ or US-5131472-$ or US-5172009-$ or US-5189388-$ or US-5366324-$ or US-5422550-$ or US-5548093-$ or US-5590976-$ or US-5655361-$).did. or (US-5736838-$ or US-5755096-$ or US-					

		5790972-$ or US- 5865247-$ or US- 5879137-$ or US- 5894888-$ or US- 5907970-$ or US- 6138764-$ or US- 6142878-$ or US- 6164910-$ or US- 6202702-$ or US- 6208098-$ or US- 6254462-$ or US- 6271637-$ or US- 6273193-$ or US- 6315523-$ or US- 6477852-$ or US- 6484490-$ or US- 6491098-$ or US- 6529135-$ or US- 6776227-$ or US- 6802690-$ or US- 6808303-$ or US- 6931310-$ or US- 6936947-$ or US- 7082993-$ or US- 7104233-$).did. or (US- 7170262-$ or US- 7173399-$ or US- 7308933-$ or US- 7312593-$ or US- 7336514-$ or US- 7445041-$ or US- 7494263-$ or US- 7500642-$ or US- 7525264-$ or US- 7563076-$ or US- 7581379-$ or US- 7675189-$ or US- 7683499-$ or US- 7717193-$ or US- 7755310-$ or US- 7807048-$ or US- 7835140-$ or US- 7894757-$ or US- 7977824-$ or US- 7984757-$ or US- 8037936-$ or US- 8054084-$ or US- 8083504-$ or US- 7926562-$ or US- 8096891-$ or US- 8139383-$ or US- 8146665-$).did. or (US- 8232892-$ or US- 8261528-$ or US- 8272439-$ or US- 8310272-$ or US- 8354817-$ or US- 8474521-$ or US-				

		8573303-$ or US-8596056-$ or US-8616005-$ or US-8616274-$ or US-8646521-$ or US-8692408-$ or US-8727068-$ or US-8760657-$ or US-8774972-$ or US-8800652-$ or US-8807960-$ or US-8838341-$ or US-8851860-$ or US-8857506-$ or US-8899940-$ or US-8905056-$ or US-8905138-$ or US-9018881-$ or US-9051822-$ or US-9067182-$ or US-9119326-$).did. or (US-9160168-$ or US-9322239-$ or US-9450385-$ or US-9611728-$ or US-9728354-$ or US-9863228-$ or US-9932799-$ or US-9976351-$ or US-10287873-$ or US-10309205-$ or US-10371012-$ or US-10436026-$ or US-10669804-$ or US-3055682-$ or US-9513055-$ or US-9061223-$ or US-8091928-$).did.					
L40	14	L39 and fitting with hose	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/21 10:20 PM
L41	2	hose with fracturing with inches	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/21 11:16 PM
L42	0	fracturing with pump with L28 adj inches	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/21 11:18 PM
L43	0	fracturing with pump with L28	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/21 11:18 PM
L44	322	fracturing with pump with "6"	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	ON	ON	2020/06/21 11:18 PM

			JPO; DERWENT; IBM_TDB)				
L45	0	fracturing with pump with "6" near2 (inch$4 diameter)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/21 11:19 PM
L46	2134	pump with "6" near2 (inch$4 diameter)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/21 11:19 PM
L47	21	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and pump with "6" near2 (inch$4 diameter)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/06/21 11:19 PM
L48	0	hose with drop adj out adj rate and fracturing	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/23 08:29 AM
L49	0	hose with drop adj out and fracturing	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/23 08:29 AM
L50	6	hose with dropout and fracturing	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/23 08:29 AM
L51	0	hose with pump with slurry with diameter and fracturing	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/23 08:30 AM
L52	109	(hose pump) with slurry with diameter and fracturing	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/23 08:30 AM
L53	0	(hose and pump) with slurry with diameter and fracturing	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/23 08:30 AM
L54	108	(pump) with slurry with diameter and fracturing	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/23 08:31 AM
L55	1	(hose) with slurry with diameter and fracturing	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/06/23 08:31 AM
L56	47	("10337308"|"10415332"|"10669804"|"20030079875"|"20060065319"|"20110052423"|"20130180722"|"20130284278"|	(US-PGPUB; USPAT)	OR	ON	ON	2020/10/19 01:01 PM

		"20130299167"|"20130306322"|"20130317750"|"20140138079"|"20140238683"|"20160258267"|"20160326854"|"20170096885"|"20170130743"|"20170175516"|"20170226838"|"20180045331"|"20180238147"|"20180266412"|"20180291713"|"20180343125"|"20190010793"|"20190112910"|"20190119096"|"20200232454"|"2610741"|"3055682"|"5004400"|"5025861"|"5230366"|"5433243"|"6719900"|"7170262"|"8091928"|"8774972"|"8997904"|"9051822"|"9061223"|"9260253"|"9324049"|"9340353"|"9499335"|"9513055"|"9909398").PN.				
L57	7	("10302079"|"20030079875"|"20110052423"|"20130180722"|"20130299167"|"20170159654"|"20170226838").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2020/10/19 03:42 PM
L58	47	("10337308"|"10415332"|"10669804"|"20030079875"|"20060065319"|"20110052423"|"20130180722"|"20130284278"|"20130299167"|"20130306322"|"20130317750"|"20140138079"|"20140238683"|"20160258267"|"20160326854"|"20170096885"|"20170130743"|"20170175516"|"20170226838"|"20180045331"|"20180238147"|"20180266412"|"20180291713"|"20180343125"|"20190010793"|"20190112910"|"20190119096"|"20200232454"|"2610741"|"3055682"|"5004400"|"5025861"|"5230366"|"5433243"|"6719900"|"7170262"|"8091928"|"8774972"|"8997904"|"9051822"|"9061223"|"9260253"|"9324049"|"9340353"|"9499335"|"9513055"|"9909398").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2020/10/19 03:42 PM
L59	25	("10184465"|"10627003	(US-PGPUB; USPAT)	OR	ON	ON	2021/01/07

		"|"10669471"|"10695950"|"10711576"|"20080095644"|"20120152716"|"20130189629"|"20130255271"|"20160273456"|"20170043280"|"20170074076"|"20170138171"|"20200047141"|"20200088152"|"5517822"|"6626646"|"6765304"|"8506267"|"8763387"|"8795525"|"9051923"|"9482086"|"9706185"|"9739546").PN.					02:15 PM
L60	3	"20170218727"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/07 02:29 PM
L61	1	(L59 L60) and pump$4 same fitting	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/07 02:32 PM
L62	0	(L59 L60) and pump$4 with plung$4	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/07 02:33 PM
L63	22	(L59 L60) and pump$4	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/07 02:33 PM
L64	1	(pump and reducer and union and shank) same fitting	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 09:05 PM
L65	0	(pump with fitting) and (reducer and union and shank) same fitting	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 09:05 PM
L66	272	(pump with fitting) and (reducer with fitting)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 09:05 PM
L67	5221	electric$4 with hydraulic$4 with pump and plunger	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 09:08 PM
L68	10	electric$4 with hydraulic$4 with pump and multi-plunger	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 09:08 PM
L69	6	electric$4 with hydraulic$4 with pump and (multi-plunger duplex triplex) with pump and pump with	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 09:12 PM

		fitting and hose with fitting					
L70	12	electric$4 with pump and (multi-plunger duplex triplex) with pump and pump with fitting and hose with fitting and pump with (hydraulic$4 fractur$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 09:30 PM
L71	11	electric$4 with pump and (multi-plunger duplex triplex) with pump and pump with fitting and pump with hose and hose with fitting and pump with (hydraulic$4 fractur$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 09:45 PM
L72	42111	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 09:54 PM
L73	8	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and pump and hose and fitting and reduc$4 with fitting and hose with fitting and hose with pump	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 09:55 PM
L74	5	(US-10563490-$ or US-10760557-$ or US-9316216-$ or US-8469108-$ or US-3652188-$).did.	(USPAT)	OR	ON	ON	2021/01/08 09:55 PM
L75	8	L73 and reduc$4 with fitting and hose with fitting and hose with pump	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 09:56 PM
L76	5	L74 and reduc$4 with fitting and hose with fitting and hose with pump	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 09:56 PM
L77	0	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and pump and hose and fitting and (union shank reduc$3) with fitting and hose with fitting and hose with pump and	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 10:09 PM

		(reduc$3 with (union shank))					
L78	15	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and pump and hose and fitting and ((reduc$3 with (union shank))(union shank reduc$3) with fitting) and hose with fitting and hose with pump	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 10:10 PM
L79	10	(US-20190055938-$ or US-20060021659-$).did. or (US-10102471-$ or US-9932981-$ or US-10563490-$ or US-10760557-$ or US-9316216-$ or US-8469108-$ or US-3652188-$).did. or (US-20150247497-$).did.	(US-PGPUB; USPAT; DERWENT)	OR	ON	ON	2021/01/08 10:14 PM
L80	10	L79 and ((reduc$3 with (union shank))(union shank reduc$3) with fitting) and hose with fitting and hose with pump	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 10:14 PM
L81	3	"20170218727"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/01/08 10:27 PM
L82	4	("20030000759"|"20140174691"|"20170302218"|"6560131").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2021/03/04 08:09 AM
L83	3	"20180183219"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/03/04 02:49 PM
L84	1	("20030000759"|"20140174691"|"20170302218"|"6560131").PN. and pump same (plunger hose fitting)	(US-PGPUB; USPAT)	OR	ON	ON	2021/03/04 02:51 PM
L85	25	("10221639"|"10408030"|"10408031"|"10740730"|"20080277120"|"20110110793"|"20130284455"|"20160326853"|"20170082033"|"20170212535"|"20170370639"|"20180090914"|"2018018	(US-PGPUB; USPAT)	OR	ON	ON	2021/03/23 09:26 PM

		1830"|"20180259080"|"20180266217"|"20180284817"|"20180298731"|"20180312738"|"20190154020"|"20190249527"|"3878884"|"5439066"|"6985750"|"9062545"|"9506333").PN.					
L86	1	L88 and fitting with hose	(US-PGPUB; USPAT)	OR	ON	ON	2021/03/23 09:29 PM
L90	415	((US-20170145918-A1 OR US-20080264625-A1 OR US-20130284278-A1 OR US-20060065319-A1 OR US-20190316447-A1 OR US-20190292866-A1 OR US-20190245348-A1 OR US-20190211661-A1 OR US-20190203567-A1 OR US-20190178235-A1 OR US-20190169971-A1 OR US-20190162061-A1 OR US-20190128080-A1 OR US-20190120024-A1 OR US-20190112910-A1 OR US-20190100989-A1 OR US-20190063309-A1 OR US-20190003329-A1 OR US-20180320483-A1 OR US-20180245428-A1 OR US-20180216455-A1 OR US-20180156210-A1 OR US-20180038216-A1 OR US-20180028992-A1 OR US-20130025706-A1 OR US-20170328179-A1 OR US-20170314979-A1 OR US-20170021318-A1 OR US-20170292513-A1 OR US-20170259227-A1 OR US-20170241221-A1 OR US-20170234250-A1 OR US-20170226842-A1 OR US-20170159570-A1 OR US-20170146189-A1 OR US-	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/01 04:56 PM

		20170114625-A1 OR US-20170051732-A1 OR US-20170036872-A1 OR US-20170022807-A1 OR US-20160348479-A1 OR US-20160341281-A1 OR US-20160319650-A1 OR US-20160312108-A1 OR US-20160290563-A1 OR US-20160290114-A1 OR US-20160281484-A1 OR US-20160265457-A1 OR US-20160230525-A1 OR US-20160230524-A1 OR US-20160221220-A1 OR US-20160208595-A1 OR US-20160186531-A1 OR US-20160160889-A1 OR US-20160105022-A1 OR US-20160102537-A1 OR US-20150330172-A1 OR US-20150314225-A1 OR US-20150300336-A1 OR US-20150225113-A1 OR US-20150217672-A1 OR US-20150211512-A1 OR US-20150176386-A1 OR US-20150159911-A1 OR US-20150136043-A1 OR US-20150114652-A1 OR US-20150097504-A1 OR US-20150083426-A1 OR US-20150075778-A1 OR US-20150053426-A1 OR US-20150027712-A1 OR US-20140379300-A1 OR US-20140290768-A1 OR US-20140277772-A1 OR US-20140255214-A1 OR US-20140251623-A1 OR US-20140246211-A1 OR US-20140219824-A1 OR US-20140124162-A1 OR US-20140095114-A1					

		OR US-20140060658-A1 OR US-20140054965-A1 OR US-20140000899-A1 OR US-20130343858-A1 OR US-20130341029-A1 OR US-20130306322-A1 OR US-20130233542-A1 OR US-20130175039-A1 OR US-20130175038-A1 OR US-20130009469-A1 OR US-20120247783-A1 OR US-20120232728-A1 OR US-20120222865-A1 OR US-20120205400-A1 OR US-20120205301-A1 OR US-20120127635-A1 OR US-20120085541-A1 OR US-20120049625-A1 OR US-20120018016-A1 OR US-20110272158-A1 OR US-20110247878-A1 OR US-20110166046-A1 OR US-20110085924-A1 OR US-20110061855-A1 OR US-20110017468-A1 OR US-20110005757-A1 OR US-20100322802-A1 OR US-20100303655-A1 OR US-20100293973-A1 OR US-20100250139-A1 OR US-20100172202-A1 OR US-20100146981-A1 OR US-20100132949-A1 OR US-20100051272-A1 OR US-20100045109-A1 OR US-20100038907-A1 OR US-20100019574-A1 OR US-20090308602-A1 OR US-20090260826-A1 OR US-20090200035-A1 OR US-20090188181-A1 OR US-20090145611-A1 OR US-20090095482-A1 OR US-					

		20090093317-A1 OR US-20090078410-A1 OR US-20090065299-A1 OR US-20090045782-A1 OR US-20080264649-A1 OR US-20080217024-A1 OR US-20080208478-A1 OR US-20080137266-A1 OR US-20080112802-A1 OR US-20080041596-A1 OR US-20080017369-A1 OR US-20070278140-A1 OR US-20070226089-A1 OR US-20070201305-A1 OR US-20070187163-A1 OR US-20070131410-A1 OR US-20060052903-A1 OR US-20050274508-A1 OR US-20050116541-A1 OR US-20050061548-A1 OR US-20040167738-A1 OR US-20040102109-A1 OR US-20040040746-A1 OR US-20040000077-A1 OR US-20020169523-A1 OR US-20030056514-A1 OR US-20030138327-A1 OR US-20200232454-A1 OR US-20190119096-A1 OR US-20170226838-A1 OR US-20130299167-A1 OR US-20130180722-A1 OR US-20110052423-A1 OR US-20030079875-A1 OR US-20190010793-A1 OR US-20180343125-A1 OR US-20180291713-A1 OR US-20180266412-A1 OR US-20180238147-A1 OR US-20180045331-A1 OR US-20170175516-A1 OR US-20170130743-A1 OR US-20170096885-A1 OR US-20160258267-A1					

		OR US-20140238683-A1 OR US-20130317750-A1 OR US-20200088152-A1 OR US-20200047141-A1 OR US-20170138171-A1 OR US-20170074076-A1 OR US-20170043280-A1 OR US-20160273456-A1 OR US-20130255271-A1 OR US-20130189629-A1 OR US-20120152716-A1 OR US-20080095644-A1 OR US-20170302218-A1 OR US-20140174691-A1 OR US-20030000759-A1 OR US-20190249527-A1 OR US-20190154020-A1 OR US-20180312738-A1 OR US-20180298731-A1 OR US-20180284817-A1 OR US-20180266217-A1 OR US-20180259080-A1 OR US-20180181830-A1 OR US-20180090914-A1 OR US-20170370639-A1 OR US-20170212535-A1 OR US-20170082033-A1 OR US-20160326853-A1 OR US-20130284455-A1 OR US-20110110793-A1 OR US-20080277120-A1).did. AND PGPB.dbnm.) OR ((US-10669804-B2 OR US-3055682-A OR US-9513055-B1 OR US-9061223-B2 OR US-8091928-B2 OR US-6719900-B2 OR US-5433243-A OR US-5230366-A OR US-2610741-A OR US-5472049-A OR US-10260327-B2 OR US-10246984-B2 OR US-10378326-B2 OR US-9915128-B2 OR US-10280724-B2 OR US-					

		9103193-B2 OR US- 9995218-B2 OR US- 9970278-B2 OR US- 9893500-B2 OR US- 9745840-B2 OR US- 9650879-B2 OR US- 10020711-B2 OR US- 9534473-B2 OR US- 9840901-B2 OR US- 9140110-B2 OR US- 10119381-B2 OR US- 10407990-B2 OR US- 10232332-B2 OR US- 9650871-B2 OR US- 10393108-B2 OR US- 10254732-B2 OR US- 9410410-B2 OR US- 10036238-B2 OR US- 9587649-B2 OR US- 10008880-B2 OR US- 10227854-B2 OR US- 8997904-B2 OR US- 9963961-B2 OR US- 8789601-B2 OR US- 9738461-B2 OR US- 8534235-B2 OR US- 8154419-B2 OR US- 7845413-B2 OR US- 1656861-A OR US- 1671436-A OR US- 2183364-A OR US- 2220622-A OR US- 2248051-A OR US- 2407796-A OR US- 2416848-A OR US- 2753940-A OR US- 3061039-A OR US- 3066503-A OR US- 3302069-A OR US- 3334495-A OR US- 3722595-A OR US- 3764233-A OR US- 3773140-A OR US- 3837179-A OR US- 3849662-A OR US- 3881551-A OR US- 4037431-A OR US- 4100822-A OR US- 4151575-A OR US- 4226299-A OR US- 4265266-A OR US- 4432064-A OR US- 4442665-A OR US- 4456092-A OR US- 4506982-A OR US- 4512387-A OR US- 4529887-A OR US- 4538916-A OR US-				

		4676063-A OR US- 4759674-A OR US- 4793386-A OR US- 4845981-A OR US- 4922463-A OR US- 5006044-A OR US- 5025861-A OR US- 5050673-A OR US- 5130628-A OR US- 5131472-A OR US- 5172009-A OR US- 5189388-A OR US- 5366324-A OR US- 5422550-A OR US- 5548093-A OR US- 5590976-A OR US- 5655361-A OR US- 5736838-A OR US- 5755096-A OR US- 5790972-A OR US- 5865247-A OR US- 5879137-A OR US- 5894888-A OR US- 5907970-A OR US- 6138764-A OR US- 6142878-A OR US- 6164910-A OR US- 6202702-B1 OR US- 6208098-B1 OR US- 6254462-B1 OR US- 6271637-B1 OR US- 6273193-B1 OR US- 6315523-B1 OR US- 6477852-B2 OR US- 6484490-B1 OR US- 6491098-B1 OR US- 6529135-B1 OR US- 6776227-B2 OR US- 6802690-B2 OR US- 6808303-B2 OR US- 6931310-B2 OR US- 6936947-B1 OR US- 7082993-B2 OR US- 7104233-B2 OR US- 7170262-B2 OR US- 7173399-B2 OR US- 7308933-B1 OR US- 7312593-B1 OR US- 7336514-B2 OR US- 7445041-B2 OR US- 7494263-B2 OR US- 7500642-B2 OR US- 7525264-B2 OR US- 7563076-B2 OR US- 7581379-B2 OR US- 7675189-B2 OR US- 7683499-B2 OR US- 7717193-B2 OR US-				

		7755310-B2 OR US- 7807048-B2 OR US- 7835140-B2 OR US- 7894757-B2 OR US- 7977824-B2 OR US- 7984757-B1 OR US- 8037936-B2 OR US- 8054084-B2 OR US- 8083504-B2 OR US- 7926562-B2 OR US- 8096891-B2 OR US- 8139383-B2 OR US- 8146665-B2 OR US- 8232892-B2 OR US- 8261528-B2 OR US- 8272439-B2 OR US- 8310272-B2 OR US- 8354817-B2 OR US- 8474521-B2 OR US- 8573303-B2 OR US- 8596056-B2 OR US- 8616005-B1 OR US- 8616274-B2 OR US- 8646521-B2 OR US- 8692408-B2 OR US- 8727068-B2 OR US- 8760657-B2 OR US- 8774972-B2 OR US- 8800652-B2 OR US- 8807960-B2 OR US- 8838341-B2 OR US- 8851860-B1 OR US- 8857506-B2 OR US- 8899940-B2 OR US- 8905056-B2 OR US- 8905138-B2 OR US- 9018881-B2 OR US- 9051822-B2 OR US- 9067182-B2 OR US- 9119326-B2 OR US- 9160168-B2 OR US- 9322239-B2 OR US- 9450385-B2 OR US- 9611728-B2 OR US- 9728354-B2 OR US- 9863228-B2 OR US- 9932799-B2 OR US- 9976351-B2 OR US- 10287873-B2 OR US- 10309205-B2 OR US- 10371012-B2 OR US- 10436026-B2 OR US- 10302079-B2 OR US- 10337308-B2 OR US- 10415332-B2 OR US- 9909398-B2 OR US- 9499335-B2 OR US- 9340353-B2 OR US-				

		9324049-B2 OR US-9260253-B2 OR US-5004400-A OR US-10711576-B2 OR US-10695950-B2 OR US-10669471-B2 OR US-10627003-B2 OR US-10184465-B2 OR US-9739546-B2 OR US-9706185-B2 OR US-9482086-B2 OR US-9051923-B2 OR US-8795525-B2 OR US-8763387-B2 OR US-8506267-B2 OR US-6765304-B2 OR US-6626646-B2 OR US-5517822-A OR US-6560131-B1 OR US-10740730-B2 OR US-10408031-B2 OR US-10408030-B2 OR US-10221639-B2 OR US-9506333-B2 OR US-9062545-B2 OR US-6985750-B1 OR US-5439066-A OR US-3878884-A).did. AND USPT.dbnm.) OR ((US-20170218727-A1).did. AND DWPI.dbnm.)					
L91	0	F16L33/2076.cpc. AND F16L13/141.cpc. AND F16L25/14.cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/01 05:57 PM
L92	11	(F16L13/141.cpc. F16L33/2076.cpc.) AND F16L25/14.cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/01 05:58 PM
L93	2	(F16L13/141.cpc. F16L33/2076.cpc. F16L25/14.cpc.) AND hydraulic$4 ADJ fractur$3	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/01 05:59 PM
L94	170	(F16L13/141.cpc. F16L33/2076.cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP,	OR	ON	ON	2022/11/02 11:31 AM

		F16L25/14.cpc.) AND fractur$3	AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L95	27	(F16L13/141.cpc. F16L33/2076.cpc. F16L25/14.cpc.) AND fractur$3 AND pump$4	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 11:32 AM
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		OR CA-3115650-A1 OR US-20200109616-A1 OR WO-2020081313-A1 OR US-20210396222-A1 OR CA-3114499-A1 OR US-20210396119-A1 OR US-20210396223-A1 OR US-11208878-B2 OR US-20210156240-A1 OR US-20210041009-A1 OR US-20210079902-A1 OR WO-2020076902-A1 OR US-20200109617-A1 OR CA-3115669-A1 OR US-20200197883-A1 OR US-11009023-B2 OR US-20200325893-A1 OR US-11255173-B2 OR US-20210140295-A1 OR US-20220056794-A1 OR US-11415125-B2 OR CA-3114005-A1 OR US-11428218-B2 OR WO-2019113147-A1 OR US-20190249754-A1 OR CA-3139970-A1 OR US-20220290549-A1 OR US-10815978-B2 OR US-20190154020-A1 OR WO-2020231483-A1 OR AR-118923-A1 OR CA-3081681-C OR US-20200362681-A1 OR US-20210108631-A1 OR US-20210301815-A1 OR CA-3084596-A1 OR EP-2440784-B1 OR US-20210396121-A1 OR WO-2021262668-A1 OR AU-2017210621-B2 OR AU-2017210621-B9 OR CA-2765155-C OR WO-2021067410-A1 OR AU-2017210621-A1).did.					
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		OR US-20070187163-A1 OR US-20070131410-A1 OR US-20060052903-A1 OR US-20050274508-A1 OR US-20050116541-A1 OR US-20050061548-A1 OR US-20040167738-A1 OR US-20040102109-A1 OR US-20040040746-A1 OR US-20040000077-A1 OR US-20020169523-A1 OR US-20030056514-A1 OR US-20030138327-A1 OR US-20200232454-A1 OR US-20190119096-A1 OR US-20170226838-A1 OR US-20130299167-A1 OR US-20130180722-A1 OR US-20110052423-A1 OR US-20030079875-A1 OR US-20190010793-A1 OR US-20180343125-A1 OR US-20180291713-A1 OR US-20180266412-A1 OR US-20180238147-A1 OR US-20180045331-A1 OR US-20170175516-A1 OR US-20170130743-A1 OR US-20170096885-A1 OR US-20160258267-A1 OR US-20140238683-A1 OR US-20130317750-A1 OR US-20200088152-A1 OR US-20200047141-A1 OR US-20170138171-A1 OR US-20170074076-A1 OR US-20170043280-A1 OR US-20160273456-A1 OR US-20130255271-A1 OR US-20130189629-A1 OR US-20120152716-A1 OR US-20080095644-A1 OR US-20170302218-A1 OR US-					

		20140174691-A1 OR US-20030000759-A1 OR US-20190249527-A1 OR US-20190154020-A1 OR US-20180312738-A1 OR US-20180298731-A1 OR US-20180284817-A1 OR US-20180266217-A1 OR US-20180259080-A1 OR US-20180181830-A1 OR US-20180090914-A1 OR US-20170370639-A1 OR US-20170212535-A1 OR US-20170082033-A1 OR US-20160326853-A1 OR US-20130284455-A1 OR US-20110110793-A1 OR US-20080277120-A1).did. AND PGPB.dbnm.) OR ((US-10669804-B2 OR US-3055682-A OR US-9513055-B1 OR US-9061223-B2 OR US-8091928-B2 OR US-6719900-B2 OR US-5433243-A OR US-5230366-A OR US-2610741-A OR US-5472049-A OR US-11009162-B1 OR US-11090709-B1 OR US-10260327-B2 OR US-10246984-B2 OR US-10378326-B2 OR US-9915128-B2 OR US-10280724-B2 OR US-9103193-B2 OR US-9995218-B2 OR US-9970278-B2 OR US-9893500-B2 OR US-9745840-B2 OR US-9650879-B2 OR US-10020711-B2 OR US-9534473-B2 OR US-9840901-B2 OR US-9140110-B2 OR US-10119381-B2 OR US-10407990-B2 OR US-10232332-B2 OR US-9650871-B2 OR US-10393108-B2 OR US-10254732-B2 OR US-					

		9410410-B2 OR US- 10036238-B2 OR US- 9587649-B2 OR US- 10008880-B2 OR US- 10227854-B2 OR US- 8997904-B2 OR US- 9963961-B2 OR US- 8789601-B2 OR US- 9738461-B2 OR US- 8534235-B2 OR US- 8154419-B2 OR US- 7845413-B2 OR US- 1656861-A OR US- 1671436-A OR US- 2183364-A OR US- 2220622-A OR US- 2248051-A OR US- 2407796-A OR US- 2416848-A OR US- 2753940-A OR US- 3061039-A OR US- 3066503-A OR US- 3302069-A OR US- 3334495-A OR US- 3722595-A OR US- 3764233-A OR US- 3773140-A OR US- 3837179-A OR US- 3849662-A OR US- 3881551-A OR US- 4037431-A OR US- 4100822-A OR US- 4151575-A OR US- 4226299-A OR US- 4265266-A OR US- 4432064-A OR US- 4442665-A OR US- 4456092-A OR US- 4506982-A OR US- 4512387-A OR US- 4529887-A OR US- 4538916-A OR US- 4676063-A OR US- 4759674-A OR US- 4793386-A OR US- 4845981-A OR US- 4922463-A OR US- 5006044-A OR US- 5025861-A OR US- 5050673-A OR US- 5130628-A OR US- 5131472-A OR US- 5172009-A OR US- 5189388-A OR US- 5366324-A OR US- 5422550-A OR US- 5548093-A OR US- 5590976-A OR US-				

		5655361-A OR US- 5736838-A OR US- 5755096-A OR US- 5790972-A OR US- 5865247-A OR US- 5879137-A OR US- 5894888-A OR US- 5907970-A OR US- 6138764-A OR US- 6142878-A OR US- 6164910-A OR US- 6202702-B1 OR US- 6208098-B1 OR US- 6254462-B1 OR US- 6271637-B1 OR US- 6273193-B1 OR US- 6315523-B1 OR US- 6477852-B2 OR US- 6484490-B1 OR US- 6491098-B1 OR US- 6529135-B1 OR US- 6776227-B2 OR US- 6802690-B2 OR US- 6808303-B2 OR US- 6931310-B2 OR US- 6936947-B1 OR US- 7082993-B2 OR US- 7104233-B2 OR US- 7170262-B2 OR US- 7173399-B2 OR US- 7308933-B1 OR US- 7312593-B1 OR US- 7336514-B2 OR US- 7445041-B2 OR US- 7494263-B2 OR US- 7500642-B2 OR US- 7525264-B2 OR US- 7563076-B2 OR US- 7581379-B2 OR US- 7675189-B2 OR US- 7683499-B2 OR US- 7717193-B2 OR US- 7755310-B2 OR US- 7807048-B2 OR US- 7835140-B2 OR US- 7894757-B2 OR US- 7977824-B2 OR US- 7984757-B1 OR US- 8037936-B2 OR US- 8054084-B2 OR US- 8083504-B2 OR US- 7926562-B2 OR US- 8096891-B2 OR US- 8139383-B2 OR US- 8146665-B2 OR US- 8232892-B2 OR US- 8261528-B2 OR US- 8272439-B2 OR US-				

		8310272-B2 OR US- 8354817-B2 OR US- 8474521-B2 OR US- 8573303-B2 OR US- 8596056-B2 OR US- 8616005-B1 OR US- 8616274-B2 OR US- 8646521-B2 OR US- 8692408-B2 OR US- 8727068-B2 OR US- 8760657-B2 OR US- 8774972-B2 OR US- 8800652-B2 OR US- 8807960-B2 OR US- 8838341-B2 OR US- 8851860-B1 OR US- 8857506-B2 OR US- 8899940-B2 OR US- 8905056-B2 OR US- 8905138-B2 OR US- 9018881-B2 OR US- 9051822-B2 OR US- 9067182-B2 OR US- 9119326-B2 OR US- 9160168-B2 OR US- 9322239-B2 OR US- 9450385-B2 OR US- 9611728-B2 OR US- 9728354-B2 OR US- 9863228-B2 OR US- 9932799-B2 OR US- 9976351-B2 OR US- 10287873-B2 OR US- 10309205-B2 OR US- 10371012-B2 OR US- 10436026-B2 OR US- 10302079-B2 OR US- 10337308-B2 OR US- 10415332-B2 OR US- 9909398-B2 OR US- 9499335-B2 OR US- 9340353-B2 OR US- 9324049-B2 OR US- 9260253-B2 OR US- 5004400-A OR US- 10711576-B2 OR US- 10695950-B2 OR US- 10669471-B2 OR US- 10627003-B2 OR US- 10184465-B2 OR US- 9739546-B2 OR US- 9706185-B2 OR US- 9482086-B2 OR US- 9051923-B2 OR US- 8795525-B2 OR US- 8763387-B2 OR US- 8506267-B2 OR US- 6765304-B2 OR US-					

		6626646-B2 OR US-5517822-A OR US-6560131-B1 OR US-10740730-B2 OR US-10408031-B2 OR US-10408030-B2 OR US-10221639-B2 OR US-9506333-B2 OR US-9062545-B2 OR US-6985750-B1 OR US-5439066-A OR US-3878884-A).did. AND USPT.dbnm.) OR ((US-20170218727-A1).did. AND DWPI.dbnm.)					
L100	7	((US-9840901-B2 OR US-9061223-B2 OR US-8474521-B2 OR US-5472049-A OR US-10669804-B2).did. AND USPT.dbnm.) OR ((US-20170218727-A1).did. AND DWPI.dbnm.) OR ((US-20130284278-A1).did. AND PGPB.dbnm.)	(USPAT; DERWENT; US-PGPUB)	OR	ON	ON	2022/11/02 12:23 PM
L101	412	(F16L13/141.cpc. F16L33/2076.cpc. F16L25/14.cpc.) AND hose WITH fitting$4 AND fitting$4 WITH diameter	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 12:26 PM
L102	98	(F16L13/141.cpc. F16L33/2076.cpc. F16L25/14.cpc.) AND hose WITH fitting$4 AND fitting$4 WITH diameter AND different$4 WITH diameter$4	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 12:26 PM
L103	0	(F16L13/141.cpc. F16L33/2076.cpc. F16L25/14.cpc.) AND hose WITH fitting$4 AND fitting$4 WITH diameter AND different$4 WITH diameter$4 AND pump$4 AND slurry	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 12:27 PM
L104	8	(F16L13/141.cpc. F16L33/2076.cpc. F16L25/14.cpc.) AND hose WITH fitting$4 AND fitting$4 WITH	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU,	OR	ON	ON	2022/11/02 12:27 PM

		diameter AND different$4 WITH diameter$4 AND pump$4 WITH hose	SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L105	5	(F16L13/141.cpc. F16L33/2076.cpc. F16L25/14.cpc.) AND fracturing AND hose AND pump$4	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 12:32 PM
L106	7	fracturing WITH (conduit hose) WITH pump$4 AND hose WITH fitting$4 AND hose WITH fitting$4 WITH diameter	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 12:34 PM
L107	59	fracturing WITH (conduit hose) WITH pump$4 AND hose WITH (fitting$4 end) WITH diameter	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 12:36 PM
L108	11	(F16L33/2076.cpc. F16L13/141.cpc.) AND F16L25/14.cpc.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 01:08 PM
L109	11751	(F16L33/2076.cpc. F16L13/141.cpc. F16L25/14.cpc.)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 01:09 PM
L110	288	(F16L33/2076.cpc. F16L13/141.cpc. F16L24/14.cpc.) AND E21B$/$.cpc.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 01:09 PM
L111	51	(F16L33/2076.cpc. F16L13/141.cpc. F16L24/14.cpc.) AND	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD,	OR	ON	ON	2022/11/02 01:09 PM

		E21B$/$.cpc. AND hose	DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L112	32	(Artificial Intelligence) More like doc: US-20220107039-A1 Text: (US-11009162-B1 OR CA-3115669-A1 OR US-11208878-B2 OR US-20170037717-A1 OR US-20220018233-A1 OR US-10934824-B2 OR US-20190040727-A1 OR AR-120897-A1 OR CA-3097051-A1 OR US-11035207-B2 OR US-20210262321-A1 OR WO-2019204242-A1 OR US-20190316447-A1 OR US-10036238-B2 OR US-20160273328-A1 OR US-20220034210-A1 OR US-10947829-B2 OR US-9650879-B2 OR US-20220178234-A1 OR US-11066912-B2).did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 01:11 PM
L113	261	hydraulic$4 ADJ fractur$4 AND reduc$4 WITH diameter$1 WITH pressur$4 WITH pump$4	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 01:12 PM
L114	101	hydraulic$4 ADJ fractur$4 AND reduc$4 near5 diameter$1 WITH (hose conduit) AND pressur$4 WITH pump$4	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO,	OR	ON	ON	2022/11/02 01:13 PM

			MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L115	16	(F16L33/2076.cpc. F16L13/141.cpc. F16L24/14.cpc.) AND L5 AND diameter WITH hose	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 01:33 PM
L116	0	(F16L33/2076.cpc. F16L13/141.cpc. F16L24/14.cpc.) AND "4" ADJ inch ADJ diameter near4 hose AND (5 "6") ADJ inch ADJ diameter near4 fitting	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 01:56 PM
L117	0	"4" ADJ inch ADJ diameter near4 hose AND (5 "6") ADJ inch ADJ diameter near4 fitting	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 01:57 PM
L118	0	"4" ADJ inch ADJ diameter near4 hose AND ("5" "6") ADJ inch ADJ diameter near4 fitting	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 01:57 PM
L119	1	"4" ADJ inch near4 hose AND ("5" "6") ADJ inch near4 fitting	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 01:57 PM
L120	13	"4" near2 diameter near4 hose AND ("5" "6") near2 diameter near4 fitting	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 01:57 PM
L121	3594	(F16L33/2076.cpc.)	(US-PGPUB; USPAT;	OR	ON	ON	2022/11/02

			USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				02:14 PM
L122	1405	(F16L33/2076.cpc.) AND diameter	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 02:15 PM
L123	1097	(F16L33/2076.cpc.) AND diameter AND (hose conduit)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 02:15 PM
L124	92	(F16L33/2076.cpc.) AND diameter AND (hose conduit) AND pump$4	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 02:15 PM
L125	104	e21B43/2607.cpc. AND robinson.in.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 02:17 PM
L126	2	"20210198153"	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 02:18 PM
L127	3	"202198953"	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 02:19 PM
L128	535	e21B43/2607.cpc. AND	(US-PGPUB; USPAT;	OR	ON	ON	2022/11/02

		flexibl$3	USOCR; FIT (AP, AT, AU, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				02:21 PM
L129	3	((US-20200109617-A1 OR US-20160273328-A1 OR US-20190316447-A1).did. AND DWPI.dbnm.)	(DERWENT)	OR	ON	ON	2022/11/02 02:23 PM
L130	3	"17321936"	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 02:23 PM
L131	41	(Artificial Intelligence) Similar to: 17/321,936 with 0 CPC Selections and 0 Text Selections Text: (US-20220107039-A1 OR US-11009162-B1 OR AR-120897-A1 OR US-10598258-B2 OR US-20220018232-A1 OR US-10914155-B2 OR CA-3115650-A1 OR US-20200109616-A1 OR WO-2020081313-A1 OR US-20210396222-A1 OR CA-3114499-A1 OR US-20210396119-A1 OR US-20210396223-A1 OR US-11208878-B2 OR US-20210156240-A1 OR US-20210041009-A1 OR US-20210079902-A1 OR WO-2020076902-A1 OR US-20200109617-A1 OR CA-3115669-A1 OR	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO))	OR	ON	ON	2022/11/02 02:24 PM

		US-20200197883-A1 OR US-11009023-B2 OR US-20200325893-A1 OR US-11255173-B2 OR US-20210140295-A1 OR US-20220056794-A1 OR US-11415125-B2 OR CA-3114005-A1 OR US-11428218-B2 OR WO-2019113147-A1 OR US-20190249754-A1 OR CA-3139970-A1 OR US-20220290549-A1 OR US-10815978-B2 OR US-20190154020-A1 OR WO-2020231483-A1 OR AR-118923-A1 OR CA-3081681-C OR US-20200362681-A1 OR US-20210108631-A1 OR US-20210301815-A1 OR CA-3084596-A1 OR EP-2440784-B1 OR US-20210396121-A1 OR WO-2021262668-A1 OR AU-2017210621-B2 OR AU-2017210621-B9 OR CA-2765155-C OR WO-2021067410-A1 OR AU-2017210621-A1).did.					
L132	42	(Artificial Intelligence) Similar to: 17/321,936 with 0 CPC Selections and 2 Text Selections Text: (US-20220107039-A1 OR US-20210156240-A1 OR US-11009162-B1 OR US-20210140423-A1 OR US-20180156210-A1 OR CA-2987665-A1 OR CA-2987665-C OR US-11181107-B2 OR US-20190154020-A1 OR US-10815978-B2 OR WO-2021138462-A1 OR CA-3162983-A1 OR US-20190234171-A1 OR US-11208878-B2 OR US-20210198989-A1 OR BR-	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO))	OR	ON	ON	2022/11/02 02:28 PM

		122020025350-A2 OR BR-122020025339-A2 OR CA-3115669-A1 OR WO-2020076902-A1 OR US-20210381929-A1 OR US-11125217-B2 OR US-20200109617-A1 OR US-20210017830-A1 OR US-6869274-B2 OR BR-122020025357-A2 OR WO-2020081313-A1 OR CA-3115650-A1 OR US-20200109616-A1 OR US-20170259267-A1 OR US-20190178234-A1 OR CA-3030549-A1 OR WO-2018052398-A1 OR CA-3030549-C OR BR-122020025342-A2 OR US-11421504-B2 OR US-10895138-B2 OR US-10688493-B2 OR CA-2905976-A1 OR US-20160108939-A1 OR US-20200362681-A1 OR US-7090473-B2 OR BR-112013025880-A2 OR CA-2917673-C OR CA-3139970-A1 OR WO-2020231483-A1 OR US-20180080439-A1 OR US-10526862-B2 OR US-8021130-B2 OR US-9297245-B2 OR US-9945374-B2).did.					
L133	140	("1051046" | "1329760" | "1615536" | "2556544" | "2934095" | "3118691" | "3233668" | "3306637" | "3393267" | "3508768" | "3581775" | "3934902" | "3993100" | "4355961" | "4366864" | "4383554" | "4385018" | "4405016" | "4437691" | "4452312" | "4559716" | "4566168" | "4570673" | "4603887" | "4632432" | "4749047" | "4767136" | "4805430" | "4998756" | "5135698" | "5158326" | "5195589" | "5244045" | "5524710" | "5636691" | "5927344" | "6003604" | "6004639" | "6006788" | "6102445" | "6192941" | "6234030"	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/11/02 02:33 PM

		| "6364024" | "6609734" | "6691743" | "6899172" | "7481239" | "7934546" | "8100182" | "8110741" | "8241453" | "8398122" | "8485262" | "8528585" | "8770277" | "8839867" | "8905056" | "8960307" | "8978763" | "9068450" | "9175556" | "9222345" | "9255469" | "9518430" | "9631469" | "9670745" | "9903190" | "9915132" | "9932800" | "10094195" | "10132146" | "10161210" | "10323475" | "10385643" | "10385645" | "10385662" | "10400538" | "10443763" | "10480300" | "10487637" | "20030205378" | "20030205385" | "20040251020" | "20060207763" | "20070125544" | "20070227722" | "20080083539" | "20080277120" | "20090014184" | "20090090515" | "20090145597" | "20090261575" | "20100032031" | "20100051261" | "20100230114" | "20100300672" | "20110030963" | "20110079399" | "20110108275" | "20110114320" | "20110132596" | "20110259584" | "20120152564" | "20120155813" | "20120181015" | "20120181016" | "20120181030" | "20120242081" | "20130284455" | "20140007970" | "20140238683" | "20150083426" | "20150159458" |				

		"20150211342" | "20150275629" | "20150345272" | "20150354313" | "20160186506" | "20160305515" | "20160363242" | "20170175905" | "20170298700" | "20180264604" | "20180291718" | "20190360624" | "20200088021" | "20200131877" | "20200131889" | "20200277845" | "20210010358").pn. OR ("11319757").urpn. AND (PGPB | USPT | USOC).dbnm.					
L134	438	((US-20170145918-A1 OR US-20080264625-A1 OR US-20130284278-A1 OR US-20060065319-A1 OR US-20120181015-A1 OR US-20190316447-A1 OR US-20190292866-A1 OR US-20190245348-A1 OR US-20190211661-A1 OR US-20190203567-A1 OR US-20190178235-A1 OR US-20190169971-A1 OR US-20190162061-A1 OR US-20190128080-A1 OR US-20190120024-A1 OR US-20190112910-A1 OR US-20190100989-A1 OR US-20190063309-A1 OR US-20190003329-A1 OR US-20180320483-A1 OR US-20180245428-A1 OR US-20180216455-A1 OR US-20180156210-A1 OR US-20180038216-A1 OR US-20180028992-A1 OR US-20130025706-A1 OR US-20170328179-A1 OR US-20170314979-A1 OR US-20170021318-	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 02:39 PM

		A1 OR US-20170292513-A1 OR US-20170259227-A1 OR US-20170241221-A1 OR US-20170234250-A1 OR US-20170226842-A1 OR US-20170159570-A1 OR US-20170146189-A1 OR US-20170114625-A1 OR US-20170051732-A1 OR US-20170036872-A1 OR US-20170022807-A1 OR US-20160348479-A1 OR US-20160341281-A1 OR US-20160319650-A1 OR US-20160312108-A1 OR US-20160290563-A1 OR US-20160290114-A1 OR US-20160281484-A1 OR US-20160265457-A1 OR US-20160230525-A1 OR US-20160230524-A1 OR US-20160221220-A1 OR US-20160208595-A1 OR US-20160186531-A1 OR US-20160160889-A1 OR US-20160105022-A1 OR US-20160102537-A1 OR US-20150330172-A1 OR US-20150314225-A1 OR US-20150300336-A1 OR US-20150225113-A1 OR US-20150217672-A1 OR US-20150211512-A1 OR US-20150176386-A1 OR US-20150159911-A1 OR US-20150136043-A1 OR US-20150114652-A1 OR US-20150097504-A1 OR US-20150083426-A1 OR US-20150075778-A1 OR US-20150053426-A1 OR US-20150027712-A1 OR US-20140379300-A1 OR					

		US-20140290768-A1 OR US-20140277772-A1 OR US-20140255214-A1 OR US-20140251623-A1 OR US-20140246211-A1 OR US-20140219824-A1 OR US-20140124162-A1 OR US-20140095114-A1 OR US-20140060658-A1 OR US-20140054965-A1 OR US-20140000899-A1 OR US-20130343858-A1 OR US-20130341029-A1 OR US-20130306322-A1 OR US-20130233542-A1 OR US-20130175039-A1 OR US-20130175038-A1 OR US-20130009469-A1 OR US-20120247783-A1 OR US-20120232728-A1 OR US-20120222865-A1 OR US-20120205400-A1 OR US-20120205301-A1 OR US-20120127635-A1 OR US-20120085541-A1 OR US-20120049625-A1 OR US-20120018016-A1 OR US-20110272158-A1 OR US-20110247878-A1 OR US-20110166046-A1 OR US-20110085924-A1 OR US-20110061855-A1 OR US-20110017468-A1 OR US-20110005757-A1 OR US-20100322802-A1 OR US-20100303655-A1 OR US-20100293973-A1 OR US-20100250139-A1 OR US-20100172202-A1 OR US-20100146981-A1 OR US-20100132949-A1 OR US-20100051272-A1 OR US-20100045109-A1 OR US-20100038907-					

		A1 OR US-20100019574-A1 OR US-20090308602-A1 OR US-20090260826-A1 OR US-20090200035-A1 OR US-20090188181-A1 OR US-20090145611-A1 OR US-20090095482-A1 OR US-20090093317-A1 OR US-20090078410-A1 OR US-20090065299-A1 OR US-20090045782-A1 OR US-20080264649-A1 OR US-20080217024-A1 OR US-20080208478-A1 OR US-20080137266-A1 OR US-20080112802-A1 OR US-20080041596-A1 OR US-20080017369-A1 OR US-20070278140-A1 OR US-20070226089-A1 OR US-20070201305-A1 OR US-20070187163-A1 OR US-20070131410-A1 OR US-20060052903-A1 OR US-20050274508-A1 OR US-20050116541-A1 OR US-20050061548-A1 OR US-20040167738-A1 OR US-20040102109-A1 OR US-20040040746-A1 OR US-20040000077-A1 OR US-20020169523-A1 OR US-20030056514-A1 OR US-20030138327-A1 OR US-20200232454-A1 OR US-20190119096-A1 OR US-20170226838-A1 OR US-20130299167-A1 OR US-20130180722-A1 OR US-20110052423-A1 OR US-20030079875-A1 OR US-20190010793-A1 OR US-20180343125-A1 OR					

		US-20180291713-A1 OR US-20180266412-A1 OR US-20180238147-A1 OR US-20180045331-A1 OR US-20170175516-A1 OR US-20170130743-A1 OR US-20170096885-A1 OR US-20160258267-A1 OR US-20140238683-A1 OR US-20130317750-A1 OR US-20200088152-A1 OR US-20200047141-A1 OR US-20170138171-A1 OR US-20170074076-A1 OR US-20170043280-A1 OR US-20160273456-A1 OR US-20130255271-A1 OR US-20130189629-A1 OR US-20120152716-A1 OR US-20080095644-A1 OR US-20170302218-A1 OR US-20140174691-A1 OR US-20030000759-A1 OR US-20190249527-A1 OR US-20190154020-A1 OR US-20180312738-A1 OR US-20180298731-A1 OR US-20180284817-A1 OR US-20180266217-A1 OR US-20180259080-A1 OR US-20180181830-A1 OR US-20180090914-A1 OR US-20170370639-A1 OR US-20170212535-A1 OR US-20170082033-A1 OR US-20160326853-A1 OR US-20130284455-A1 OR US-20110110793-A1 OR US-20080277120-A1).did. AND PGPB.dbnm.) OR ((US-10669804-B2 OR US-3055682-A OR US-9513055-B1 OR US-9061223-B2 OR US-8091928-B2 OR US-					

		6719900-B2 OR US- 5433243-A OR US- 5230366-A OR US- 2610741-A OR US- 5472049-A OR US- 11009162-B1 OR US- 11090709-B1 OR US- 8752666-B2 OR US- 11090708-B1 OR US- 10132434-B2 OR US- 11319757-B2 OR US- 9068450-B2 OR US- 4603887-A OR US- 8839867-B2 OR US- 4998756-A OR US- 10323475-B2 OR US- 10480300-B2 OR US- 4570673-A OR US- 8978763-B2 OR US- 10260327-B2 OR US- 10246984-B2 OR US- 10378326-B2 OR US- 9915128-B2 OR US- 10280724-B2 OR US- 9103193-B2 OR US- 9995218-B2 OR US- 9970278-B2 OR US- 9893500-B2 OR US- 9745840-B2 OR US- 9650879-B2 OR US- 10020711-B2 OR US- 9534473-B2 OR US- 9840901-B2 OR US- 9140110-B2 OR US- 10119381-B2 OR US- 10407990-B2 OR US- 10232332-B2 OR US- 9650871-B2 OR US- 10393108-B2 OR US- 10254732-B2 OR US- 9410410-B2 OR US- 10036238-B2 OR US- 9587649-B2 OR US- 10008880-B2 OR US- 10227854-B2 OR US- 8997904-B2 OR US- 9963961-B2 OR US- 8789601-B2 OR US- 9738461-B2 OR US- 8534235-B2 OR US- 8154419-B2 OR US- 7845413-B2 OR US- 1656861-A OR US- 1671436-A OR US- 2183364-A OR US- 2220622-A OR US- 2248051-A OR US- 2407796-A OR US-				

		2416848-A OR US- 2753940-A OR US- 3061039-A OR US- 3066503-A OR US- 3302069-A OR US- 3334495-A OR US- 3722595-A OR US- 3764233-A OR US- 3773140-A OR US- 3837179-A OR US- 3849662-A OR US- 3881551-A OR US- 4037431-A OR US- 4100822-A OR US- 4151575-A OR US- 4226299-A OR US- 4265266-A OR US- 4432064-A OR US- 4442665-A OR US- 4456092-A OR US- 4506982-A OR US- 4512387-A OR US- 4529887-A OR US- 4538916-A OR US- 4676063-A OR US- 4759674-A OR US- 4793386-A OR US- 4845981-A OR US- 4922463-A OR US- 5006044-A OR US- 5025861-A OR US- 5050673-A OR US- 5130628-A OR US- 5131472-A OR US- 5172009-A OR US- 5189388-A OR US- 5366324-A OR US- 5422550-A OR US- 5548093-A OR US- 5590976-A OR US- 5655361-A OR US- 5736838-A OR US- 5755096-A OR US- 5790972-A OR US- 5865247-A OR US- 5879137-A OR US- 5894888-A OR US- 5907970-A OR US- 6138764-A OR US- 6142878-A OR US- 6164910-A OR US- 6202702-B1 OR US- 6208098-B1 OR US- 6254462-B1 OR US- 6271637-B1 OR US- 6273193-B1 OR US- 6315523-B1 OR US- 6477852-B2 OR US-				

		6484490-B1 OR US- 6491098-B1 OR US- 6529135-B1 OR US- 6776227-B2 OR US- 6802690-B2 OR US- 6808303-B2 OR US- 6931310-B2 OR US- 6936947-B1 OR US- 7082993-B2 OR US- 7104233-B2 OR US- 7170262-B2 OR US- 7173399-B2 OR US- 7308933-B1 OR US- 7312593-B1 OR US- 7336514-B2 OR US- 7445041-B2 OR US- 7494263-B2 OR US- 7500642-B2 OR US- 7525264-B2 OR US- 7563076-B2 OR US- 7581379-B2 OR US- 7675189-B2 OR US- 7683499-B2 OR US- 7717193-B2 OR US- 7755310-B2 OR US- 7807048-B2 OR US- 7835140-B2 OR US- 7894757-B2 OR US- 7977824-B2 OR US- 7984757-B1 OR US- 8037936-B2 OR US- 8054084-B2 OR US- 8083504-B2 OR US- 7926562-B2 OR US- 8096891-B2 OR US- 8139383-B2 OR US- 8146665-B2 OR US- 8232892-B2 OR US- 8261528-B2 OR US- 8272439-B2 OR US- 8310272-B2 OR US- 8354817-B2 OR US- 8474521-B2 OR US- 8573303-B2 OR US- 8596056-B2 OR US- 8616005-B1 OR US- 8616274-B2 OR US- 8646521-B2 OR US- 8692408-B2 OR US- 8727068-B2 OR US- 8760657-B2 OR US- 8774972-B2 OR US- 8800652-B2 OR US- 8807960-B2 OR US- 8838341-B2 OR US- 8851860-B1 OR US- 8857506-B2 OR US- 8899940-B2 OR US-				

		8905056-B2 OR US-8905138-B2 OR US-9018881-B2 OR US-9051822-B2 OR US-9067182-B2 OR US-9119326-B2 OR US-9160168-B2 OR US-9322239-B2 OR US-9450385-B2 OR US-9611728-B2 OR US-9728354-B2 OR US-9863228-B2 OR US-9932799-B2 OR US-9976351-B2 OR US-10287873-B2 OR US-10309205-B2 OR US-10371012-B2 OR US-10436026-B2 OR US-10302079-B2 OR US-10337308-B2 OR US-10415332-B2 OR US-9909398-B2 OR US-9499335-B2 OR US-9340353-B2 OR US-9324049-B2 OR US-9260253-B2 OR US-5004400-A OR US-10711576-B2 OR US-10695950-B2 OR US-10669471-B2 OR US-10627003-B2 OR US-10184465-B2 OR US-9739546-B2 OR US-9706185-B2 OR US-9482086-B2 OR US-9051923-B2 OR US-8795525-B2 OR US-8763387-B2 OR US-8506267-B2 OR US-6765304-B2 OR US-6626646-B2 OR US-5517822-A OR US-6560131-B1 OR US-10740730-B2 OR US-10408031-B2 OR US-10408030-B2 OR US-10221639-B2 OR US-9506333-B2 OR US-9062545-B2 OR US-6985750-B1 OR US-5439066-A OR US-3878884-A).did. AND USPT.dbnm.) OR ((US-20170218727-A1 OR US-20220107039-A1 OR WO-2012006326-A1 OR US-20210198953-A1 OR					

		US-20190316447-A1 OR US-20160273328-A1 OR US-20200109617-A1).did. AND DWPI.dbnm.) OR ((EP-1262703-A1).did. AND FTDB.dbnm.) OR ((US-3433505-A).did. AND USOC.dbnm.)					
L135	103	L134 AND pump AND (frac$4 ADJ fluid fluid ADJ source)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 02:40 PM
L136	5	L134 AND pump SAME (frac$4 ADJ fluid fluid ADJ source) WITH (hose flexible)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 02:40 PM
L137	15	L134 AND pump SAME (frac$4 ADJ fluid fluid ADJ source) SAME (hose flexible)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 02:40 PM

L138	6	L134 AND pump SAME (frac$4 ADJ fluid fluid ADJ source) SAME (hose flexible) AND diameter$4	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 02:43 PM
L139	144	E21B43/$.cpc. AND pump SAME (frac$4 ADJ fluid fluid ADJ source) SAME (hose flexible) AND diameter$4	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 02:48 PM
L140	13	E21B43/$.cpc. AND pump SAME (frac$4 ADJ fluid fluid ADJ source) SAME (hose flexible) WITH diameter$4	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/02 02:48 PM
L141	20	E21B43/$.cpc. AND pump SAME ((frack$4 fractur$4 frac$4) ADJ fluid fluid ADJ source) SAME (hose flexible) WITH diameter$4	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL,	OR	ON	ON	2022/11/02 02:48 PM

			NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L142	15	((US-9840901-B2 OR US-9061223-B2 OR US-8474521-B2 OR US-5472049-A OR US-10132434-B2 OR US-9068450-B2 OR US-4603887-A OR US-8839867-B2 OR US-4998756-A OR US-10323475-B2 OR US-10480300-B2 OR US-10669804-B2).did. AND USPT.dbnm.) OR ((US-20170218727-A1 OR WO-2012006326-A1).did. AND DWPI.dbnm.) OR ((US-20130284278-A1).did. AND PGPB.dbnm.)	(USPAT; DERWENT; US-PGPUB)	OR	ON	ON	2022/11/02 02:55 PM
L143	5512	electric$4 WITH (fractur$4 frack$4 hydraulic$4) WITH pump$4 AND (hose flexible ADJ conduit) AND (slurry fluid)	(US-PGPUB; USPAT; DERWENT)	OR	ON	ON	2022/11/02 03:04 PM
L144	816	electric$4 near4 (fractur$4 frack$4 hydraulic$4) near4 pump$4 AND pump$4 WITH (hose flexible ADJ conduit) WITH (slurry fluid)	(US-PGPUB; USPAT; DERWENT)	OR	ON	ON	2022/11/02 03:04 PM
L145	38	electric$4 near4 (fractur$4 frack$4 hydraulic$4) near4 pump$4 AND pump$4 WITH (hose flexible ADJ conduit) WITH (slurry fluid) AND diameter WITH (hose flexible ADJ conduit)	(US-PGPUB; USPAT; DERWENT)	OR	ON	ON	2022/11/02 03:04 PM
L146	6	(fractur$4 frack$4) AND electric$4 near4 (hydraulic$4) near4 pump$4 AND pump$4 WITH (hose flexible ADJ conduit) WITH (slurry fluid) AND diameter WITH (hose	(US-PGPUB; USPAT; DERWENT)	OR	ON	ON	2022/11/02 03:06 PM

		flexible ADJ conduit)					
L147	6	((US-9840901-B2 OR US-8474521-B2 OR US-4603887-A OR US-10480300-B2 OR US-10669804-B2).did. AND USPT.dbnm.) OR ((US-20130284278-A1).did. AND PGPB.dbnm.)	(USPAT; US-PGPUB)	OR	ON	ON	2022/11/02 03:09 PM
L148	1	multi-plunger near3 pump WITH hose WITH fitting	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/02 05:13 PM
L149	1	multi ADJ plunger near3 pump WITH hose WITH fitting	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/02 05:14 PM
L150	2	multi ADJ plunger near3 pump AND hose WITH fitting	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/02 05:14 PM
L151	2	(multiplunger multi-plunger multi ADJ plunger) near3 pump AND hose WITH fitting	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/02 05:14 PM
L152	95	(multiplunger multi-plunger multi ADJ plunger) near3 pump	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/02 05:14 PM
L153	14	(multiplunger multi-plunger multi ADJ plunger) near3 pump AND hose	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/02 05:14 PM
L154	22	(multiplunger multi-plunger multi ADJ plunger) near3 pump AND (fracturing fracking)	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/02 05:15 PM

PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N1	7	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and pump and hose and fitting and reduc$4 with fitting and hose with fitting and hose with pump	(USPAT)	OR	ON	ON	2021/01/08 09:58 PM
N2	23674	(F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and	(USPAT)	OR	ON	ON	2021/01/08 10:09 PM

N3	0	pump and hose and fitting and (union shank reduc$3) with fitting and hose with fitting and hose with pump reduc$3 with fitting (F16L33/02.cpc. E21B43/26.cpc. F04B1/00.cpc. F04B15/02.cpc. F04B17/03.cpc.) and pump and hose and fitting and (union shank reduc$3) with fitting and hose with fitting and hose with pump and (reduc$3 with (union shank))	(USPAT)	OR	ON	ON	2021/01/08 10:09 PM

PE2E SEARCH - Search History (Similarity Search)

Ref #	Application Number	Text Selections	CPC Selections
L11	17/321,936	No selections	No selections
L98	17/321,936	No selections	No selections
L131	17/321,936	No selections	No selections
L132	17/321,936	(Specification) Embodiments of the present disclosure present an improvement over existing systems by removing the standard 4" (0.1016 m) supply hoses while maintaining standard 6" connection types by utilizing a particularly designed ferrule. The standard 4" supply hose provides an insufficient volume of fracturing fluid to a pump utilizing in hydraulic fracturing operation. These problems may be compounded when 4" connections are also used. Using a 5" diameter hose supplies more volume, reduces pressure drop, and reduces cavitation and other poor conditions pumps can experience when not supplied adequately. (Specification) Embodiments of the present disclosure include specialty-sized hoses developed in order to allow greater flow/supply to frac pumps (e.g., positive displacement, multi plunger pumps). This increased flow capability reduces cavitation events and prolongs equipment life. Specially selecting a 5" (0.127 m) diameter hose allows for fluid velocity to be maintained above a threshold at which sand particles would begin to fall out and eventually cause a blockage (sand off) the hose itself. In order to utilize this diameter/size hose in a large-scale function, a connection point was developed to enable use of standard 6" (0.1524 m) components, such	No selections

		as but not limited to hammer unions, butterfly valves, and other 6" steel pipe components. Embodiments include a hybrid of 5" hose and 6" end connectors. This then results in an improvement to existing methods of supplying fluid to a positive displacement pump.	

Bibliographic Data

Application No: 17/321,936

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /AARON L LEMBO/ Examiner's Signature | Initials

Title: SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
05/17/2021	166	3679	047158.100090
RULE			

APPLICANTS

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

INVENTORS

Jared Oehring, Houston, TX, UNITED STATES

Brandon Hinderliter, Houston, TX, UNITED STATES

Lon Robinson, Houston, TX, UNITED STATES

Alexander James Christinzio, Houston, TX, UNITED STATES

CONTINUING DATA

This application is a CON of 16728359 12/27/2019 PAT 11009162

FOREIGN APPLICATIONS

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
17/321,936	05/17/2021	Jared Oehring	047158.100090

CONFIRMATION NO. 4613

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

PUBLICATION NOTICE



Title:SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE

Publication No.US-2022-0107039-A1
Publication Date:04/07/2022

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Application Number	17321936
Filing Date	2021-05-17
First Named Inventor	Jared OEHRING
Art Unit	
Examiner Name	Not Yet Assigned
Attorney Docket Number	047158.100090

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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	4601629	A	1986-07-22	Zimmerman	
	2	10648270	B2	2020-05-12	Brunty et al.	
	3	6585455	B1	2003-07-01	Petersen et al.	
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	First Named Inventor	Jared OEHRING
	Art Unit	
	Examiner Name	Not Yet Assigned
	Attorney Docket Number	047158.100090

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	10	10781752	B2	2020-09-22	Kikkawa et al.	
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	19	9945365	B2	2018-04-17	Hernandez et al.	

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	First Named Inventor	Jared OEHRING
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	Examiner Name	Not Yet Assigned
	Attorney Docket Number	047158.100090

	20	10988998	B2	2021-04-27	Fischer et al.	
	21	10686301	B2	2020-06-16	Oehring et al.	

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	1	20040045703	A1	2004-03-11	Hooper et al.	
	2	20160230660	A1	2016-08-11	Zeitoun et al.	
	3	20130051971	A1	2013-02-28	Wyse et al.	
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	First Named Inventor	Jared OEHRING
	Art Unit	
	Examiner Name	Not Yet Assigned
	Attorney Docket Number	047158.100090

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	1	2014177346	WO		2014-11-06	Kaarstad		
	2	2009046280	WO		2009-04-09	Williams et al.		
	3	2019210417	WO		2019-11-07	David Sherman et al.		

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	1	Kroposki et al., Making Microgrids Work, 6 IEEE Power and Energy Mag. 40, 41 (2008).	
	2	Dan T. Ton & Merrill A. Smith, The U.S. Department of Energy's Microgrid Initiative, 25 The Electricity J. 84 (2012), pages 84-94.	

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	Filing Date	2021-05-17
	First Named Inventor	Jared OEHRING
	Art Unit	
	Examiner Name	Not Yet Assigned
	Attorney Docket Number	047158.100090

	3	Non-Final Office Action issued in US Patent Application No. 16/871,328 mailed December 9, 2021	
	4	Non-Final Office Action issued in US Patent Application No.16/943,935 mailed October 21, 2021	
	5	Non-Final Office Action issued in US Patent Application No. 16/564,186, mailed October 15, 2021	
	6	Final Office Action issued in US Application No. 16/356,263 mailed October 7, 2021	
	7	Non-Final Office Action issued in US Application No. 17/060,647 mailed September 20, 2021	
	8	Non-Final Office Action issued in US Application No. 16/901,774 mailed September 14 2021	
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Name/Print	Tayloy P. Evans	Registration Number	60506

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(19) World Intellectual Property Organization
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60/977,956 5 October 2007 (05.10.2007) US

(71) Applicant *(for all designated States except US)*: **WEATHERFORD/LANB, INC.** [US/US]; 515 Post Oak Boulevard, Suite 600, Houston, TX 77027 (US).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **WILLIAMS, Ellis** [US/US]; 339 Magnolia Business Park Drive, Magnolia, TX 77354-8913 (US). **WILLIAMS, Michael, R.** [US/US]; 339 Magnolia Business Park Drive, Magnolia, TX 77354-8913 (US). **WILLIAMS, Jason, C.** [US/US]; 22906 Bramblevine Drive, Magnolia, TX 77355-3526 (US).

(74) Agent: **MCDERMOTT, Sean, P.**; Wong, Cabello, Lutsch, Rutherford & Brucculeri, LLP, 20333 Tomball Parkway, Suite 600, Houston, TX 77070 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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Published:
— *with international search report*

(54) Title: QUINTUPLEX MUD PUMP

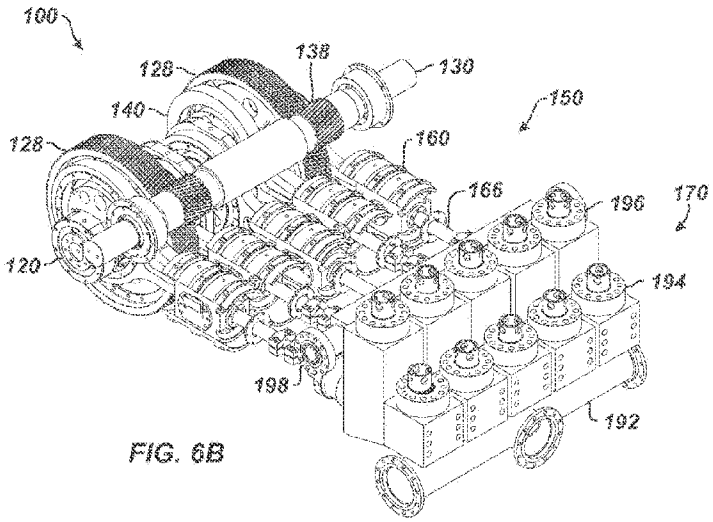


FIG. 6B

(57) Abstract: A quintuplex mud pump has a crankshaft supported in the pump by external main bearings. The crankshaft has five eccentric sheaves, two internal main bearing sheaves, and two bull gears. Each of the main bearing sheaves supports the crankshaft by a main bearing. One main bearing sheave is disposed between second and third eccentric sheaves, while the other main bearing sheave disposed between third and fourth eccentric sheaves. One bull gear is disposed between the first and second eccentric sheaves, while the second bull gear is disposed between fourth and fifth eccentric sheaves. A pinion shaft has pinion gears interfacing with the crankshaft's bull gears. Connecting rods on the eccentric sheaves use roller bearings and transfer rotational movement of the crankshaft to pistons of the pump's fluid assembly.

WO 2009/046280 A1

QUINTUPLEX MUD PUMP

CROSS-REFERENCE TO RELATED APPLICATIONS

[Para 1] This is a non-provisional of U.S. Provisional Appl. Ser. No. 60/977,956, filed 05-OCT-2007, which is incorporated herein by reference and to which priority is claimed.

BACKGROUND

[Para 2] Triplex mud pumps pump drilling mud during well operations. An example of a typical triplex mud pump 10 shown in FIG. 1A has a power assembly 12, a crosshead assembly 14, and a fluid assembly 16. Electric motors (not shown) connect to a pinion shaft 30 that drives the power assembly 12. The crosshead assembly 14 converts the rotational movement of the power assembly 12 into reciprocating movement to actuate internal pistons or plungers of the fluid assembly 16. Being triplex, the pump's fluid assembly 16 has three internal pistons to pump the mud.

[Para 3] As shown in FIG. 1B, the pump's power assembly 14 has a crankshaft 20 supported at its ends by double roller bearings 22. Positioned along its intermediate extent, the crankshaft 20 has three eccentric sheaves 24-1…24-3, and three connecting rods 40 mount onto these sheaves 24 with cylindrical roller bearings 26. These connecting rods 40 connect by extension rods (not shown) and the crosshead assembly (14) to the pistons of the pump's fluid assembly 16.

[Para 4] In addition to the sheaves, the crankshaft 20 also has a bull gear 28 positioned between the second and third sheaves 24-2 and 24-3. The bull gear 28 interfaces with the pinion shaft (30) and drives the crankshaft 20's rotation. As shown particularly in FIG. 1C, the pinion shaft 30 also mounts in the power assembly 14 with roller bearings 32 supporting its ends. When electric motors couple to the pinion shaft's ends 34 and rotate the pinion shaft 30, a pinion gear 38 interfacing with the crankshaft's bull gear 28 drives the crankshaft (20), thereby operating the pistons of the pump's fluid assembly 16.

[Para 5] When used to pump mud, the triplex mud pump 10 produces flow that varies by approximately 23%. For example, the pump 10 produces a maximum flow level of about 106% during certain crankshaft angles and produces a minimum flow level of 83% during other crankshaft angles, resulting in a total flow variation of 23% as the pump's pistons are moved in differing exhaust strokes during the crankshaft's rotation. Because the total flow varies, the pump 10 tends to produce undesirable pressure changes or "noise" in the pumped mud. In turn, this noise interferes with downhole telemetry and other techniques used during measurement-while-drilling (MWD) and logging-while-drilling (LWD) operations.

[Para 6] In contrast to mud pumps, well-service pumps (WSP) are also used during well operations. A well service pump is used to pump fluid at higher pressures than those used to pump mud. Therefore, the well service pumps are typically used to pump high pressure fluid into a well during frac operations or the like. An example of a well-service pump 50 is shown in FIG. 2. Here, the well service pump 50 is a quintuplex well service pump, although triplex well service pumps are also used. The pump 50 has a power assembly 52, a crosshead assembly 54, and a fluid assembly 56. A gear reducer 53 on one side of the pump 50 connects a drive (not shown) to the power assembly 52 to drive the pump 50.

[Para 7] As shown in FIG. 3, the pump's power assembly 52 has a crankshaft 60 with five crankpins 62 and an internal main bearing sheave 64. The crankpins 62 are offset from the crankshaft 60's axis of rotation and convert the rotation of the crankshaft 60 in to a reciprocating motion for operating pistons (not shown) in the pump's fluid assembly 56. Double roller bearings 66 support the crankshaft 60 at both ends of the power assembly 52, and an internal double roller bearing 68 supports the crankshaft 60 at its main bearing sheave 64. One end 61 of the crankshaft 60 extends outside the power assembly 52 for coupling to the gear reducer (53; Fig. 2) and other drive components.

[Para 8] As shown in FIG. 4A, connecting rods 70 connect from the crankpins 62 to pistons or plungers 80 via the crosshead assembly 54. FIG. 4B shows a typical connection of a connecting rod 70 to a crankpin 62 in the well service pump 50. As shown, a bearing cap 74 fits on one side of the crankpin 62 and couples to the profiled end of the connecting rod 70. To reduce friction, the connection uses a sleeve bearing 76 between the rod 70, bearing cap 74, and crankpin 62. From the crankpin 62, the connecting rod 70 connects to a crosshead 55 using a wrist pin 72 as shown in FIG. 4A. The wrist pin 72 allows the connecting rod 70 to pivot with respect to the crosshead 55, which in turn is connected to the plunger 80.

[Para 9] In use, an electric motor or an internal combustion engine (such as a diesel engine) drives the pump 50 by the gear reducer 53. As the crankshaft 60 turns, the crankpins 62 reciprocate the connecting rods 70. Moved by the rods 70, the crossheads 55 reciprocate inside fixed cylinders. In turn, the plunger 80 coupled to the crosshead 55 also reciprocates between suction and power strokes in the fluid assembly 56. Withdrawal of a plunger 80 during a suction stroke pulls fluid into the assembly 56 through the input valve 82 connected to an inlet hose or pipe (not shown). Subsequently pushed during the power stroke, the plunger 80 then forces the fluid under pressure out through the output valve 84 connected to an outlet hose or pipe (not shown).

[Para 10] In contrast to using a crankshaft for a quintuplex well-service pump that has crankpins 62 as discussed above, another type of quintuplex well-service pump uses eccentric sheaves on a direct drive crankshaft. FIG. 4C is an isolated view of such a crankshaft 90 having eccentric sheaves 92-1…92-5 for use in a quintuplex well-service pump. External main bearings (not shown) support the crankshaft 90 at its ends 96 in the well-service pumps housing (not shown). To drive the crankshaft 90, one end 91 extends beyond the pumps housing for coupling to drive components, such as a gear box. The crankshaft 90 has five eccentric sheaves 92-1…92-5 for coupling to connecting rods (not shown) with roller

bearings. The crankshaft 90 also has two internal main bearing sheaves 94-1, 94-2 for internal main bearings used to support the crankshaft 90 in the pump's housing.

[Para 11] In the past, quintuplex well-service pumps used for pumping frac fluid or the like have been substituted for mud pumps during drilling operations to pump mud. Unfortunately, the well-service pump has a shorter service life compared to the conventional triplex mud pumps, making use of the well-service pump as a mud pump less desirable in most situations. In addition, a quintuplex well-service pump produces a great deal of white noise that interferes with MWD and LWD operations, further making the pump's use to pump mud less desirable in most situations. Furthermore, the well-service pump is configured for direct drive by a motor and gear box directly coupling on one end of the crankshaft. This direct coupling limits what drives can be used with the pump. Moreover, the direct drive to the crankshaft can produce various issues with noise, balance, wear, and other associated problems that make use of the well-service pump to pump mud less desirable.

[Para 12] One might expect to provide a quintuplex mud pump by extending the conventional arrangement of a triplex mud pump (*e.g.*, as shown in FIG. 1B) to include components for two additional pistons or plungers. However, the actual design for a quintuplex mud pump is not as easy as extending the conventional arrangement, especially in light of the requirements for a mud pump's operation such as service life, noise levels, crankshaft deflection, balance, and other considerations. As a result, acceptable implementation of a quintuplex mud pump has not been achieved in the art during the long history of mud pump design.

[Para 13] What is needed is an efficient mud pump that has a long service life and that produces low levels of white noise during operation so as not to interfere with MWD and LWD operations while pumping mud in a well.

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BRIEF DESCRIPTION OF THE DRAWINGS

[Para 14] FIG. 1A is a top view of a triplex mud pump according to the prior art.

[Para 15] FIG. 1B is a cross-sectional view of the triplex mud pump's power assembly showing the crankshaft.

[Para 16] FIG. 1C shows the triplex mud pump's pinion shaft.

[Para 17] FIG. 2 is a top view of a quintuplex well service pump according to the prior art.

[Para 18] FIG. 3 is an end-sectional view of the power assembly for the quintuplex well service pump in FIG. 2.

[Para 19] FIG. 4A is a side cross-section of the quintuplex well service pump of FIG. 2.

[Para 20] FIG. 4B is a side view of a bearing for a connector rod coupled to the well service pump's crankpin.

[Para 21] FIG. 4C is an isolated view of another crankshaft having eccentric sheaves for use in a quintuplex well service pump.

[Para 22] FIG. 5 is a top view of a quintuplex mud pump according to the present disclosure.

[Para 23] FIGS. 6A-6B are top and perspective views of the quintuplex mud pump of FIG. 5 showing internal components.

[Para 24] FIG. 7 is an isolated view of the pump's crankshaft.

[Para 25] FIG. 8 is a cross-sectional view of the pump's power assembly showing the crankshaft and roller bearings.

[Para 26] FIG. 9 shows the quintuplex mud pump's pinion shaft.

[Para 27] FIG. 10A shows a cross-section of a crosshead assembly for the quintuplex mud pump.

[Para 28] FIG. 10B shows a cross-section of a fluid assembly for the quintuplex mud pump.

DETAILED DESCRIPTION

[Para 29] A quintuplex mud pump is a continuous duty, reciprocating plunger/piston pump. The mud pump has a crankshaft supported in the pump by external main bearings and uses internal gearing and a pinion shaft to drive the crankshaft. Five eccentric sheaves and two internal main bearing sheaves are provided on the crankshaft. Each of the main bearing sheaves supports the intermediate extent of crankshaft using bearings. One main bearing sheave is disposed between the second and third eccentric sheaves, while the other main bearing sheave is disposed between the third and fourth eccentric sheaves.

[Para 30] One or more bull gears are also provided on the crankshaft, and the pump's pinion shaft has one or more pinion gears that interface with the one or more bull gears. If one bull gear is used, the interface between the bull and pinion gears can use herringbone or double helical gearing of opposite hand to avoid axial thrust. If two bull gears are used, the interface between the bull and pinion gears can use helical gearing with each having opposite hand to avoid axial thrust. For example, one of two bull gears can disposed between the first and second eccentric sheaves, while the second bull gear can be disposed between fourth and fifth eccentric sheaves. These bull gears can have opposite hand. The pump's internal gearing allows the pump to be driven conventionally and packaged in any standard mud pump packaging arrangement. Electric motors (for example, twin motors made by GE) may be used to drive the pump, although the pump's rated input horsepower may be a factor used to determine the type of motor.

[Para 31] Connecting rods connect to the eccentric sheaves and use roller bearings. During rotation of the crankshaft, these connecting rods transfer the crankshaft's rotational movement to reciprocating motion of the pistons or plungers in the pump's fluid assembly. As such, the quintuplex mud pump uses all roller bearings to support its crankshaft and to transfer crankshaft motion to the connecting rods. In this way, the quintuplex mud pump can reduce the white noise typically produced by

conventional triplex mud pumps and well service pumps that can interfere with MWD and LWD operations.

[Para 32] Turning to the drawings, a quintuplex mud pump 100 shown in FIGS. 5 and 6A-6B has a power assembly 110, a crosshead assembly 150, and a fluid assembly 170. Twin drives (*e.g.*, electric motors, etc.) couple to ends of the power assembly's pinion shaft 130 to drive the pump's power assembly 110. As shown in FIGS. 6A-6B, internal gearing within the power assembly 110 converts the rotation of the pinion shaft 130 to rotation of a crankshaft 120. The gearing uses pinion gears 138 on the pinion shaft 130 that couple to bull gears 128 on the crankshaft 120 and transfer rotation of the pinion shaft 130 to the crankshaft 120.

[Para 33] For support, the crankshaft 120 has external main bearings 122 supporting its ends and two internal main bearings 127 supporting its intermediate extent in the assembly 110. As best shown in FIG. 6A, rotation of the crankshaft 120 reciprocates five independent connecting rods 140. Each of the connecting rods 140 couples to a crosshead 160 of the crosshead assembly 150. In turn, each of the crossheads 160 converts the connecting rod 40's movement into a reciprocating movement of an intermediate pony rod 166. As it reciprocates, the pony rod 166 drives a coupled piston or plunger (not shown) in the fluid assembly 170 that pumps mud from an intake manifold 192 to an output manifold 198. Being quintuplex, the mud pump 100 has five such pistons movable in the fluid assembly 170 for pumping the mud.

[Para 34] Shown in isolated detail in FIG. 7, the crankshaft 120 has five eccentric sheaves 124-1 through 124-5 disposed thereon. Each of these sheaves can mechanically assemble onto the main vertical extent of the crankshaft 120 as opposed to being welded thereon. During rotation of the crankshaft 120, the eccentric sheaves actuate in a firing order of 124-1, 3, 5, 2 and 4 to operate the fluid assembly's pistons (not shown). This order allows the crankshaft 120 to be assembled by permitting the various sheaves to be mounted thereon. Preferably, each of the eccentric

sheaves 124-1…124-5 is equidistantly spaced on the crankshaft 120 for balance.

[Para 35] The crankshaft 120 also has two internal main bearing sheaves 125-1 and 125-2 positioned respectively between the second and third sheaves 124-2 and 124-3 and the third and fourth sheaves 124-3 and 124-4. In the present embodiment, the crankshaft 120 also has two bull gear supports 128-1 and 128-2 disposed thereon, although one bull gear may be used by itself in other embodiments. The first bull gear support 128-1 is positioned between the first and second eccentric sheaves 124-1 and 124-2, and the second of the bull gear support 128-2 is positioned between the fourth and fifth eccentric sheaves 124-4 and 124-5.

[Para 36] Preferably, each of the sheaves 124-1…124-5, bull gear supports 128-1 & 128-2, and bearing sheaves 125-1 & 125-2 are equidistantly spaced on the crankshaft 120 for balance. In one implementation for the crankshaft 120 having a length a little greater than 90-in. (*e.g.*, 90.750-in.), each of the sheaves 124, 125 and supports 128 are equidistantly spaced from one another by 9-inches between their rotational centers. The end sheaves 124-1 and 124-5 can be positioned a little over 9-in. (*e.g.*, 9.375-in.) from the ends of the crankshaft 120.

[Para 37] The additional detail of FIG. 8 shows the crankshaft 120 supported in the power assembly 110 and having the connecting rods 140 mounted thereon. As noted above, double roller bearings 122 support the ends of the crankshaft 120 in the assembly 110. Internally, main bearings 123 support the intermediate extent of the crankshaft 120 in the assembly 110. In particular, the main bearings 126 position on the main bearing sheaves 125-1 and 125-2 and are supported by carriers 125 mounted to the assembly 110 at 129. The external main bearings 122 are preferably spherical bearings to better support radial and axial loads. The internal main bearings 125 preferably use cylindrical bearings.

[Para 38] Five connector rods 140 use roller bearings 126 to fit on the eccentric sheaves 124-1…124-5. Each of the roller bearings 126 preferably uses cylindrical bearings. The rods 140 extend from the

sheaves 124-1…124-5 (perpendicular to the figure) and couple the motion of the crankshaft 120 to the fluid assembly (170) via crossheads (160) as is discussed in more detail below with reference to FIGS. 10A-10B.

[Para 39] As shown in FIG. 9, the pinion shaft 130 mounts with roller bearings 132 in the power assembly 110 with its free ends 134 extending on both sides of the assembly 110 for coupling to drive components (not shown). As noted previously, the pinion gears 138 on the shaft 130 interface with the bull gears 128 on the crankshaft (120). Preferably, the interface uses helical gearing of opposite hand. In particular, the two pinion gears 138 on the pinion shaft 130 have helical teeth that have an opposite orientation or hand relative to one another. These helical teeth couple in parallel fashion to oppositely oriented helical teeth on the complementary bull gears 128 on the crankshaft 120. (The opposing orientation of helical teeth on the bull gears 128 and pinion gears 138 can best be seen in FIGS. 6A-6B). The helical gearing transfers rotation of the pinion shaft 130 to the crankshaft 120 in a balanced manner. In an alternative embodiment, the pinion shaft 130 can have one pinion gear 138, and the crankshaft 120 can have one bull gear 128. Preferably, these single gears 138/128 use herringbone or double helical gearing of opposite hand to avoid imparting axial thrust to the crankshaft 120.

[Para 40] The cross-section in FIG. 10A shows a crosshead 160 for the quintuplex mud pump. The end of the connecting rod 140 couples by a wrist pin 142 and bearing 144 to a crosshead body 162 that is movable in a crosshead guide 164. A pony rod 166 coupled to the crosshead body 162 extends through a stuffing box gasket 168 on a diaphragm plate 169. An end of this pony rod 166 in turn couples to additional components of the fluid assembly (170) as discussed below.

[Para 41] The cross-section in FIG. 10B shows portion of the fluid assembly 170 for the quintuplex mud pump. An intermediate rod 172 has a clamp 174 that couples to the pony rod (166; Fig. 10A) from the crosshead assembly 160 of FIG. 10A. The opposite end of the rod 172 couples by another clamp to a piston rod 180 having a piston head 182 on

its end. Although a piston arrangement is shown, the fluid assembly 170 can use a plunger or any other equivalent arrangement so that the terms piston and plunger can be used interchangeably herein. Moved by the pony rod (166), the piston head 182 moves in a liner 184 communicating with a fluid passage 190. As the piston 182 moves, it pulls mud from a suction manifold 192 through a suction valve 194 into the passage 190 and pushes the mud in the passage 190 to a discharge manifold 198 through a discharge valve 196.

[Para 42] As noted previously, a triplex mud pump produces a total flow variation of about 23%. Because the present mud pump 100 is quintuplex, the pump 100 offers a lower variation in total flow, making the pump 100 better suited for pumping mud and producing less noise that can interfere with MWD and LWD operations. In particular, the quintuplex mud pump 100 can produce a total flow variation as low as about 7%. For example, the quintuplex mud pump 100 can produce a maximum flow level of about 102% during certain crankshaft angles and can produce a minimum flow level of 95% during other crankshaft angles as the pump's five pistons move in their differing strokes during the crankshaft's rotation. Being smoother and closer to ideal, the lower total flow variation of 7% produces less pressure changes or "noise" in the pumped mud that can interfere with MWD and LWD operations.

[Para 43] Although a quintuplex mud pump is described above, it will be appreciated that the teachings of the present disclosure can be applied to multiplex mud pumps having at least more than three eccentric sheaves, connecting rods, and fluid assembly pistons. Preferably, the arrangement involves an odd number of these components so such mud pumps may be septuplex, nonuplex, etc. For example, a septuplex mud pump according to the present disclosure may have seven eccentric sheaves, connecting rods, and fluid assembly pistons with at least two bull gears and at least two bearing sheaves on the crankshaft. The bull gears can be arranged between first and second eccentric sheaves and sixth and seventh eccentric sheaves on the crankshaft. The internal main

bearings supporting the crankshaft can be positioned between third and fourth eccentric sheaves and the fourth and fifth eccentric sheaves on the crankshaft.

[Para 44] The foregoing description of preferred and other embodiments is not intended to limit or restrict the scope or applicability of the inventive concepts conceived of by the Applicants. In exchange for disclosing the inventive concepts contained herein, the Applicants desire all patent rights afforded by the appended claims. Therefore, it is intended that the appended claims include all modifications and alterations to the full extent that they come within the scope of the following claims or the equivalents thereof.

WHAT IS CLAIMED IS:

1. A quintuplex mud pump, comprising:
   a crankshaft rotatably supported in the pump by a plurality of main bearings, the crankshaft having five eccentric sheaves and a first bull gear disposed thereon;
   a pinion shaft for driving the crankshaft, the pinion shaft rotatably supported in the pump and having a first pinion gear interfacing with the first bull gear on the crankshaft; and
   five connecting rods, each of the connecting rods disposed on one of the eccentric sheaves of the crankshaft with a roller bearing.

2. The pump of claim 1, further comprising five pistons for pumping mud, each of the connecting rods coupled to one of the pistons.

3. The pump of claim 2, wherein each of the connecting rods couples to a crosshead by a wristpin, and wherein the crosshead couples to the piston.

4. The pump of claim 1, wherein the crankshaft comprises a first internal main bearing sheave disposed between the second and third eccentric sheaves and comprises a second internal main bearing sheave disposed between the third and fourth eccentric sheaves.

5. The pump of claim 1, wherein the pinion shaft has opposing ends extending from the pump for coupling to drive components.

6. The pump of claim 1, wherein the first pinion gear and the first bull gear comprise herringbone gearing.

7. The pump of claim 1, wherein the crankshaft comprises a second bull gear disposed thereon, and wherein the pinion shaft comprises a second pinion gear disposed thereon and interfacing with the second bull gear.

8. The pump of claim 7, wherein the first bull gear is disposed between the first and second eccentric sheaves, and wherein the second bull gear is disposed between the fourth and fifth eccentric sheaves.

9. The pump of claim 7, wherein the five eccentric sheaves, two internal main bearing sheaves, and the first and second bull gears are equidistantly spaced from one another on the crankshaft.

10. The pump of claim 7, wherein the first and second pinion gears comprise helical gearing of opposite hand, and wherein the first and second bull gears comprise helical gearing of opposite hand complementary to the pinion gears.

11. The pump of claim 1, wherein—

the main bearings comprise external main bearings disposed at ends of the crankshaft and each being a spherical bearing,

the main bearings comprise internal main bearings disposed on the crankshaft and each having cylindrical bearings, and

each of the roller bearings for the connecting rods has cylindrical bearings.

12. A quintuplex mud pump, comprising:

a crankshaft rotatably supported in the pump by two external main bearings and two internal main bearings, the crankshaft having five eccentric sheaves, two internal main bearing sheaves for the internal main bearings, and at least one bull gear disposed thereon;

a pinion shaft rotatably disposed in the pump and having at least one pinion gear interfacing with the at least one bull gear on the crankshaft;

five connecting rods, each of the connecting rods using a roller bearing and disposed on one of the eccentric sheaves of the crankshaft; and

five pistons for pumping mud, each of the connecting rods coupled to one of the pistons.

13. The pump of claim 12, wherein each of the connecting rods couples to a crosshead by a wristpin, and wherein the crosshead couples to the piston.

14. The pump of claim 12, wherein the a first of the main bearing sheaves is disposed between the second and third eccentric sheaves, and wherein a second of the main bearing sheaves is disposed between the third and fourth eccentric sheaves.

15. The pump of claim 12, wherein the pinion shaft has opposing ends extending from the pump for coupling to drive components.

16. The pump of claim 12, wherein the at least one pinion gear and the at least one bull gear comprise herringbone gearing.

17. The pump of claim 12, wherein the crankshaft comprises first and second bull gears disposed thereon, and wherein the pinion shaft comprises first and second pinion gears disposed thereon.

18. The pump of claim 17, wherein the first bull gear is disposed between the first and second eccentric sheaves, and wherein the second bull gear is disposed between the fourth and fifth eccentric sheaves.

19. The pump of claim 17, wherein the five eccentric sheaves, the two internal main bearing sheaves, and the first and second bull gears are equidistantly spaced from one another on the crankshaft.

20. The pump of claim 17, wherein the first and second pinion gears comprise helical gearing of opposite hand, and wherein the first and second bull gears comprise helical gearing of opposite hand complementary to the pinion gears.

21. The pump of claim 12, wherein—

each of the two external main bearings is a spherical bearing,

each of the two internal main bearings has cylindrical bearings, and

each of the roller bearings for the connecting rods has cylindrical bearings.

22. A multiplex mud pump, comprising:

a crankshaft rotatably disposed in the pump and supported by main bearings, the crankshaft at least including—

at least one internal main bearing sheave disposed on the crankshaft,

at least five or more eccentric sheaves equidistantly disposed on the crankshaft, and

at least one bull gear disposed on the crankshaft;

a pinion shaft for driving the crankshaft, the pinion shaft rotatably disposed in the pump and having at least one pinion gear interfacing with the at least one bull gear on the crankshaft;

at least five or more connecting rods, each of the connecting rods disposed on one of the eccentric sheaves of the crankshaft with a roller bearing; and

at least five or more pistons for pumping mud, each of the connecting rods coupled to one of the pistons.

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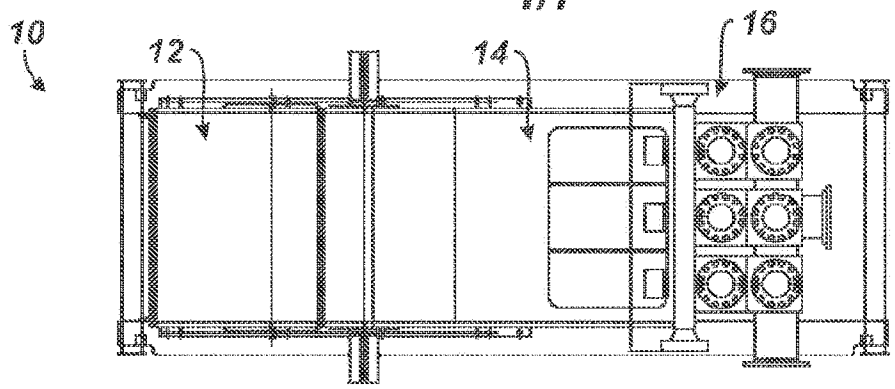


FIG. 1A
(Prior Art)

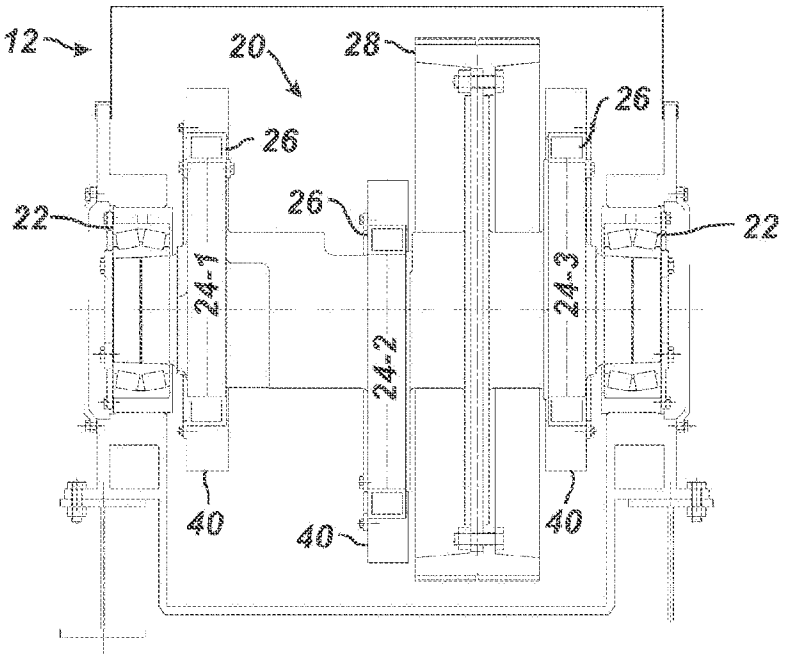


FIG. 1B
(Prior Art)

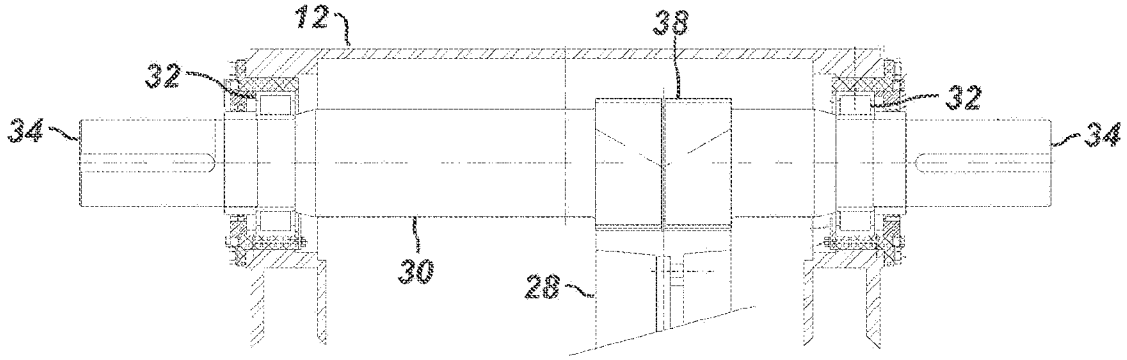


FIG. 1C
(Prior Art)

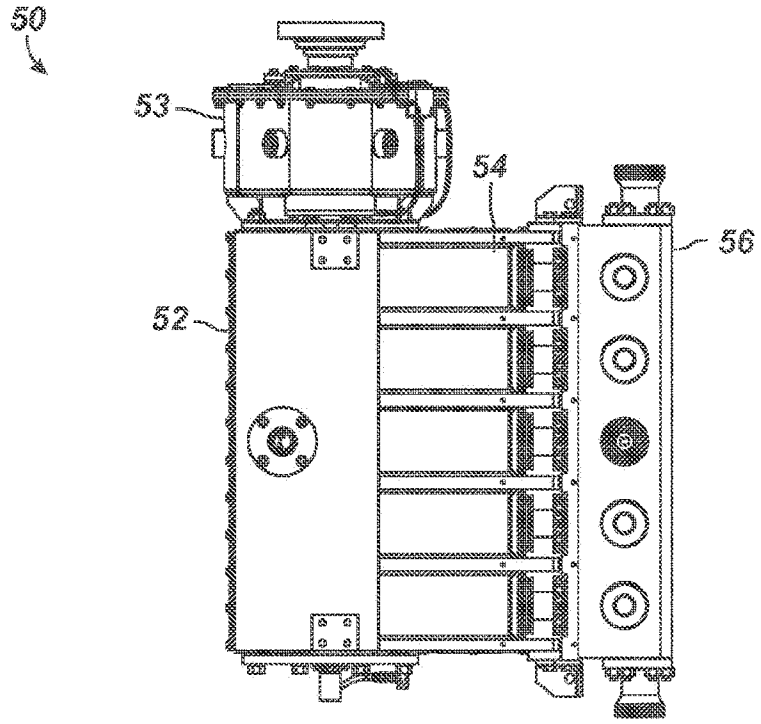


FIG. 2
(Prior Art)

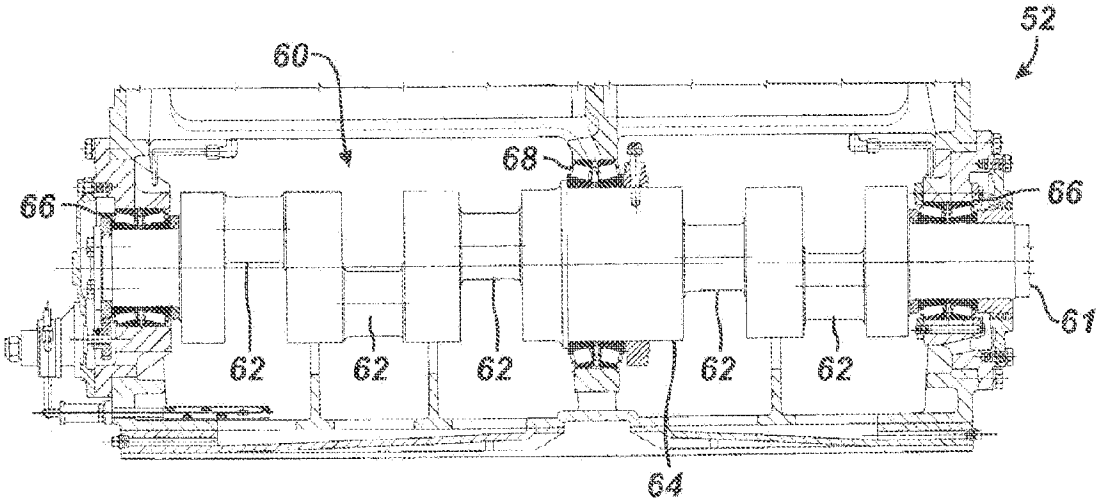


FIG. 3
(Prior Art)

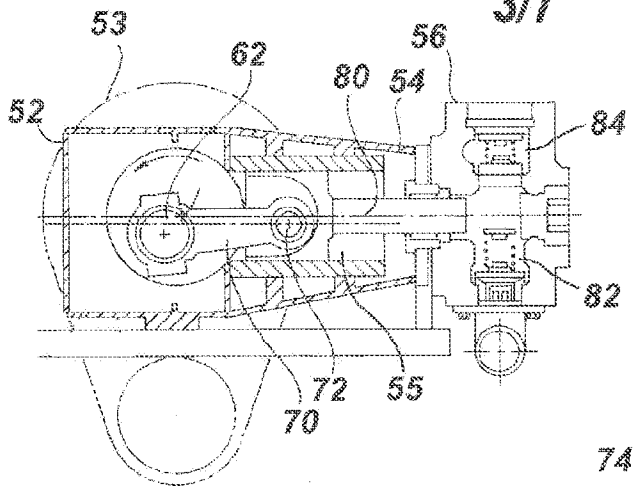


FIG. 4A
(Prior Art)

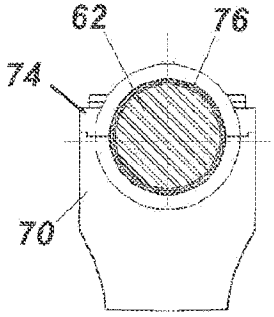


FIG. 4B
(Prior Art)

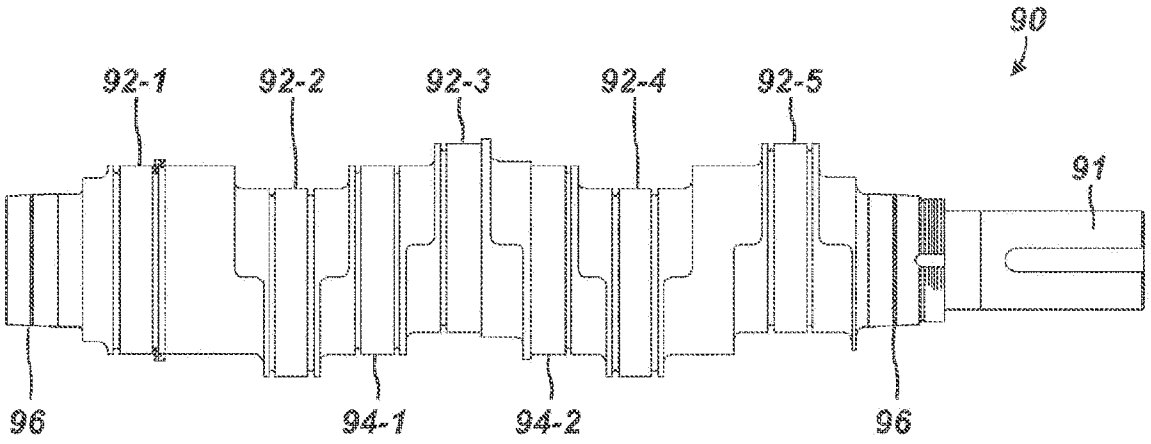


FIG. 4C
(Prior Art)

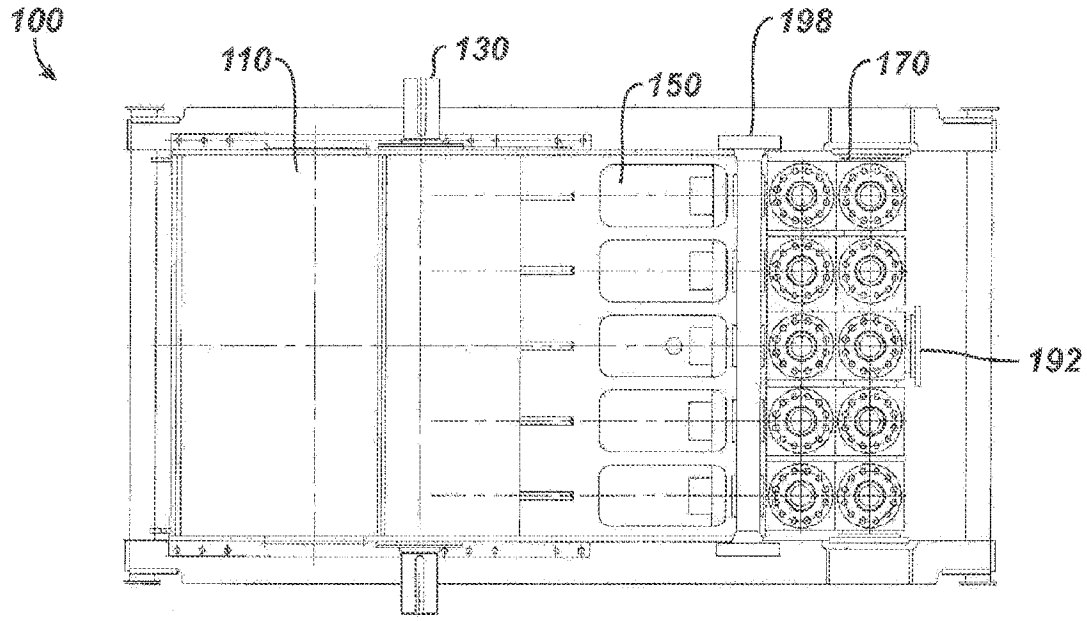

100
110
130
150
198
170
192

FIG. 5

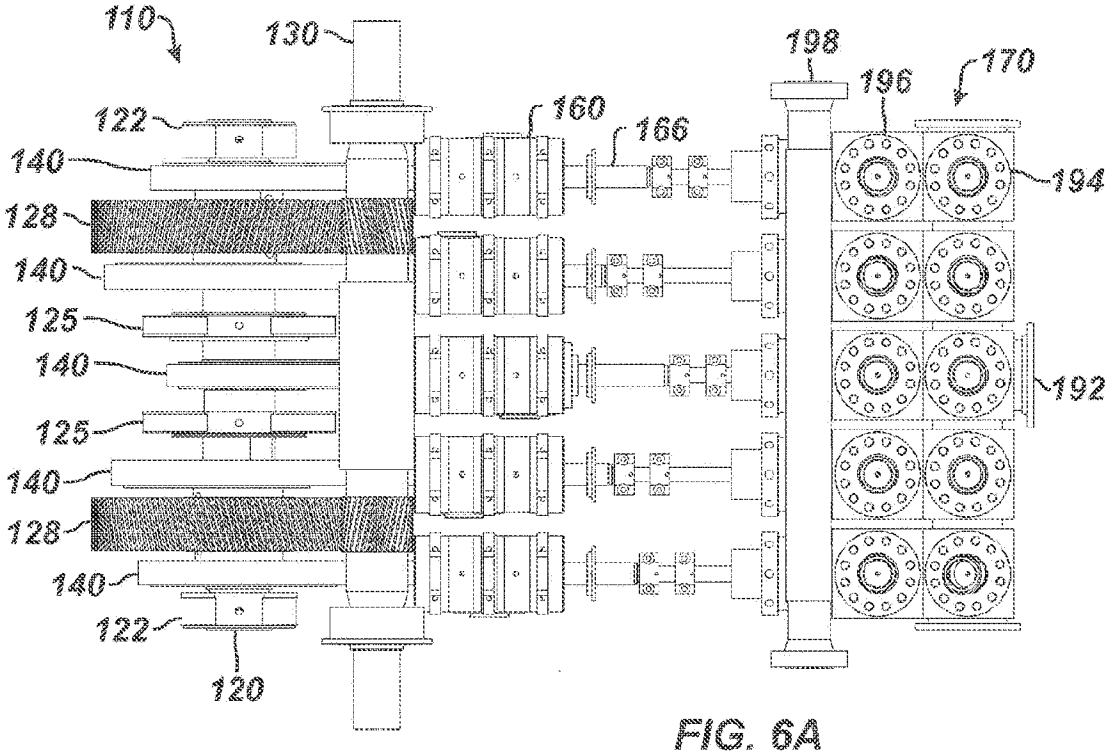

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FIG. 6A

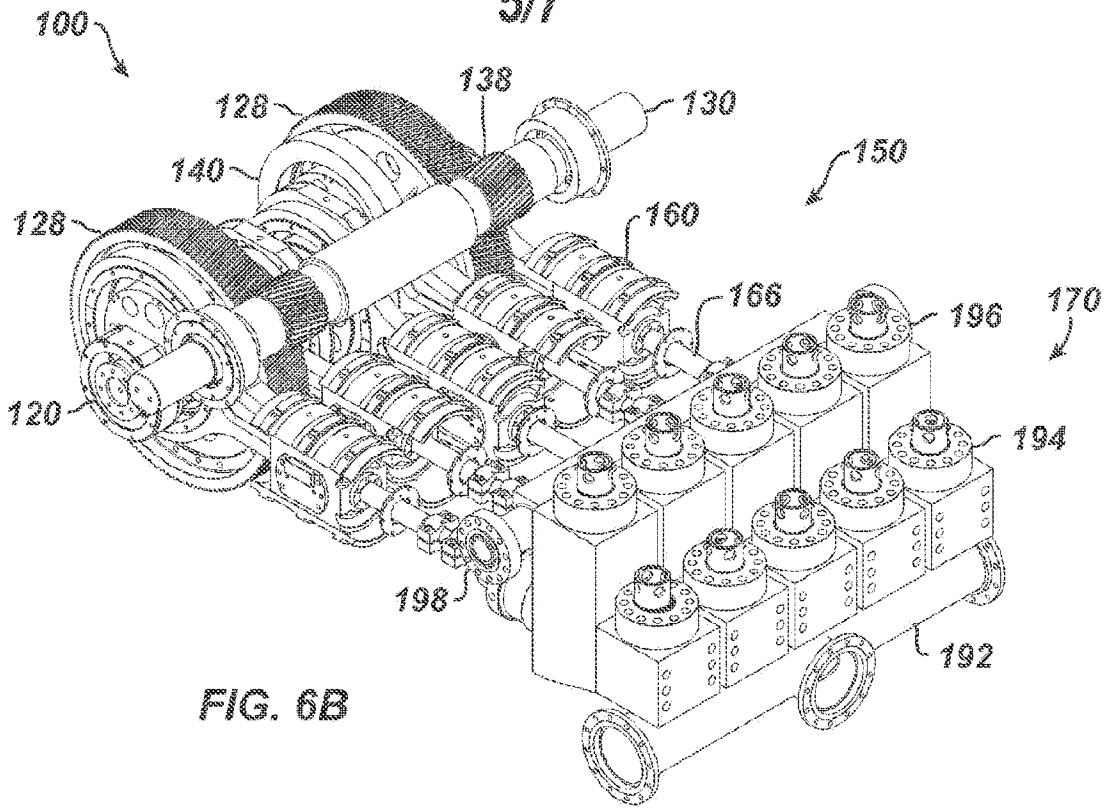

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FIG. 6B

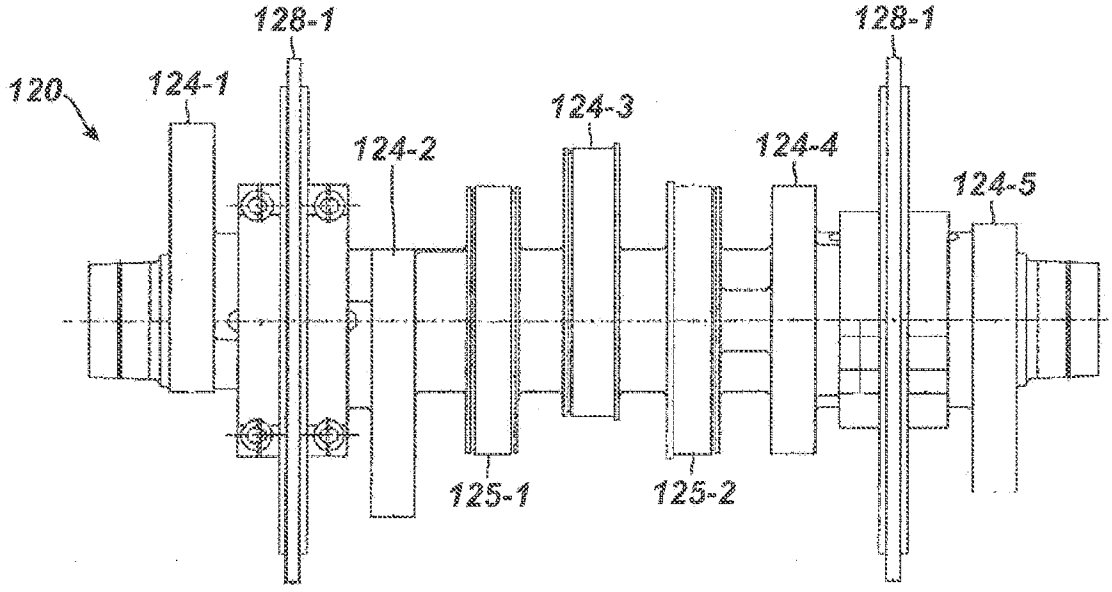

128-1
128-1
120
124-1
124-3
124-2
124-4
124-5
125-1
125-2

FIG. 7

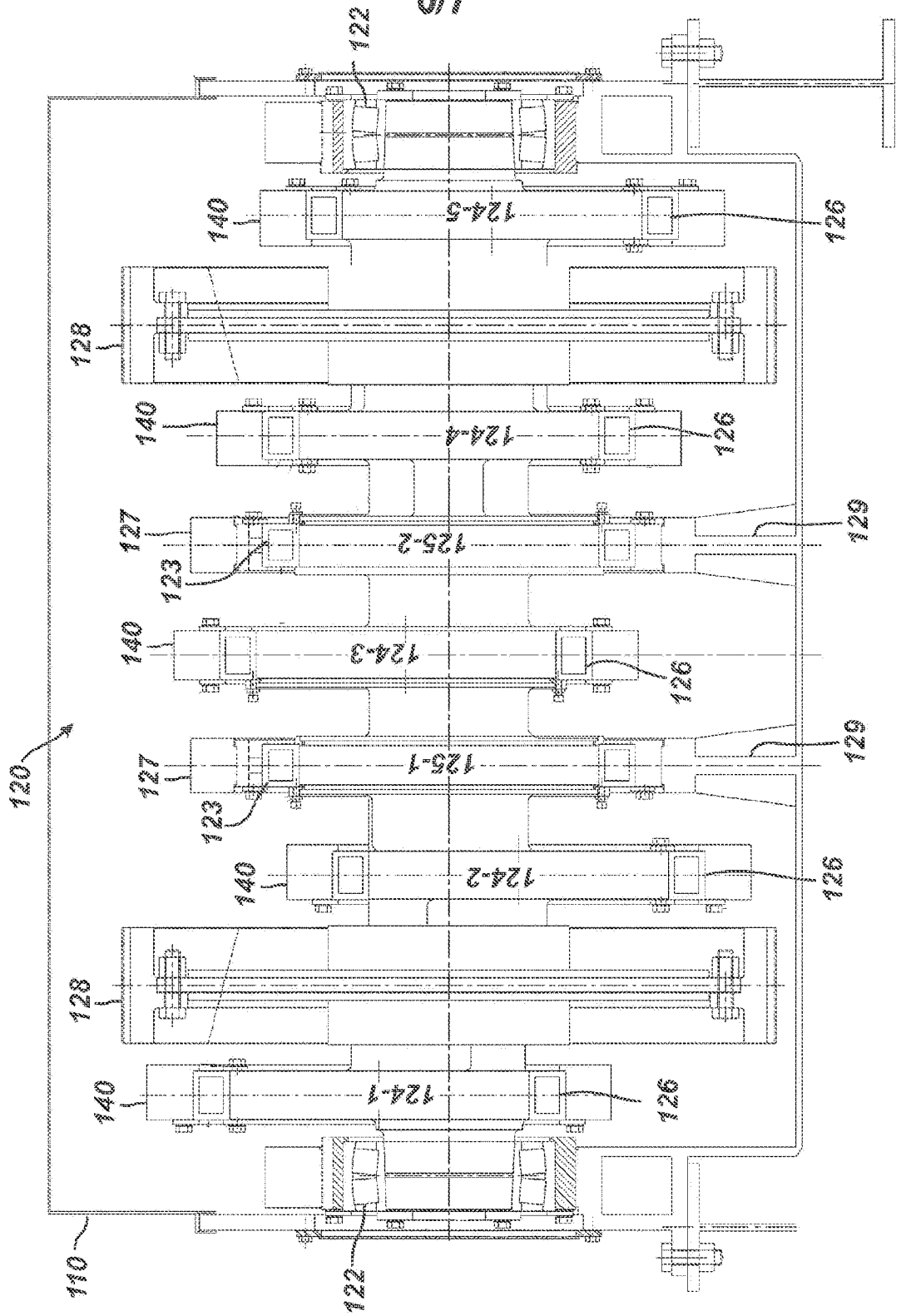

122
140
124-5
126
128
140
124-4
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127
125-2
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123
140
124-3
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125-1
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123
140
124-2
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128
140
124-1
126
110
122

FIG. 8

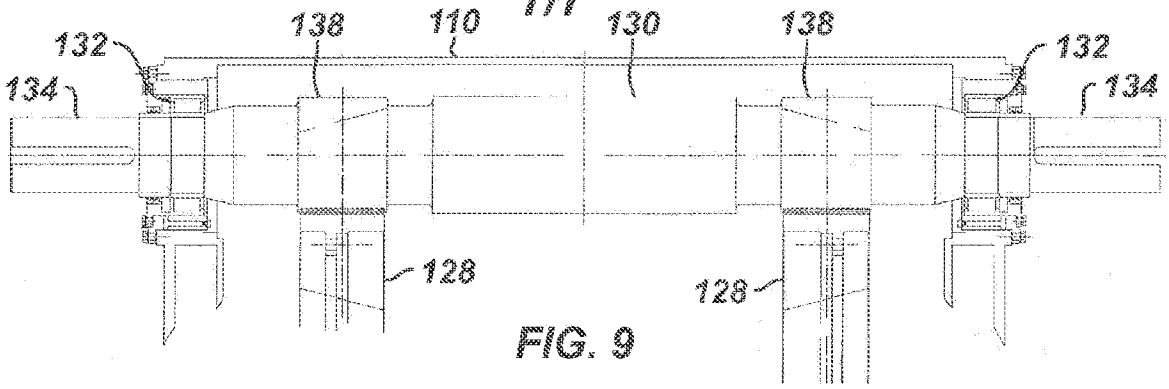


FIG. 9

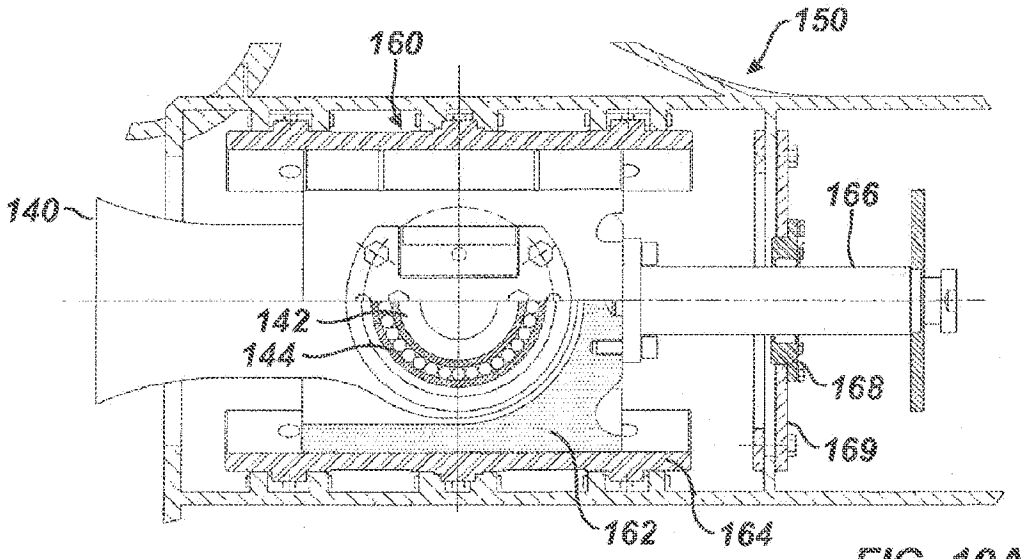


FIG. 10A

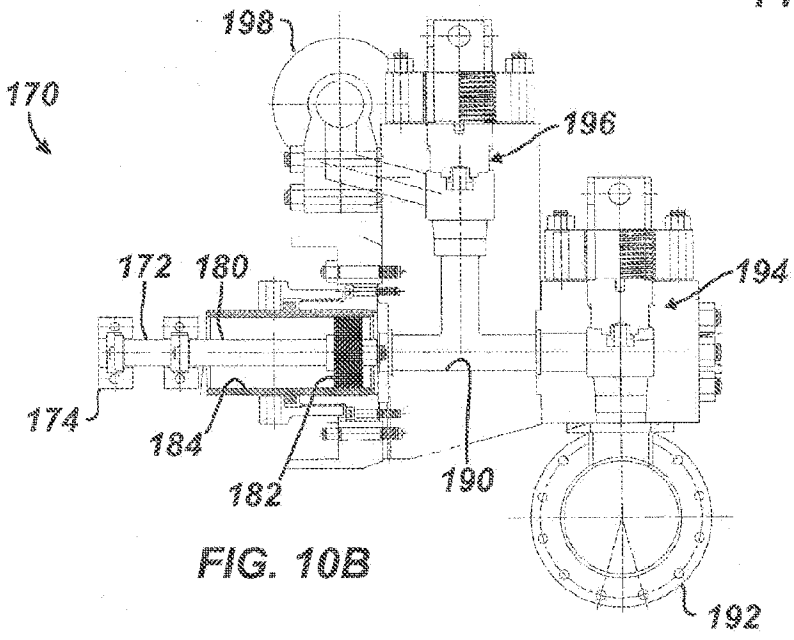


FIG. 10B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2008/078720

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - F16C 3/04 (2008.04)
USPC - 74/595, 596; 475/311; 417/521
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(8) - F16C 3/04 (2008.04)
USPC - 74/595, 596; 475/311; 417/521

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Delphion- mud pump, crankshaft, connecting rod, quintuplex, Micropatent

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4,305,311 A (MCGILL) 15 December 1981 (15.12.1981) entire document	1-3, 5-7, 10, 11, 24
Y	US 2007/0099746 A1 (HAHLBECK) 03 May 2007 (03.05.2007) entire document	1-3, 5-7, 10, 11, 24
Y	US 3,595,101 A (COOPER, SR.) 27 July 1971 (27.07.1971) entire document	1-3, 5-7, 10, 11, 24
Y	US 5,246,355 A (MATZNER et al) 21 September 1993 (21.09.1993) entire document	3

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"O" document referring to an oral disclosure, use, exhibition or other means
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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 November 2008	02 DEC 2008
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. 571-273-3201	Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

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(71) Applicant: **SIEMENS AKTIENGESELLSCHAFT** [DE/DE]; Wittelsbacherplatz 2, 80333 München (DE).

(72) Inventor: **KAARSTAD, Vemund**; Idas vei 94, N-0981 Oslo (NO).

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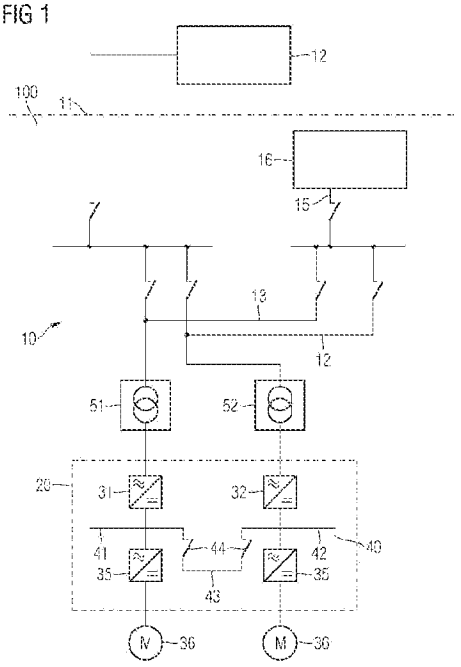
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(54) Title: POWER SYSTEM FOR A FLOATING VESSEL

FIG 1



(57) Abstract: A power system for a floating vessel is provided, in particular for a drilling vessel. The power system includes an external power feed connection (11) which is electrically connectable to an external power source (12) which is external to the floating vessel (100), the external power feed connection (11) being adapted to receive AC electric power from the external power source (12); a further power feed connection (15) adapted to receive AC electric power from a further power source (16); and a drive system (20) for driving electric motors (36) of the floating vessel, wherein the drive system comprises a DC-bus (40) and at least a first rectifier (31) and a second rectifier (32) which are configured to receive AC electric power and to provide DC electric power to the DC-bus (40).

WO 2014/177346 A1

Description

Power system for a floating vessel

Field of the invention

The present invention relates to a power system for a floating vessel, in particular for a drilling vessel, such as a drill ship, a jack-up rig, a floating drilling platform or the like. The invention further relates to a method of operating a power system of a floating vessel.

Background

In offshore oil production, floating drilling vessels such as offshore platforms, drilling rigs, jack-up rigs or drill ships are used for exploratory offshore drilling and for drilling offshore wells. Several technical difficulties are involved in offshore drilling.

Generally, such drilling vessel will have an onboard power generation system for generating the electric power required to operate the drilling equipment. Drilling equipment may for example comprise a top drive, drawworks for raising and lowering the drill string, mud pumps and the like. A substantial amount of electric power can be required for operating such equipment. In difficult conditions, the drilling equipment may for example require an electric power of up to 10 MW. A drilling vessel further comprises other electric consumers requiring a substantial amount of electric power, such as a jacking system of a jack-up rig, anchor winches, cranes and auxiliary devices (e.g. cooling and lubrication pumps) of such systems.

Onboard power generation may occur by means of a prime mover, such a a diesel engine or a gas turbine, coupled to a generator. Accordingly, such onboard power systems generally have relatively high fuel consumption. This contributes to the

substantial operational costs of such vessel. Also, the high and fluctuating load on the generators and prime movers often results in excessive wear of components. If the power generation system needs to be tested, inspected or serviced, a drilling operation generally needs to be interrupted, resulting in significant financial losses for the operator of the vessel.

Accordingly, it is desirable to provide electric power to a vessel from a power source other than the onboard power generation system. In general, this is difficult since the onboard power system is usually configured to operate at a particular AC frequency of the generated AC electric power. Accordingly, if the power system of such floating vessel is to be connected to an external power source, it is required to adjust the AC frequency of the external power source to the AC frequency of the power system of the floating vessel. One possibility might be the use of a containerized frequency converter, which can be connected between the external power source and the power system of the floating vessel to achieve a frequency adaptation. Such solution, however, suffers from the additional space requirements and the additional weight of such converter, as well as from the required installation efforts. The additional weight may be above 100 t, which in turn has significant cost implication, with space and weight on such floating vessel being a valuable asset.

Summary

Accordingly, there is a need for a power system for a floating vessel which mitigates at least some of the drawbacks mentioned above. In particular, there is a need for a power system which enables a flexible use of power provided by a power source external to the floating vessel.

This need is met by the features of the independent claims. The dependent claims describe embodiments of the inventions.

An embodiment of the invention provides a power system for a floating vessel, in particular for a drilling vessel, such as a jack-up rig. The power system comprises an external power feed connection which is electrically connectable (e.g. via a switch) to an external power source which is external to the floating vessel, the external power feed connection being adapted to receive AC (alternating current) electric power from the external power source and a further power feed connection adapted to receive AC electric power from a further power source, in particular from an onboard power generation system. The power system further comprises a drive system, such as a drilling drive system, for driving electric motors of the floating vessel, wherein the drive system comprises a DC-bus and at least a first rectifier and a second rectifier which are configured to receive AC electric power and to provide DC (direct current) electric power to the DC-bus. The external power feed connection is electrically connectable (e.g. via a switch) to the first rectifier of the drive system and the further power feed connection is electrically connectable (e.g. via a switch) to the second rectifier of the drive system such that in operation, electric power can be supplied to the DC-bus from the external power feed connection via the first rectifier and the from the further power feed connection via the second rectifier.

In such configuration, the power system of the floating vessel may be operated with AC electric power at a first frequency received on the external power feed connection and with AC electric power at a different second AC frequency received on the further power feed connection, e.g. from an onboard power generation system or a second external power source. This way, a flexible use of an external power source is enabled while at the same time, a redundant power supply for the drive system is realized. Accordingly, if e.g. the connection to the external power source is cut, the drive system may continue to operate on AC electric power supplied from the further power feed connection. Electric power may be provided to the DC-bus simultaneously from the external power

feed connection and from the further power feed connection. Since no additional containerized converter needs to be provided, significant savings in space, weight and cost may be achieved with the power system.

In an embodiment, the power system is configured to have at least a first mode of operation in which the external power feed connection is connected to the first rectifier to supply electric power to the first rectifier, the external power feed connection being disconnected from the second rectifier, in which the further power feed connection is connected to the second rectifier to supply electric power to the second rectifier, the further power feed connection being disconnected from the first rectifier, and in which the first and the second rectifiers provide electric power to the DC bus. The first mode of operation is such that the external power source and the first power source do not need to be synchronized. Accordingly, if the further power source operates at e.g. 50 Hz, external power sources operating at 50Hz or 60Hz can be connected via the external power feed connection. The floating vessel can thus be connected to an offshore power source, e.g. an offshore petroleum production unit, irrespective of the frequency at which the power system of such unit operates. Further, it is possible that the external power feed connection is disconnected or interrupted without prior notice, since the power system for the floating vessel remains operable without any gap in the power supply since the DC bus is fed in parallel from the further power source, e.g. an onboard generator.

The drive system may be a variable speed drive system adapted to drive the electric motors at variable speed. It may accordingly include one or more inverters coupled to the DC-bus and to an electric motor for supplying AC electric power at variable frequency to the respective electric motor.

In an embodiment, the power system is adapted to be capable of operating the drive system at the same time with AC elec-

tric power received at a first AC frequency at the external power feed connection and AC electric power received at a second AC frequency at the further power feed connection, the second AC frequency being different from the first AC frequency. Accordingly, the power system can be connected to an external power source irrespective of the AC frequency which the onboard power system is configured for.

In an embodiment, the power system is further configured such that the external power feed connection is electrically connectable to the second rectifier and the further power feed connection is electrically connectable to the first rectifier of the drive system. An increased availability and operational flexibility of the power system may thus be achieved. Also, if a rectifier or a power source fails, the power system may still be operable by appropriately switching the respective electrical connections, so that fault protection of the power system can be improved.

In an embodiment, the power system is configured such that the first rectifier is selectively connectable to either the external power feed connection or the further power feed connection (and disconnected from the respective other power feed connection) and such that the second rectifier is selectively connectable to either the external power feed connection or the further power feed connection (and disconnected from the respective other power feed connection).

In an embodiment, the power system further comprises a first AC transformer, an output of which is connectable to the first rectifier and a second AC transformer, an output of which is connectable to the second rectifier. The external power feed connection is connectable (e.g. via a switch) to the input of the first AC transformer and the further power feed connection is connectable (e.g. via a switch) to the input of the second AC transformer. The AC transformers are thus connected between the respective power feed connection and the respective rectifier. The first and the second AC

transformers may be configured to be operable at at least two different AC frequencies of AC electrical power received at the input of the respective transformer. By providing the transformers, the appropriate voltage can be supplied to the drive system. Further, by enabling operation of the transformers at different AC frequencies, flexibility of the power system is ensured. Electric power at different AC frequencies can thus be provided via the external power feed connection and via the internal power feed connection.

The power system may for example be configured to be operable at an AC frequency within the range of about 40 to about 120 Hz, preferable of about 45 to about 70 Hz. It may for example be configured to be operable at least at an AC frequency of about 50 Hz and of about 60 Hz of the AC electric power received on the external power feed connection.

In an embodiment, the drive system is a drilling drive system and is powering an electric motor of at least one of a mud pump, a cement pump, draw works or a top drive. It may be adapted to power these motors at variable frequency, so that they can be operated at variable speed.

The power system may be adapted to deliver an electric power of at least 0.5 MW, preferably at least 1.0 MW to the drive system. For example, the delivered electric power may lie within a range of about 0.5 to about 25 MW.

The power system may be configured such that an electric power within the range of about 0.5 to about 10 MW can be supplied from the external power feed connection to the drive system.

In an embodiment, the drive system comprises a first drive system including the first and second rectifiers and a second drive system for driving electric motors of the floating vessel, wherein the second drive system comprises a DC-bus and at least a third rectifier and a fourth rectifier which are

configured to receive AC electric power and to provide DC electric power to the DC-bus. The external power feed connection is electrically connectable (e.g. via a switch) to the third rectifier of the second drive system and the further power feed connection is electrically connectable (e.g. via a switch) to the fourth rectifier of the second drive system such that in operation, electric power can be supplied to the DC-bus of the second drive system from the external power feed connection via the third rectifier and from the further power feed connection via the fourth rectifier. In the first mode of operation, the external power feed connection may be connector to the third rectifier but disconnected from the further rectifier, and the further power feed connection may be connected to the fourth rectifier but disconnected from the third rectifier. Accordingly, also the second drive system can be powered even if the external power source and the further power source are not synchronous and the external power source can be disconnected without any interruption in the power supply of the drives (e.g. in case of an emergency disconnect).

As mentioned above, electric connections can further be provided for connecting the third rectifier to the further power feed connection and for connecting the fourth rectifier to the external power feed connection. Accordingly, an improved resistivity against faults in the power system can be achieved, and operation may be continued even in case of a blackout of some part of the power system.

Similar to what was mentioned above, a corresponding AC transformer may be connected before each of the third and fourth rectifiers.

The AC-transformers may be three or four winding transformers. In some configurations, an AC transformer may have three secondary windings, providing three phase shifted AC power outputs for rectification. In other embodiments, an AC transformer may have three secondary windings which provide two

phase shifted AC power outputs for rectification and a further auxiliary power output (which may for example be at a different voltage and/or phase). Transformers of one or the other configuration can be used together in the power system.

Each of the first, second, third and fourth rectifiers may comprise one or more rectifiers, e.g. two, three or more. As an example, the AC transformer may provide three phase shifted AC power outputs, and each of said rectifiers may comprise three rectifiers, one connected to each AC power output. This way, harmonic distortions may be decreased and a relatively smooth DC voltage may be obtained on the DC bus.

In an embodiment, the power system has at least a first part and a second part that are physically separate on the floating vessel. The further power source comprises a first generator set in the first part (A-side) (e.g. in a first engine room) and a second generator set in the second part (B-side) (e.g. in a second engine room). The first part comprises the first drive system and the second part comprises a second drive system including at least a third and a fourth rectifier. In each drive system, one rectifier is selectively connectable to either the external power feed connection or the first generator set without being connected to the second generator set, and one rectifier is selectively connectable to either the external power feed connection or the second generator set without being connected to the first generator set. Accordingly, redundancy can be provided in the power system and the reliability is improved. Since each drive if provided with electric energy both from the first part and the second part of the vessel (i.e. form the A-side and from the B-side of the power system), a fire or flooding on one part of the vessel will not lead to a blackout of a drive system. Rather, both drive systems can remain operational.

In an embodiment, the second drive system is a cantilever drilling drive system provided on a cantilever of the floating vessel, the second drive system being configured to drive

at least a top drive of a drilling system of the floating vessel. Accordingly, it becomes possible to operate major drilling equipment with electric power supplied from the external power feeder connection.

A cantilever may be a movable part of the floating vessel which includes a drill tower and which is moved out from the deck of the vessel when the vessel is about to drill. In an example embodiment, the first drive system may be a hull drive system which powers electric motors of a mud pump and a cement pump, and the second drive system may be a cantilever drive system which may power the electric motors of draw works of the drill string and of a top drive.

In an embodiment, the floating vessel is a jack-up rig, wherein the power system is further configured to provide electric power to a jacking drive system having two or more variable frequency drives for driving electric motors of a jacking system of the jack-up rig, wherein the external power feed connection is electrically connectable to a first of the at least two variable frequency drives and wherein the further power feed connection is electrically connectable to a second of the at least two variable frequency drives of the jacking drive system. Accordingly, also a jacking operation may be power from electric power received via the external power feed connection.

In an embodiment, the DC-bus of the drive system may comprise a first bus section coupled to the first rectifier and a second bus section coupled to the second rectifier. In operation, the first bus section may be connected to the second bus section. The first bus section may for example be connected to the second bus section by means of a bus tie comprising one or more bus tie breakers. One section of the drive system may thus be isolated from the other section (by opening the bus tie breaker), e.g. to prevent fault propagation or the like. After a fault in one part of the drive system, the other part may thus continue to operate.

In an embodiment, the further power feed connection is an onboard power feed connection and the further power source is an onboard power generation system located onboard the floating vessel. The onboard power generation system may for example comprise a prime mover, such as a diesel engine or a gas turbine, and a generator connected thereto. This way, redundancy of the power supply can be achieved while only a single external connection is required.

In other embodiments, the further power feed connection may be a second external power feed connection and the further power source may be a second external power source external to the floating vessel. This way, redundancy of the power supply can be achieved.

In an embodiment, the power system further comprises an (first) external power feed switchgear having a power input which is connected to the external power feed connection and a power output which is connectable to the first rectifier, the external power feed switchgear having switches for switching at least the power output, wherein the power system comprises an electric connection from the onboard power generation system to the power output of the external power feed switchgear. The electric connection may be a switchgear-internal connection, i.e. a connection from the onboard power generating system to the switchgear, which is internally connected to the switchgear output.

The external power feed switchgear is generally located onboard the floating vessel, the term 'external power feed' is used since it may switch the external power feed connection.

If an AC transformer is provided, the electric connection from onboard power generation system to the power output of the external power feed switchgear is preferably before the transformer, so that either the electric power from the ex-

ternal power feed switchgear or from the onboard power generation system is supplied to the transformer (e.g. dependent on the switching state).

In an embodiment, the power system further comprises a second external power feed switchgear having a power input which is connectable to the first external power feed switchgear and/or to a second external power feed connection which is configured to receive AC electric power from a second external power source.

The second external power feed switchgear may for example be located in a different switchgear room, so as to achieve physical separation, increasing the operational safety against fire and the like. By providing a second external power feed switchgear which can be selectively connected to either the first external power feed switchgear and thus to the external power feed connection, or to a second external power feed connection, the power system may be operated with one or two external power feed connection, e.g. for providing redundancy in the external power supply.

In an embodiment, the power system further comprises an onboard power generation switchgear having a power input connected to the onboard power generation system and having a power output connectable to the second rectifier, wherein the onboard power generation switchgear has switches for switching the power input or the power output or both.

The power system may further comprise a second onboard power generation switchgear having a power input connected to the onboard power generation system, wherein the power input of the first onboard power generation switchgear is connected to a first set of generators and the power input of the second onboard power generation switchgear is connected to a second set of generators of the onboard power generation system. Accordingly, safety of the system against blackout can be improved. If one switchgear or one set of generators should

fail, operation can continue with the other switchgear or the other set of generators.

In an embodiment, the first and second onboard power generation switchgears each comprise an AC bus, the AC buses of the first and second onboard power generation switchgears being interconnected by means of a bus tie comprising one or more bus tie breakers.

Preferably, the first and second sets of generators are provided in different engine rooms of the floating vessel. Continued supply with electric power can thus be ensured, e.g. if the external power feed connection is cut and on generator set is failing, e.g. due to fire in an engine room.

In an embodiment, the power system may be a redundant power system. A first part of the power system (A-side) may comprise the first external power feed switchgear and the second onboard power generation switchgear, whereas a second part of the power system (B-side) may comprise the second external power feed switchgear and the first onboard power generation switchgear. A-side and B-side of the power system may be provided in physically separate rooms on the floating vessel, e.g. in separate switchboard rooms.

The power system can be configured such that the first rectifier is supplied with AC electric power from the A-side and the second rectifier is supplied with electric power from the B-side of the power system. Accordingly, if a rectifier or one side of the power system fails, the drive system can still be supplied with electric power via the other side of the power system and the other rectifier. By means of the DC-bus, in particular the interconnected DC-bus sections, most if not all loads of the drive system can still be supplied with electric power.

The above mentioned second drive system may be configured and connected correspondingly, so that its at least two rectifi-

ers can be supplied with electric power from the A-side or the B-side of the power system.

In an embodiment, the power system is configured to enable an autonomous supply of the drive system with electric power from the onboard power generation system of the floating vessel when the external power feed connection is not connected to an external power source, and to enable a simultaneous supply of the drive system with electric power from the onboard power generation system and from an external power source when the external power feed connection is connected to the external power source. A continued drilling operation may thus be achieved, even is the external power source is suddenly disconnected or stops the supply of electric power.

The external power feeder connection may be provided by a power cable, in particular an three phase power cable or three single phase power cables, and it may be termed 'cable interconnect'. The external power source may for example be provided by a power generation system of a fixed offshore platform, or of another floating vessel, such as a floating offshore rig or production vessel, e.g. a semi-submersible offshore platform. As an example, the other fixed platform or vessel may produce a surplus of electric power, e.g. when a surplus of gas is available during production, and may export this surplus of electric power via the cable interconnect to the power system of the floating vessel.

A further embodiment according to the invention provides a method of operating a power system of a floating vessel, in particular of a drilling vessel, the power system comprising a drive system for driving electric motors of the floating vessel, wherein the drive system comprises a DC-bus and at least a first rectifier and a second rectifier configured to receive AC electric power and to provide DC electric power to the DC-bus. The method comprises the steps of connecting an external power feed connection to an external power source which is external to the floating vessel for receiving AC

electric power from the external power source; connecting a further power feed connection to a further power source for receiving AC electric power from the further power source (e.g. by closing a corresponding switch); connecting the external power feed connection to the first rectifier of the drive system; connecting the further power feed connection to the second rectifier of the drive system; and operating the power system such that electric power is supplied to the DC-bus from the external power feed connection via the first rectifier and the from the further power feed connection via the second rectifier.

With such method, advantages similar to the ones outlined further above with respect to the power system may be achieved. The power system can be configured in accordance with any of the above outlined embodiments.

In an embodiment, the method may further comprise the steps of receiving AC electric power on the external power feed connection at a first AC frequency and receiving electric power on the further power feed connection at a second AC frequency different to the first AC frequency. Accordingly, the drive system may be fed by AC electric power at two AC frequencies, enabling a flexible use of the power system with respect to the import of electric power via the external power feeder connection.

The features of the embodiments of the invention mentioned above and those yet to be explained below can be combined with each other unless noted to the contrary. In particular, the power system may be configured as described with respect to embodiments of the method, whereas the method may be performed by means of a power system in any of the above outlined configurations.

Brief description of the drawings

The foregoing and other features and advantages of the invention will become further apparent from the following detailed description read in conjunction with the accompanying drawings. In the drawings, like reference numerals refer to like elements.

Figure 1 shows a schematic diagram of a power system of a floating vessel according to an embodiment of the invention.

Figure 2 shows a schematic diagram of a power system of a floating vessel according to an embodiment of the invention, wherein redundancy is provided in the power system.

Detailed description

In the following, embodiments of the invention will be described in detail with reference to the accompanying drawings. It is to be understood that the following description of the embodiments is given only for the purpose of illustration and is not to be taken in a limiting sense.

The drawings are to be regarded as being schematic representations only, and elements in the drawings are not necessarily to scale with each other. Rather, the representation of the various elements is chosen such that their function and general purpose become apparent to a person skilled in the art. It is also to be understood that the coupling of physical or functional units as shown in the drawings and described hereinafter does not necessarily need to be a direct connection or coupling, but may also be an indirect connection or coupling, i.e. a connection or a coupling with one or more additional intervening elements. The skilled person will further appreciate that the physical or functional units illustrated and described herein with respect to the different embodiments do not necessarily need to be implemented as physically separate units. One or more physical or functional blocks or units may be implemented in a common circuit, chip, circuit element or unit, while other physical or functional

blocks or units may be implemented in separate circuits, chips, circuit elements or units.

The term 'connectable' as used herein may include providing an electric coupling which can but does not need to comprise one or more intervening elements (such as switches, fuses, transformers or the like). It can be a permanent electric coupling or a switchable electric coupling. A switch may be provided for selected electric connections, for example as illustrated in the figures.

Figure 1 is a schematic diagram of a power system 10 of a floating vessel 100. The components of the power system 10 are installed on the floating vessel 100. The floating vessel 100 may for example be a floating offshore platform, a jack-up rig or a ship, it may in particular be a drilling vessel, i.e. a drilling platform, a drilling rig or a drill ship.

Power system 10 comprises an external power feed connection 11 towards an external power source 12, which is external to the vessel 100. This external power source 12 may for example be provided by power generation equipment on a fixed offshore platform or of another floating vessel, which may for example generate excess power that can be used onboard the vessel 100. For this purpose, the external power feed connection 11 is adapted to receive AC electric power from the external power source 12. The external power feed connection may for example be provided by an electric power cable, in particular by a three phase electric power cable, or an alternative arrangement for transferring three phase AS electric power to the power system 10.

The power system 10 comprises a further power feed connection 15, which in the embodiment of figure 1 is a connection to a onboard power generation system 16. This system may for example comprise generators and prime movers, such as diesel engines of gas turbines, installed on the floating vessel 100. In other embodiments, the further power feed connection may

be a connection to another external power source (not shown) which is external to the vessel 100.

The power system 100 further comprises a drive system 20 for driving electric motors 36 of the vessel 100. It is in particular a variable speed drive system which can provide AC electric power to the electric motors 36 at a variable AC frequency. For this purpose, the drive system 20 comprises at least a first rectifier 31 and a second rectifier 32 which, at their respective inputs, receive AC electric power. In operation, they rectify the received AC electric power and at their respective outputs provide DC electric power to a DC-bus 40 of the drive system 20.

The DC-bus 40 has two bus sections 41 and 42, which can be interconnected by means of the bus tie 43 by closing respective bus tie breakers 44. This way, in case of a fault of a component connected to one DC-bus section, the DC-bus section can be disconnected and operation can continue with the other DC-bus section. In normal operation, the bus tie breakers 44 are closed, thus providing a common DC-bus 40 into which both rectifiers 31, 32 feed DC electric power.

Two or more inverters 35 can be connected to the DC-bus 40 for providing AC electric power at variable AC frequency to electric motors 36. It should by clear that any number of inverters 35 may be connected to the DC-bus 40, and that the number of inverters does not need to match the number of rectifiers.

The drive system 20 is for example a drilling drive system. The electric motors 36 can comprise electric motors of a top drive, mud pumps, of cement pumps, of drawworks or the like. Accordingly, the drive system 20 needs to be supplied with electric power of considerable magnitude, e.g. within a range of about 0.5 to about 25 MW. It should be clear that the particular power requirement will depend on the configuration of the drive system 20 and the vessel 100.

As can be seen from the drawing, the external power feed connection 11 is connectable, via respective switches and via a first AC transformer 51, to the first rectifier 31. Further, the further power feed connection 15, hereinafter termed onboard power feed connection, is connectable to the second rectifier 32 via respective switches, the electric connection 12 and the AC transformer 52. Accordingly, the DC-bus 40 can be fed with electric power from both the external power feed connection 11 and the onboard power feed connection 15 by closing the respective switches, which may be implemented as circuit breakers (CBs).

Using such electric connections, it is possible to supply electric power at a first AC frequency via the first rectifier 31 and AC power at a second AC frequency via the second rectifier 32. Since the electric power is first rectified and then fed to a common DC bus, a power supply from the two power sources becomes possible without requiring synchronization. Accordingly, the external power feed connection 11 can be connected to a external power source 12 irrespective of the AC frequency at which the external power source 12 provides electric power. As an example, the onboard power generation system 16 may operate at an AC frequency of 60 HZ, while the external power source 12 may provide power at an AC frequency of 50 Hz, or vice versa. The power system can operate the drive system 20 simultaneously on the electric power from both power sources. Power balancing can thus occur on the common DC-bus 40.

Furthermore, the external power feed connection 11 is connectable to the second rectifier 32 via respective switches and the second AC transformer 52. Also, the further power feed connection 15 is connectable via respective switches, the electric connection 13 and the first AC transformer 51 to the first rectifier 31. Accordingly, an improved protection against blackout of the power system 10 can be provided, since for example if the external power source 12 is not con-

nected and rectifier 32 or transformer 52 should fail, the DC-bus 40 can still receive electric power from the onboard power generation system 16 via the first rectifier 31.

In the described configuration, the power provided via the external power feed connection 11 can be fully used, while the power required from the onboard power generation system 16 can be reduced. This leads to significant fuel savings on the vessel 100. Also, due to a higher available power, drilling efficiency may be improved. Continuous drilling operation can be ensured even if the power supply by the external power source 12 is shed, e.g. due to a blackout or other problems on the respective other platform or vessel. In such case, the DC-bus 40 is still supplied with electric power via the onboard power generation system 16, which can as a response increase its power output. Redundancy in the power supply is thus achieved.

The transformers 51 and 52 are adapted to convert the AC power received from the external power source 12 and from the onboard power generation system 16 to an AC voltage suitable for operating the drive system 20. They may for example be adapted to convert from a medium voltage range (e.g. between 5000 V and 20000 V) to a low voltage range (e.g. between 200 V and 1000 V). Other voltage ranges are also conceivable.

The transformers 51 and 52 are adapted to be operable within a AC frequency range. Preferably, they are adapted to be at least operable at an AC frequency of 50 HY and at an AC frequency of 60 Hz. This way, flexibility regarding the AC frequency of the power supplied via the external power feed connection 11 or the further power feed connection 15 can be ensured.

Turning now to figure 2, a particular implementation of the power system 10 of figure 1 is schematically shown. Accordingly, all the explanations given above with respect to fig-

ure 1 are equally applicable to the power system 10 illustrated in figure 2.

In figure 2, the onboard power generation system 16 is shown as several generators (G), which can for example be provided in two generator sets (as illustrated), which can be located in different engine rooms. In the example of figure two, the switches illustrated in figure 1 are provided in switchboards. The power system is separated into a first part, termed A-side and into a second part, termed B-side. The switchboards of the A-side may be provided in a first switchboard room 81 and the switchboards of the B-side may be provided in a second switchboard room 82 which are physically separated. This way, continued operation of power system 10 can be ensured even if fire should break out in on of the room 81, 82.

On the A-side, a first external power feed switchboard 61 is provided, which may have an AC-bus 64 and an input of which is connected to or provides the external power feed connection 11. It further provides, at an output, an electric connection to the first rectifier 31.

On the B-side, a second external power feed switchboard 62 is provided, having an AC bus 63. A switchable interconnection 65 is provided between the first and second external power feed switchboards 61 and 62. Furthermore, the second external power feed switchboard 62 may comprise an input connected to or providing a second external power feed connection, so that power can received from a second external power source (not shown). Via the second external power feed switchboard 62, the external power feed connection 11 is also connectable to the second rectifier 32.

On the A-side, a first onboard power generation switchboard 71 is further provided, having an AC-bus 73. Similarly, a first onboard power generation switchboard 72 is provided on the B-side of the power system 10 having an AC-bus 73, and an

interconnection 75 is provided to interconnect the AC-bus 73 and the AC-bus 74.

Note that A-side and B-side switchboard are configured essentially symmetrically with respect to the power system 10.

The drive system 20 comprises two parts: a first drive system 21 with the first and second rectifiers 31 and 32, and a second drive system 22 with the third and fourth rectifiers 33 and 34. Corresponding AC-transformers 51, 52, 53 and 54 are provided. Note that each rectifier 31, 32, 33 and 34 actually comprises three rectifiers coupled to three secondary winding of the respective AC-transformer. This way, phase shifted AC electric power can be provided at the three transformer outputs, leading to reduced harmonic distortions an smoother DC-voltage on the DC-bus 40.

Note that the configuration is such that each rectifier 31, 32, 33, 34 can be connected to each switchboard, so that protection against faults in the power system is improved. In normal operation, one rectifier of the first and second drive systems 21, 22 can be fed from the A-side of the power system and the other rectifier from the B-side of the power system. Thus, even if the A-side or B-side should fail, each drive system 21, 22 remains operable due to the common DC-bus of each drive system 21, 22.

A jacking system 90 is provided on the vessel, e.g. when the vessel is a jack-up rig. The jacking system 90 comprises a jacking drive system with variable frequency drives 91, 92, which operate electric motors of the drive system. As shown, electric connections are provided so that the variable frequency drives 91, 92 are also connectable to the external power feed connection 11 and the onboard power feed connection 15. Accordingly, they can also be operated with electric power received from the external power source 12 (not shown in figure 2).

In an exemplary configuration, both drive systems 21, 22 are drilling drive systems. Drive system 20 is powering electric motors of a mud pump and cement pump. Power distribution transformers 103, 104 are provided for powering auxiliary equipment, including for example an anchor winch drive, cranes, cooling pumps and the like. The second drive system 22 is provided on a cantilever 101 which is movable. The cantilever comprises the drill tower and can be moved out for a drilling operation. Cable drag chains 102 are provided to enable movement. The electric motors 36 powered by the second drive system 22 may for example comprise motors of a top drive and of the draw work of the vessels drilling system. The draw works is for example used to raise and lower the drill string.

The generators 15 providing the onboard power generation can be cycled, i.e. the generator currently in operation can be switched through. Accordingly, the generators of one side of the power system 10 can be taken out of operation for servicing and testing, while a drilling operation can continue, with power supply redundancy being provided by the external power feed and the other side of the power system.

As can be seen, the configuration is such that both drive systems 21, 22 can be powered simultaneously from the external power feed connection 11 and from the onboard power feed connections 15, while maintaining flexibility with respect to the supplied AC frequency. Also, the system requires hardly any additional weight and space and is thus cost efficient to implement. Also, the system provides redundancy in the power supply.

Note that the voltages and frequencies given in the drawing are only an example and may be changed or may be completely different.

While specific embodiments are disclosed herein, various changes and modifications can be made without departing from

the scope of the invention. The present embodiments are to be considered in all respects as illustrative and non-restrictive, and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.

Claims

1. A power system for a floating vessel, in particular for a drilling vessel, comprising

- an external power feed connection (11) which is electrically connectable to an external power source (12) which is external to the floating vessel (100), the external power feed connection (11) being adapted to receive AC electric power from the external power source,
- a further power feed connection (15) adapted to receive AC electric power from a further power source (16), and
- a drive system (20) for driving electric motors (36) of the floating vessel, wherein the drive system (20) comprises a DC-bus (40) and at least a first rectifier (31) and a second rectifier (32) which are configured to receive AC electric power and to provide DC electric power to the DC-bus (40),

wherein the external power feed connection (11) is electrically connectable to the first rectifier (31) of the drive system and wherein the further power feed connection (15) is electrically connectable to the second rectifier (32) of the drive system such that in operation, electric power can be supplied to the DC-bus (40) from the external power feed connection (11) via the first rectifier (31) and the from the further power feed connection (15) via the second rectifier (32),

wherein the power system is configured to have at least a first mode of operation in which

- the external power feed connection (11) is connected to the first rectifier (31) to supply electric power to the first rectifier (31), the external power feed connection (11) being disconnected from the second rectifier (32), and
- the further power feed connection (15) is connected to the second rectifier (32) to supply electric power to the second rectifier (32), the further power feed connection (15) being disconnected from the first rectifier (31), and

- the first and the second rectifiers (31, 32) provide electric power to the DC bus (40).

2. The power system according to claim 1, wherein power system is further configured such that the external power feed connection (11) is electrically connectable to the second rectifier (32) and the further power feed connection (15) is electrically connectable to the first rectifier (31) of the drive system.

3. The power system according to claim 2, wherein power system (10) is configured to have a second mode of operation in which
- the external power feed connection (11) is connected to the second rectifier (32) to supply electric power to the second rectifier (32), the external power feed connection (11) being disconnected from the first rectifier (31), and
- the further power feed connection (15) is connected to the first rectifier (31) to supply electric power to the first rectifier (31), the further power feed connection (15) being disconnected from the second rectifier (32), and
- the first and the second rectifiers (31, 32) provide electric power to the DC bus (40).

4. The power system according to any of the preceding claims, further comprising first AC transformer (51) an output of which is connectable to the first rectifier (31) and a second AC transformer (52) an output of which is connectable to the second rectifier (32), wherein the external power feed connection (11) is connectable to the input of the first AC transformer (51) and the further power feed connection (15) is connectable to the input of the second AC transformer (52), wherein each of the first and second AC transformers (51, 52) is configured to be operable at at least two different AC frequencies of AC electrical power received at the input of the respective transformer.

5. The power system according to any of the preceding claims, wherein the drive system (20) is a drilling drive system and is powering an electric motor of at least one of a mud pump, a cement pump, draw works or a top drive.

6. The power system according to any of the preceding claims, wherein the drive system (20) comprises a first drive system (21) including the first and second rectifiers (31, 32) and a second drive system (22) for driving electric motors (36) of the floating vessel, wherein the second drive system (22) comprises a DC-bus (40) and at least a third rectifier (33) and a fourth rectifier (34) which are configured to receive AC electric power and to provide DC electric power to the DC-bus,
wherein the external power feed connection (11) is electrically connectable to the third rectifier (33) of the second drive system and the further power feed connection (15) is electrically connectable to the fourth rectifier (34) of the second drive system such that in operation, electric power can be supplied to the DC-bus of the second drive system (22) from the external power feed connection (11) via the third rectifier (33) and from the further power feed connection (15) via the fourth rectifier (34).

7. The power system according to any of the preceding claims, wherein the power system has at least a first part and a second part that are physically separate on the floating vessel, wherein the further power source (16) comprises a first generator set in the first part and a second generator set in the second part, and wherein the first part comprises the first drive system (21) and the second part comprises a second drive system (22) including at least a third and a fourth rectifier (33, 34),
wherein in each drive system (21, 22), one rectifier (31, 33) is selectively connectable to either the external power feed connection (11) or the first generator set without being connected to the second generator set, and one rectifier (32, 34) is selectively connectable to either the external power

feed connection (11) or the second generator set without being connected to the first generator set.

8. The power system according to claim 6 or 7, wherein the second drive system (22) is a cantilever drilling drive system provided on a cantilever of the floating vessel, the second drive system being configured to drive at least a top drive of a drilling system of the floating vessel.

9. The power system according to any of the preceding claims, wherein the floating vessel (100) is a jack-up rig, wherein the power system (10) is further configured to provide electric power to a jacking drive system (90) having two or more variable frequency drives (91, 92) for driving electrical motors of a jacking system of the jack-up rig, wherein the external power feed connection (11) is electrically connectable to a first of the at least two variable frequency drives and wherein the further power feed connection (15) is electrically connectable to a second of the at least two variable frequency drives of the jacking drive system.

10. The Power system according to any of the preceding claims, wherein the further power feed connection (15) is an onboard power feed connection and the further power source (16) is a power generation system located onboard the floating vessel.

11. The Power system according to claim 10, wherein the power system further comprises an external power feed switchgear (61) having a power input which is connected to the external power feed connection (11) and a power output which is connectable to the first rectifier (31), the external power feed switchgear (61) having switches for switching at least the power output, wherein the power system (10) comprises an electric connection from the onboard power generation system (16) to the power output of the external power feed switchgear (61).

12. The Power system according to claim 11, wherein the power system further comprises a second external power feed switchgear (62) having a power input which is connectable to the first external power feed switchgear (61) and/or to a second external power feed connection which is configured to receive AC electric power from a second external power source.

13. The Power system according to any of claims 10-12, further comprising a onboard power generation switchgear (71) having a power input connected to the onboard power generation system (16) and having a power output connectable to the second rectifier (32), wherein the onboard power generation switchgear (71) has switches for switching the power input or the power output or both.

14. The Power system according to claim 13, wherein the power system further comprises a second onboard power generation switchgear (72) having a power input connected to the onboard power generation system (16), wherein the power input of the first onboard power generation switchgear (71) is connected to a first set of generators and the power input of the second onboard power generation switchgear (72) is connected to a second set of generators of the onboard power generation system (16).

15. The Power system according to any of claims 10-14, wherein the power system is configured to enable an autonomous supply of the drive system (20) with electric power from the onboard power generation system (16) of the floating vessel (100) when the external power feed connection (11) is not connected to an external power source, and to enable a simultaneous supply of the drive system with electric power from the onboard power generation system (16) and from the external power source (12) when the external power feed connection (11) is connected to an external power source.

16. The Power system according to any of the preceding claims, wherein in the first mode of operation, the outputs

of the first and second rectifiers (31, 32) are electrically connected by the DC bus (40).

17. The Power system according to claim 16, wherein the power system is configured such that in the first mode of operation, when one of the first or the further power feed connection (11, 15) is disconnected, the DC bus (40) receives electric power from the other of the first or the further power feed connection (11, 15) thereby enabling a continued operation of the electric motors (36) connected to the DC bus (40).

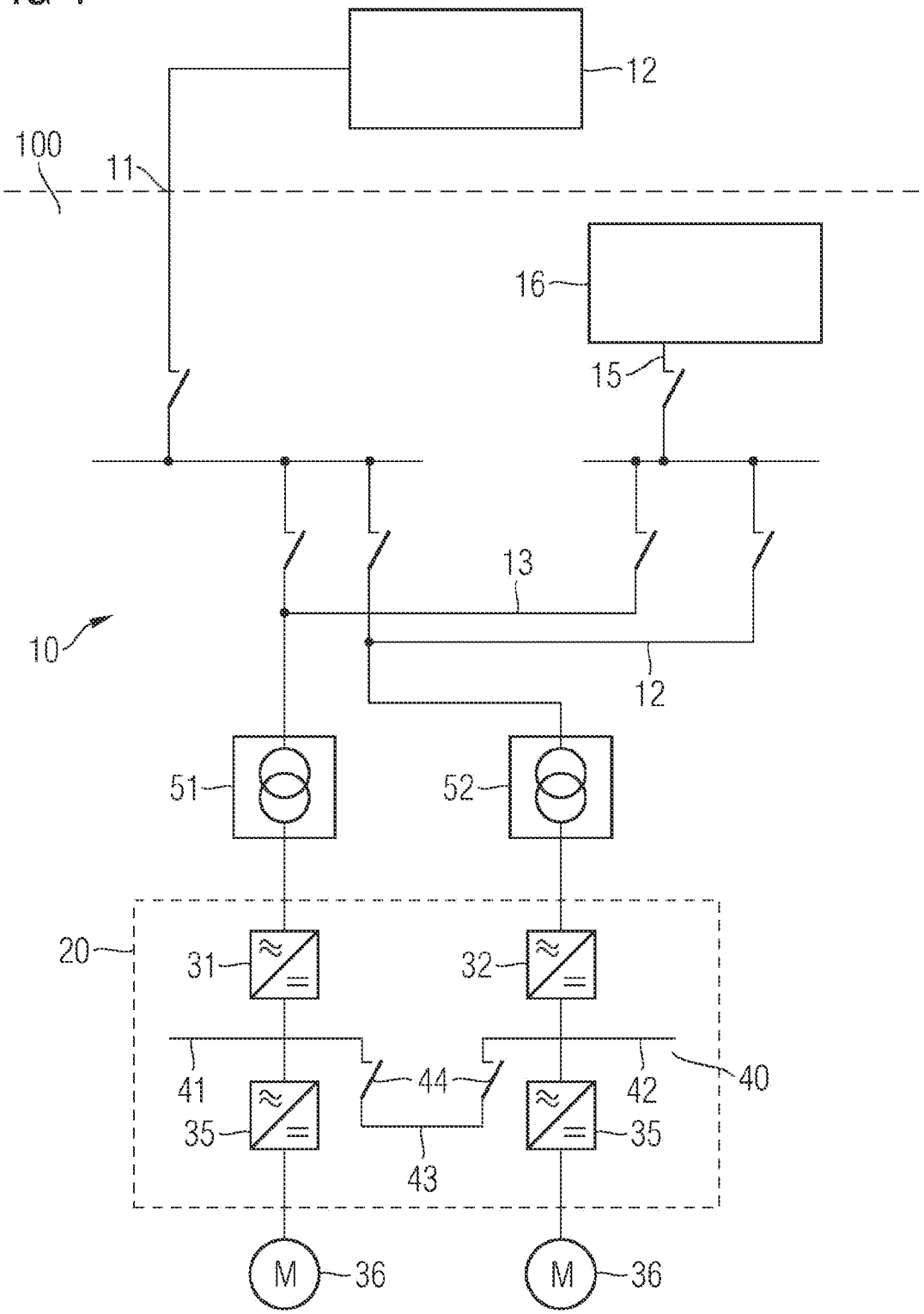
18. A method of operating a power system of a floating vessel, in particular of a drilling vessel, the power system comprising a drive system (20) for driving electric motors (36) of the floating vessel (100), wherein the drive system (20) comprises a DC-bus (40) and at least a first rectifier (31) and a second rectifier (32) configured to receive AC electric power and to provide DC electric power to the DC-bus, the method comprising the steps of:

- connecting an external power feed connection (11) to an external power source (12) which is external to the floating vessel (100) for receiving AC electric power from the external power source (12),
- connecting a further power feed connection (15) to a further power source (16) for receiving AC electric power from the further power source,
- connecting the external power feed connection (11) to the first rectifier (31) of the drive system (20), the first rectifier being disconnected from the further power feed connection (15),
- connecting the further power feed connection (15) to the second rectifier (32) of the drive system (20), the second rectifier being disconnected from the external power feed connection (11),
- operating the power system (10) such that electric power is supplied to the DC-bus (40) from the external power

feed connection (11) via the first rectifier (31) and the from the further power feed connection (15) via the second rectifier (32).

19. The method according to claim 18, further comprising the steps of receiving AC electric power on the external power feed connection (11) at a first AC frequency and receiving electric power on the further power feed connection (15) at a second AC frequency different to the first AC frequency.

FIG 1



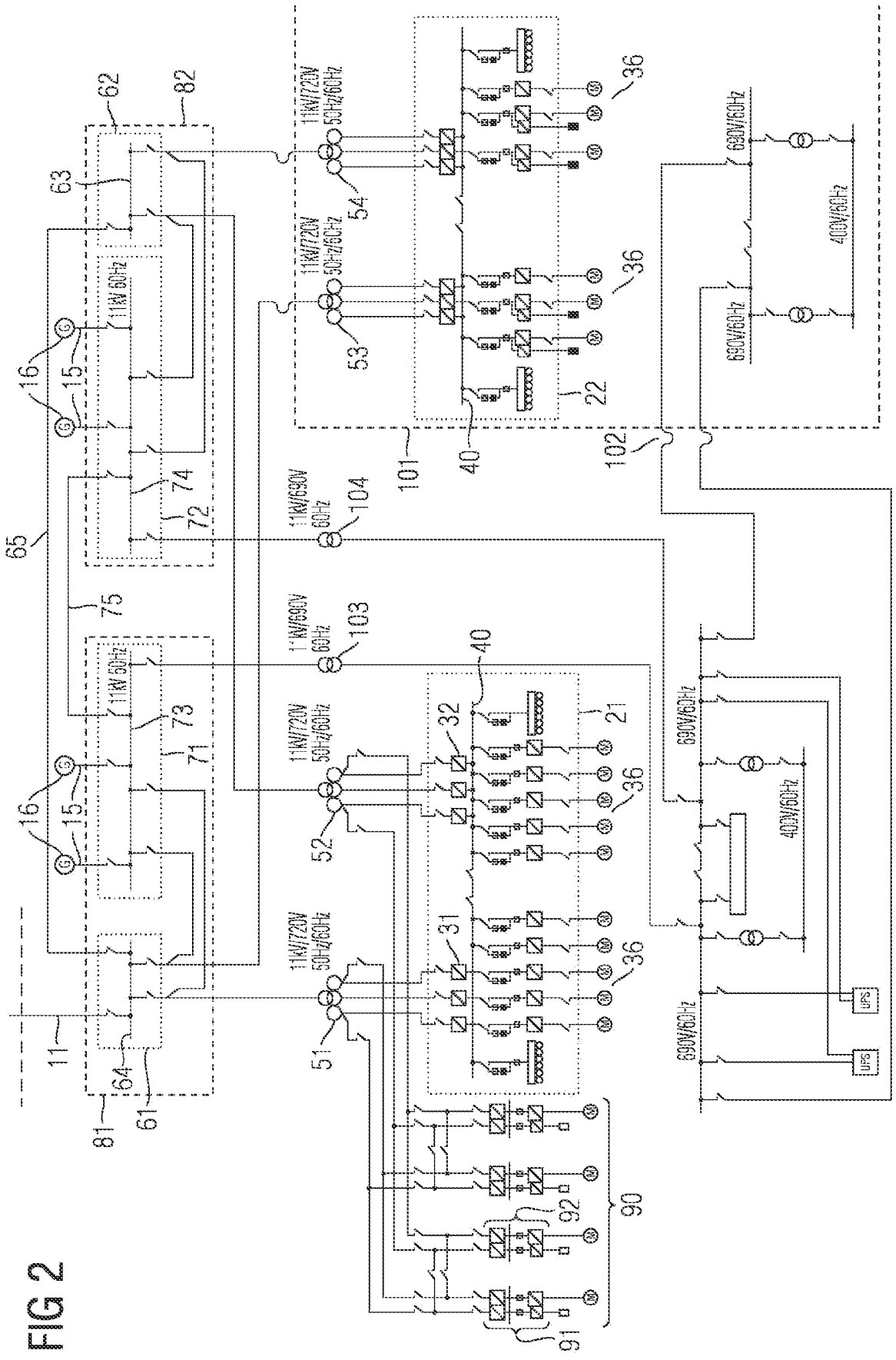

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FIG 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/057039

A. CLASSIFICATION OF SUBJECT MATTER
INV. B63J3/04
ADD.

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)
B63J B63B

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2009/067722 A1 (LEGACY AUTOMATION POWER & DESI [US]; REMBACH PAUL [US]; CASTLEMAN GREG) 28 May 2009 (2009-05-28) page 2, lines 23-26 page 4, line 15 - page 5, line 26 page 6, lines 15-18 page 7, lines 15-24 page 8, lines 15-22 page 9, lines 12-16 page 11, lines 8-10 page 14, lines 13-30 page 15, lines 1-5 figures 1-2 --- -/--	1-19

[X] Further documents are listed in the continuation of Box C. [X] 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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
14 May 2014	21/05/2014

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Blazquez Lainez, R

Form PCT/ISA/210 (second sheet) (April 2005)

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2008/130968 A1 (GLACIER BAY INC [US]; ALSTON GERALD ALLEN [US]) 30 October 2008 (2008-10-30) paragraphs [0006], [0008], [0018], [0045], [0048], [0049], [0052], [0053], [0054], [0056], [0059], [0062], [0069], [0072], [0078], [0084] figures 6-9	1,2,4,5, 10,15-19
A	US 2013/029543 A1 (GJERPE PAUL FREDRIK [NO]) 31 January 2013 (2013-01-31) paragraphs [0007], [0068] - [0070] figures 2,3	1-19

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2014/057039

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		CA 2706777 A1	28-05-2009
		EP 2225152 A1	08-09-2010
		US 2009176417 A1	09-07-2009
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		KR 20130093492 A	22-08-2013
		US 2013029543 A1	31-01-2013
		WO 2011124470 A2	13-10-2011

Electronic Acknowledgement Receipt

EFS ID:	44631580
Application Number:	17321936
International Application Number:	
Confirmation Number:	4613
Title of Invention:	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE
First Named Inventor/Applicant Name:	Jared Oehring
Customer Number:	132858
Filer:	Taylor P. Evans/Tina Fluharty
Filer Authorized By:	Taylor P. Evans
Attorney Docket Number:	047158.100090
Receipt Date:	29-DEC-2021
Filing Date:	17-MAY-2021
Time Stamp:	13:40:43
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	047158-100090-IDS.pdf	1035915 2f179a42ac81f5795d9947a8e312953543878b2d	no	7

Warnings:

Information:					
2	Non Patent Literature	CAOA1.pdf	251536 a964a6f76bd7d95855038d15d131ae7fdec315e8	no	5
Warnings:					
Information:					
3	Non Patent Literature	Kroposki1-7.pdf	15432398 e1ca44084a11aedc324f7f3727085781e97288ce	no	7
Warnings:					
Information:					
4	Non Patent Literature	Kroposki8-14.pdf	14381698 320c5d104926e6ba6f4ea7b283d304aab554b702	no	7
Warnings:					
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5	Non Patent Literature	Ton.pdf	15290463 1a2be3821e63effba50df35300b9e05a33319970	no	11
Warnings:					
Information:					
6	Non Patent Literature	USOA1.pdf	5939262 6a2da54886bed340d5b041246d2cb0b687ff2afb	no	9
Warnings:					
Information:					
7	Non Patent Literature	USOA2.pdf	3909010 0a2d3595471aac4d0e723fc9939257517a0a5a27	no	6
Warnings:					
Information:					
8	Non Patent Literature	USOA3.pdf	4958166 cde1ac71d719a6c7e4f18bf25e37602956b47756	no	8
Warnings:					
Information:					

9	Non Patent Literature	USOA4.pdf	7589516 0c13e73f94ec35a603d45900534fdc2b398570f3	no	12
Warnings:					
Information:					
10	Non Patent Literature	USOA5.pdf	8352494 a31cae12281cf331fa6d20de16ae296526914670	no	12
Warnings:					
Information:					
11	Non Patent Literature	USOA6.pdf	4242213 e1df36a3f77749afe4f8efb7d38ef1f03974433e	no	7
Warnings:					
Information:					
12	Foreign Reference	WO2009046280A1.pdf	17234891 bf235e8f686c298daf4b0763deff3f5a3241997e	no	25
Warnings:					
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13	Foreign Reference	WO2014177346A1.pdf	24672919 b633a03887f5f198ccde6a5601f0ac968e0373d6	no	36
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14	Foreign Reference	WO2019210417A1-1-26.pdf	16937764 8cc3739d2558a9e7a7fe92578380cab0f853e9a4	no	26
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(72) Inventors; and
(71) Applicants: **SHERMAN, David** [CA/CA]; 1408 Southdale Place SW, Calgary, Alberta T2W 0X7 (CA). **TALBOT, Craig** [CA/CA]; 120 Baker Crescent NW, Calgary, Alberta T2L 1R4 (CA).

(74) Agent: **PARLEE MCLAWS LLP (CGY)**; 3300-421 7 Ave SW, Calgary, Alberta T2P 4K9 (CA).

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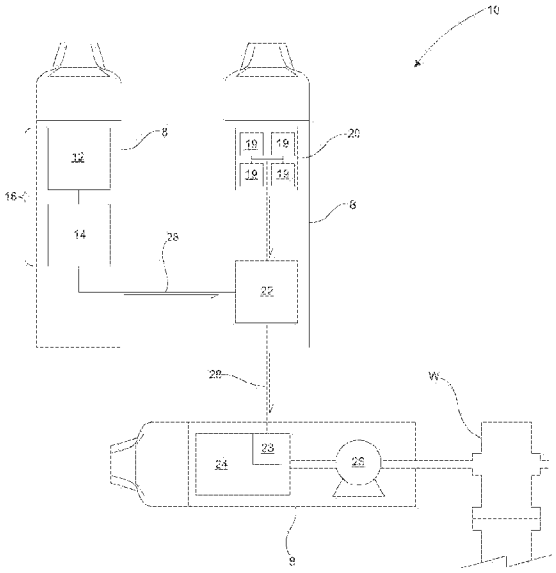


Fig. 1A

(57) Abstract: A powertrain for powering wellsite pumping operations includes a power source for producing energy, a power bank, electric motors coupled to pumps, and a power management system. The power source can be a prime mover coupled to a generator, the prime mover sized for supply up to the average power demand of the pumping operation, and the power bank is sized to supply up to at least the difference between the peak and average power demand of the pumping operation, thereby providing a load levelling means to satisfy peak demand of the operation. The power management system manages the direction of current flow, state of charge of the power bank, and power source operation to provide least fuel consumption while meeting the power demand of the pumping operation.

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"POWERTRAIN FOR WELLSITE OPERATIONS AND METHOD"

FIELD

[0001] Embodiments herein relate to pumping operations for oil and gas wells. In particular, embodiments herein relate to an improved powertrain incorporating an energy storage medium for powering wellsite pumping operations.

BACKGROUND

[0002] Many oil and gas wells require stimulation in order to increase the production of hydrocarbons from an earth formation. Stimulation is typically accomplished using the process of hydraulic fracturing, which injects water, sand, and other chemicals from surface into a wellbore in communication with the formation to create and maintain fractures in the formation rock, and thus pathways for the oil and gas to flow from the formation to the wellbore and subsequently to the surface to be collected and transported.

[0003] Traditionally, water, sand, and other ingredients to be injected into the formation are blended at surface and then pumped downhole as a slurry. The pumps used are typically plunger style-pumps. Other injection methods are sometimes used, where a concentrated sand slurry is pumped by plunger style pumps, while clean water is pumped by pumps typically used in water pumping applications, and the two pressurized streams are blended together at the desired density before

being transported downhole. Other wellbore operations such as acidizing, cementing, cleaning, and displacing are also performed using pumps to pump a fluid downhole in a manner similar to that used for wellbore stimulation.

[0004] Typically, a plurality of pumps is used to pump the slurry downhole, each pump mechanically driven by a prime mover such as a diesel engine through a multispeed gearbox/transmission to provide an appropriate level of gear reduction to match the desired pumping rate and pressure with the available power the diesel engine can produce.

[0005] Wellbore pumping operations typically start at a minimal "feed rate" which is gradually increased over time, resulting in a peak pumping power for the particular pressure pumping operation. Other pumping factors such as geological stresses, fluid viscosity, proppant, downhole duning and sweeping, dendritic branch development, spurt losses, and fluid density also affect pumping power requirements. The resulting power requirement over the course of a pumping operation can be plotted as a hydraulic horsepower profile, hydraulic horsepower (HHP) being a measurement of how much power is required to pump a fluid.

[0006] At the beginning of a wellbore stimulation pumping operation, the pump ramps up the volumetric flowrate and pressure until there is formation breakdown, which is the point where fractures in the rock initiate. Once fracturing is initiated, substantially less energy is required to propagate the fractures. Thus, there is a large, or peak, HHP hydraulic horsepower demand to initiate a fracture, which

decreases rapidly once fracturing is initiated. Additionally, downhole stimulations result in increased dendritic branching, which requires the stimulation pressure pumping rate to be gradually increased in order to continue to develop the fracture network.

[0007] Prior to commencing pressure pumping operations, a job design is done based on known conditions from neighbouring wells and geologic conditions. From this known data, the maximum and average HHP requirements can be anticipated relatively accurately. The number of proposed stages of the fracturing operation and the amount of proppant desired to be placed are also determined before the beginning of pumping operations.

[0008] Typical HHP profiles, over time for stimulations of less than 500 kg/m3 result in a peak-to-average HHP demand ratio of about 1.5 (see Fig. 4B). High sand concentration pumping operations with aggressive sand ramps greater than 1000 kg/m3 can result in a peak-to-average HHP ratio of greater than 3 (see Fig. 4C). Typically, HHP ratios range from 1.5 to 3. However, it is necessary to have sufficient power on site to meet the expected peak hydraulic horsepower demand, plus a contingency. This can result in the onsite available HHP being 2-4 times the average HHP that is needed for the operation. This is inefficient, as significant capital is required to purchase the diesel engines to supply the peak HHP, such peak-demand engines being quite large and heavy, making transport difficult and costly, and substantial manpower is required to commission the engines for operation.

[0009] Further, the use of diesel engines as prime movers is disadvantageous, due to their relatively high fuel consumption and emissions, driven by the necessity for the engines to be oversized to be capable of providing peak power only periodically for fracture initiation. Such sizing means that the diesel engines are idling for extended times when peak power is not required, with consequent inefficiencies.

[0010] A further disadvantage of diesel engine-powered pumping operations is that diesel engines are typically coupled to the pump through a multispeed hydraulically controlled gearbox. The gearbox can overheat if the cooling system is not well maintained, and thus limits the rate at which water and slurry can be pumped into the wellbore. Maintaining the gearbox in good condition is extremely difficult in oilfield operations, as such environments are often dirty and dusty. Thus, the gearbox is often a major limiting factor in how much power may be output by the diesel engine, and therefore the available HHP for the pumping operation.

[0011] Gas turbine prime movers, using natural gas as fuel, can reduce CO2 and NOx emissions by approximately 30-60% compared to conventional diesel engines. However, gas turbines sized for generating sufficient power for wellbore pumping operations (i.e. at least up to peak HHP) typically comprise three or more semi-truck loads of equipment, require a large capacity crane onsite to assemble all the components into an operable unit, and necessitate at least a week of setup time.

In comparison, conventional diesel powered fracturing equipment can be driven onto site on a single semi-truck and operating in a few hours.

[0012] There also exist "bi-fuel" diesel engines that are capable of operating on part natural gas, part diesel fuel. However, such bi-fuel diesel engines have greater mechanical complexity so as to provide two types of fuel to the engine, with two separate fuel systems. Other disadvantages are that the engine must idle on pure diesel fuel and, when in bi-fuel mode and under power, only about 40% of the diesel fuel can be substituted by natural gas, thus limiting the improvement in fuel consumption and emissions. There is also a phenomenon called "methane slip", where a certain portion of the natural gas is not burned and simply passes through the engine, thus increasing greenhouse gas emissions. Overall, experience has shown that the cost savings associated with operating bi-fuel engines is negligible as compared to conventional diesel engines.

[0013] There is a need for a powertrain for wellbore pumping operations that is capable of meeting at least the peak HHP demand of such operations while providing increased fuel efficiency and a reduction in emissions, capital expenditure, manpower requirements, and space needed to accommodate the powertrain equipment, and further to maintain the ease of setup and short commission of conventional diesel-powered equipment.

SUMMARY

[0014] Generally, a powertrain is provided for powering wellsite pumping operations including a power source for producing energy onsite that is operated at peak efficiency, but not necessarily at the peak power demand of the operations. In addition, for meeting peak power demands, energy storage such as a power bank is provided to make up the power shortfall of the power source. One or both the power source and power bank direct energy to one or more electric motors coupled to pumps. A power management system directs the source and/or bank energy to the motors or to the power bank as appropriate for charging purposes. The power source can be a prime mover, such as a fuel-powered device, coupled to a generator, the prime mover being sized for supply up to the average power demand of the pumping operation, and the power bank is sized to supply up to at least the difference between the peak and average power demand of the pumping operation, thereby providing a load levelling means to satisfy peak demand of the operation. As a result, the prime mover can be operated at peak efficiency for average operation without a need for over-design to meet peak power demand.

[0015] The power management system manages the direction of current flow, a state of charge of the power bank, and power source operation to provide least fuel consumption while meeting the power demand of the pumping operation.

[0016] In one aspect, a powertrain is provided for a wellbore pumping operation having a power demand and a peak power demand. The powertrain

comprises a power source producing a first power capacity at less than the peak power demand. A power bank is provided having a second power capacity. At least one electric motor is coupled to at least one pump, and power management system electrically connected to the power source, the power bank, and each motor, and configured to selectably direct electrical current from one or both of the power source and the power bank to one or both of the power bank and each motor. The power management system directs the electrical current for either or both energy sources to meet the power demand of the wellbore pumping operation.

[0017] In embodiments, the power management system is configured to selectably operate the powertrain in one of a hybrid mode or one or more non-hybrid modes, the power management system selecting the hybrid mode when the power demand of the wellbore pumping operation exceeds the first power capacity; and in the hybrid mode, a first electrical current is directed from the power source to each motor, and a second electrical current is directed from the power bank to each motor.

[0018] In embodiments, a variety of non-hybrid operational modes are also available including electric-only mode, a turbine-only mode, a charge-pump mode, and a charge-only mode. In the electric-only mode, the second electrical current is directed from the power bank to each motor. In the turbine-only mode, the first electrical current is directed from the power source to each motor. In the charge-pump mode, the first electrical current is directed from the power source to each

motor, and a third electrical current is directed from the power source to the power bank. Further, in the charge-only mode, the third electrical current is directed from the power source to the power bank.

[0019] In another aspect, a powertrain for a wellbore pumping operation, is provided comprising a power bank, at least one electric motor coupled to at least one pump; and a power management system electrically coupled to the power bank and the at least one motor, and configured to direct electrical current from the power bank to each motor. In an embodiment, a power source is electrically connected to the power management system, wherein the power management system is further configured to selectably direct electrical current from the power source to the power bank.

[0020] In a method aspect, powertrain for a wellbore pumping operation is operated comprising: determining a power demand of the wellbore pumping operation; directing electrical current from a power source that produces power to each motor to meet a portion of the power demand, and directing electrical current from a power bank to each motor to meet a balance of the power demand. The power source has a first power capacity and the power bank has a second power capacity.

[0021] In an embodiment the method further comprises determining a state of charge of the power bank of the powertrain and directing electrical current from the

power source to each motor and, based on the state of charge of the power bank, directing electrical current to the power bank and to each motor.

[0022] In embodiments the directing of the electrical current further comprises selecting, based on the power demand and the state of charge, an operating mode of the powertrain out of a hybrid mode and one or more non-hybrid modes. In the hybrid mode, the method comprises directing a first electrical current from the power source to each motor, and directing a second electrical current from a power bank to each motor. In the one or more non-hybrid modes the method comprises, in an electric-only mode, directing the second electrical current from the power bank to each motor. In a turbine-only mode, the method comprises directing the first electrical current from the power source to each motor. In a charge-pump mode, the method comprises directing the first electrical current from the power source to each motor, and directing a third electrical current from the power source to the power bank to charge the power bank. In the charge-only mode, , the method comprises directing the third electrical current from the power source to the power bank.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] Figure 1A is a schematic representation of an embodiment of a powertrain in a hybrid mode, using both generated energy and stored energy;

[0024] Figure 1B is a schematic representation of an embodiment of a powertrain in a charge-pump mode using excess generated energy directed to storage;

[0025] Figure 1C is a schematic representation of an embodiment of a powertrain in a generated-energy mode only;

[0026] Figure 1D is a schematic representation of an embodiment of a powertrain in a stored energy mode only;

[0027] Figure 1E is a schematic representation of an embodiment of a powertrain in a charge-only mode using generated energy directed to storage;

[0028] Figure 1F is a schematic representation of an embodiment of a powertrain in a charge-electric mode in which the generated energy is sent to storage and all energy for the powertrain is drawn from storage;

[0029] Figure 2A is a schematic representation of an embodiment of an electric powertrain in an electric-only mode;

[0030] Figure 2B is a schematic representation of an embodiment of an electric powertrain in a charge-electric mode;

[0031] Figure 3C is a schematic representation of an embodiment of an electric powertrain in a charge-only mode;

[0032] Figure 3 is a perspective view of an embodiment of a battery module of the powertrain containing multiple battery packs;

[0033] Figure 4A is an illustration of the typical power demands over time of a multistage fracturing operation;

[0034] Figure 4B is an illustration of the power demand over time of a single stage of a low sand concentration fracturing operation; and

[0035] Figure 4C is an illustration of the power demand over time of a single stage of a high sand concentration fracturing operation.

DESCRIPTION

[0036] As used herein, the term "prime mover" means a machine for transforming energy into mechanical work, such as for example a diesel engine, gas turbine, electric motor, and the like. "Horsepower" means the shaft work that is produced by a prime mover, either at the flywheel or shaft of the diesel engine, electric motor, or gas turbine. "Hydraulic horsepower" (HHP) is a calculated number for determining how much power is required to pump a fluid, and is not the same as the horsepower produced by the prime mover. The industry accepted formula for calculating hydraulic horsepower is HHP = pressure (in PSI) * flow rate (in US gallons per minute) / 1714.

[0037] Embodiments of an improved powertrain for use in wellsite operations are described herein. Wellsite operations are generally pressure pumping operations, such as wellbore stimulation (e.g. hydraulic fracturing), cementing, or acidizing. In exemplary embodiments herein, Applicant's invention is described with

reference to a hydraulic fracturing operation. However, one of skill in the art would understand that the powertrain and methods described herein are applicable to any wellsite operation in which fluid is pumped downhole.

[0038] With reference to Figs. 1A-1F, an embodiment of a wellsite operation powertrain 10 comprises one or more prime movers 12 operatively coupled to one or more generators 14 to function as a power generation assembly or power source 16, generating energy for producing power, and an energy storage or power bank 20 comprising one or more modules 19 containing power storage media 18 for storing and supplying power. Prime mover 12 can receive suitable fuel from a fuel source, such as a fuel tank or gas line (not shown). Power storage media 18 can comprise batteries or any other form of energy storage, such as capacitors. Herein, the power storage media 18 shall be assumed to be batteries.

[0039] The power generation assembly 16 and power bank 20 can be electrically connected to a power management system 22. The power management system 22 is electrically connected to one or more electric motors 24 configured to drive one or more fracturing pumps 26 to pump fluid into the wellbore W. In hydraulic fracturing operations, pump 26 is typically a plunger-style positive displacement pump. The various components of the powertrain 10 are electrically connected by known means including via electrical cables 28. The arrows in Figs. 1A-1F indicate the direction of current flow in a given operational mode.

[0040] Figs. 1A-2C show components of the powertrain 10 mounted on the beds of trucks 8 for convenient transport. However, one of skill in the art would understand that the components of the powertrain 10 can be provided in various different arrangements on trucks 8, or alone without any trucks 8 such as on skids or other forms of transport. Further, while only one prime mover 12, generator 14, motor 24, and pump 26 are shown for the sake of simplicity, combinations of one or more of prime movers 12, generators 14, motors 24, and pumps 26 may be used to provide the necessary pumping power for the wellsite operation.

[0041] The power management system 22 is configured for allocate current according to various operational modes of the powertrain 10. The power generation assembly 16 can be sized to generate enough energy to power the motors 24 so as to provide up to at least the average HHP demand of the wellbore operation. The power bank 20 can be sized to supply enough energy to at least make up enough power to the motor 24 to provide up to at least the peak HHP demand of the wellbore operation, when combined with the power generated by the power generation assembly 16. In this manner, the prime mover 12 can be run at a fuel efficient load for most of the duration of the wellbore operation as opposed to idling, and does not need to be oversized to meet peak HHP demand. Aa a result, the system provides a significant improvement in fuel consumption as compared to conventional fueled systems sized for peak demands.

[0042] Each electric motor 24 can be directly coupled to its respective pump 26, thereby dispensing with the need for a hydraulic transmission or gearbox and the corresponding limits to pumping rate. By eliminating the hydraulic transmission, the pumping rates of the present powertrain 10 can be greatly increased. The various components of the powertrain 10 shall now be described in further detail.

[0043] In an embodiment, prime mover 12 is a gas turbine. The gas turbine 12 is configured to be primarily fueled by natural gas, but can also be configured to be fueled by any suitable hydrocarbon fuel such as propane, diesel fuel, kerosene, jet fuel or a combination thereof. The turbine 12 can also be configured to be capable of switching between various fuels "on the fly" such that, if there is an interruption to the natural gas supply, the gas turbine 12 can be switched to a standby supply of diesel fuel or other fuels without shutting down the turbine 12.

[0044] Use of a gas turbine 12 is advantageous over conventional diesel engines, as such turbines 12 provide a reduction of emissions of approximately 30%. In particular, CO2, NOx, and particulate emissions are reduced through use of a gas turbine. A further advantage of using a gas turbine 12 over conventional diesel engines is a significant reduction in noise emissions. For example, observed sound pressure levels of diesel engines are approximately 100-103 dB at 1 meter. In contrast, a packaged gas turbine MPU unit available from Siemens of 4615 Southwest Freeway, Suite 900, Houston, TX 77027, United States, rated at 85dB at 1 meter, and the addition of an optional quiet kit can reduce the noise to 58 dB.

Diesel engines also typically produce a lower frequency noise, which carries farther than the higher pitched noise produced by a gas turbine. Thus, a turbine is less likely to disturb people and wildlife living close to the worksite.

[0045] While the prime mover 12 is referred to as a gas turbine in embodiments herein, any other suitable source of mechanical power for generating energy may be used as a prime mover, such as a diesel engine, natural gas fired reciprocating engine, steam turbine, and the like.

[0046] Prime movers 12 and coupled generators 14 are typically manufactured in a variety of different capacities. Thus, multiple prime movers 12 and generators 14 of different sizes may be used to supply the desired amount of power for the wellsite operation. When the anticipated power demands are greater the output of a single prime mover 12, multiple prime mover 12 and generator 14 units can be brought to the wellsite and operated together as a power generation assembly 16, or microgrid. For example, prime movers 12 are available in sizes supplying 3.4MW and 5.7MW of power. Prime movers units 12 can be sized up to 30MW and, when applied to meet peak demand, such units are large, heavy, present a single point of failure, require many trucks to transport, and take 7 to 11 days to commission and bring into operation.

[0047] In comparison, smaller prime movers 12 as employed herein can be commissioned and operational in as little as 2 hours after being driven to the wellsite, and are easier to transport. Thus, it is preferable to use multiple smaller

prime movers 12 and generators 14 to provide average power for the operation. A further advantage of utilizing power generation assemblies 16 comprised of smaller prime mover 12 and generator 14 units is that, should a single prime mover 12 or generator 14 fail, there remain other prime movers 12 and generators 14 that, when combined with the added energy of the power bank 20, can provide enough power to flush (displace) the wellbore of proppant and leave the wellbore filled with clean water. This will prevent the wellbore being "sanded off" in the event of the failure of a prime mover 12 or generator 14 and ensure that fracturing operations can recommence once the cause of the failure has been rectified.

[0048] With reference to Fig. 3, the power bank 20 comprises a plurality of battery packs 18, each pack containing a plurality of battery cells. The battery packs 18 can be configured to provide voltages higher than that of a single battery cell, such as by arranging the batteries in series, according to the power demand of the wellsite operation. The battery packs 18 can be further consolidated into larger battery modules 19 for convenient transportation and replacement. The battery modules 19 can be electrically tied together via a bus, such that the battery packs 18 do not need to be individually wired to the power management system 22.

[0049] In preferred embodiments, the battery packs 18 are thermally managed, such that they do not overheat and avoid catching fire, or become too cold where their performance for both charging and discharging is reduced. As such, the battery modules 19 can be arranged onto an electrical trailer or container that is

climate controlled to ensure the battery packs 18 are maintained substantially at ideal temperatures, or within an ideal temperature range, for charging and discharging. Such ideal temperatures change according to the specific chemistry of various batteries, but are typically in the range of 15-35°C. The number of modules 19 can be changed according to the individual power requirements and level of redundancy required for a particular fracturing operation. In embodiments, power bank 20, the battery thermal management system, and/or the power management system 22 may be integrated into a single unit for ease of transportation.

[0050] In one embodiment, the battery packs 18 comprise multiple lithium ion cells, chosen for their desirable combination of energy density, lifetime number of charge and discharge cycles, and cost. However, as one of skill in the art would understand, any suitable battery type that is capable of accepting and delivering charge from an external load or power source can be used.

[0051] The electric motor 24 is typically an AC induction motor rated between 2,000-3,000 HP, but other suitable types and power ratings (such as DC motors) can be used depending upon job conditions, desired fluid flow rate to be pumped, and weight restrictions for equipment transport. Where AC motors 24 are used, respective variable frequency drives (VFD) 23 are located between the power management system 22 and the AC motors 24. The VFD 23 provides a method of controlling the speed of an AC motor steplessly from zero to the maximum rotational speed of the motor. The VFD 23 allows an AC motor to mimic the control available

to vary the speed of a DC motor by varying DC voltage. One or more VFDs 23 may control multiple electric motors 24. If a DC motor is used, a VFD 16 is not necessary, but alternative well known speed regulating means are used in place of a VFD, such as adjusting voltage to the DC motor 24 with rheostats or potentiometers, or varying the speed of the prime mover 12.

[0052] Typically, multiple motors 24 and accompanying VFDs 23 drive multiple pumps 26 to meet the HHP demand of the operation, as a single motor-driven hydraulic pump 26 would be too large to practically transport to the well site. For example, for large well operations, it is impractical or impossible to use a single pump to provide the total fluid rate, as present pumps are only available up to 5000hp, and are too wide to move on highways without obtaining special permits.

[0053] The power management system 22 can comprise components for regulating and converting the electrical power from the generator 14 to a form appropriate for driving the electric motor 24 and charging the power bank 20. Generator 14 typically produces AC current which must be rectified to DC current having a specific voltage and current in order to charge the battery packs 18 of the power bank 20 without damaging them. As such, the power conditioning module 22 can comprise rectifiers, transformers, and other equipment for conditioning current from the generator 14 to be suitable for charging the battery packs 18. Similarly, when power is drawn from the power bank 20, it may need to be stepped up or down and inverted to AC current to drive the electric motor 24. Accordingly, the power

management system 22 can comprise suitable transformers and inverters for conditioning the current from the power bank 20 to be suitable for driving the motor 24.

[0054] The power management system 22 can further be configured to manage power for the entire pumping operation. For example, the management system 22 can have computer processors, machine-readable media, input/output interfaces, or other suitable components operative to manage the output of the power generation assembly 16 and the power bank 20, monitor the state of charge of the power bank 20, monitor the power demands of the motor 24, and automatically adjust the operation of the system in a manner to minimize fuel consumption while providing enough power to meet the pumping demands of the wellsite operation. In embodiments, the power management system 22 can also be configured to communicate with, and receive instructions from, a fracturing controller configured to control the entire wellsite operation, such that control of the powertrain 10 is centralized at the fracturing controller.

[0055] With reference to Figs. 1A-1F, to optimize the operation of the powertrain 10, the power management system 22 can be configured to selectably run the powertrain 10 in a number of operational modes. In the depicted embodiment, the power management system 22 can operate the powertrain 10 in a hybrid mode (Fig. 1A), charge-pump mode (Fig. 1B), turbine-only mode (Fig. 1C),

electric-only mode (Fig. 1D), charge-only mode (Fig. 1E), or charge-electric mode (Fig. 1F).

[0056] When the powertrain 10 is in the hybrid mode, the power management system directs current from the power generation assembly 16 and power bank 20 to the electric motor 24, such that the motor 24 is powered by both the power generation assembly 16 and the power bank 20. With reference to Fig. 1B, when the powertrain 10 is in the charge-pump mode, the power management system 22 directs some of the current generated by the power generation assembly 16 to meet a low energy demand of the electric motor 24, and the remaining surplus current to the power bank 20 to charge the battery packs 18 thereof. In the turbine-only mode of Fig. 1C, the power management system 22 directs all of the current generated by the power generation assembly 16 to the electric motor 24, and no current is either directed to or drawn from the power bank 20. In the electric-only mode of Fig. 1D, the power generation assembly 16 does not generate any current, and the power management system 22 draws current only from the power bank 20 and directs said current to the electric motor 24. This mode is useful if a fuel-powered generator is down or being serviced.

[0057] In the charge-only mode, the power management system 22 directs all of the current generated by the power generation assembly 16 to the power bank 20. This can charge the power bank when well operations have ceased. In the charge-electric mode, the power management system 22 directs all of the current generated

by the power generation assembly 16 to the power bank 20, and draws current from the power bank 20 to power the motor 24. This is useful for alternate power management of the motor.

[0058] The power management system 22 can be configured to select the appropriate operational mode in response to various factors, such as the state of the charge of the power bank 20, the power demands of the motor 24, and to optimize the system for the greatest fuel efficiency. The power management system 22 can be further configured to automatically compensate for situations wherein the gas turbine 12 is derated due to factors such as elevation and temperature, such that any shortfall of power generated by the gas turbine 12 can be compensated by drawing power from the power bank 20 to meet the HHP demand of the wellsite operation.

[0059] In embodiments, the power management system 22 can be comprised of a number of discrete modules that perform specific functions as opposed to an integral unit. For example, a battery management module that adjusts the charging rate and state of charge of the batteries, such as a module commercially available from Lithium Werks in the Netherlands, can be installed in the power management system 22 and be configured to communicate with other components of the system 22 through a CAN bus protocol. Another module that can be part of the power management system 22 is a turbine/generator controller, such as the controller forming part of the Siemens MPU (Mobile Power Unit) which is a combined gas

turbine and generator package that is trailer mounted and can be transported as a single load.

Example Pumping Operation

[0060] Fig. 4A is an excerpt from SPE paper number 187192 (the "SPE Paper") and provides an example of the time-power plot recorded from a 27 stage fracturing operation in a well in Oklahoma. From the plot, it can be seen that the peak HHP demand of the operation is approximately 12,000 kW, but such peak HHP is only required for very short periods of time to initiate fracturing. From the data in the SPE Paper, it can be calculated that the average HHP demand is 8125 kW, and the difference between the peak and average HHP demand is approximately 3875 kW.

[0061] To supply power for the fracturing operation example set forth in the SPE Paper, the prime movers 12 and generators 14 of the present powertrain 10 are sized to provide up to at least the average equivalent HHP demand of the fracturing operation, and the power bank 20 is configured to provide up to at least the difference between the peak HHP and average HHP demand to the motor 24, such that the prime mover 12 and power bank 20 together are capable of providing up to at least the expected peak HHP demand of the operation. In preferred embodiments, the prime movers 12, generators, 14, and power bank 20 are configured to cumulatively provide up to 20% greater power than the expected peak HHP

demand, such that redundant power is available in the operation in the event of an unexpectedly high HHP demand, the failure of one or more prime movers 12, generators 14, or battery packs 18, etc. In this manner, the prime movers 12 and generators 14 can supply power to the electric motors 24 for most of the fracturing operation, and the remaining power demand above the average HHP demand is provided by the power bank 20 for the short amount of time needed.

[0062] In another embodiment, for the SPE Paper fracturing operation shown in Fig. 4A, the prime movers 12 are sized to provide 8125 kW of equivalent HHP. The power bank 20 is configured to provide the remaining 3875 kW of power such that the electric motors 24 can provide 12,000kW of HHP to meet peak HHP demand.

[0063] In use, with reference to Fig. 1A, if the motor 24 requires power above 8125 kW, for example during initiation of a fracture, the power management system 22 can operate the powertrain 10 in the hybrid mode such that both the power generation system 16 and power bank 20 supply power to the motors 24 to meet the HHP demand of the operation. With reference to Fig. 1B, if the HHP demand of the fracturing operation falls below 8125 kW, then the power management system 22 operates the powertrain 10 in the charge-pump mode and directs any power generated by the power generation system 16 and not required to satisfy the HHP demand to the power bank 20 to replenish its stored energy. With reference to Fig. 1C, if the demand of the fracturing operation is below 8125 kW and the power bank

20 is already at or above an upper threshold efficiency level, such as 80% charge, the power management system 22 can operate the powertrain 10 in the turbine-only mode and such that no power is directed to the power bank 20, and adjust the speed of the prime movers 12 to maintain the pumping rate of the operation within a desired range.

[0064] Alternatively, turning to Fig. 1D, if the power bank 20 has sufficient charge and is capable of supplying enough power to meet the HHP demand of the operation, the power management system 22 can operate the powertrain 10 in the electric-only mode such that the prime mover 12 can be shut off completely and the power bank 20 supplies all of the power to meet the HHP demand. With reference to Fig. 1E, if the fracturing operation does not require any power, for example when the operation has completed a fracturing stage and has not yet begun the next stage, the power management system 22 can operate the powertrain in a charge-only mode and direct all power generated by the power generation assembly 16 to the power bank 20 to replenish its stored energy. With reference to Fig. 1F, the power management system 22 can also operate the powertrain 10 in a charge-electric mode, wherein the power bank 20 supplies all of the power to meet the HHP demand, and all power from the power generation assembly 16 is directed to the power bank 20.

[0065] In embodiments, the power management system 22 can be configured to run the prime movers 12 at about their most fuel efficient load for as much of the

wellbore operation as possible, only idling the prime movers 12 when necessary. As the prime movers 12 are sized to provide the average HHP demand of the operation, and the power generated by the power generation assembly 16 can be used to fulfill HHP demand and/or charge the power bank 20, the power management system 22 can select between the various modes of the powertrain 10 to keep the prime movers 12 operating at their most fuel efficient loads and effectively utilize all of the power generated thereby. As an example, gas turbines used as prime movers 12, operate at peak efficiency under full load. At idle, the specific fuel consumption of gas turbines at idle is very high, and thus it is desirable to operate the turbine 12 at full load for as long as possible and avoid idling. Therefore, the management system 22 can be configured to operate the turbines 12 at full throttle for as long as possible while the powertrain is operating in the hybrid, charge-pump, charge-electric, charge-only, or turbine-only modes. If needed, the management system 22 can reduce the speed of the turbines 12 in the turbine-only mode in order to maintain the pump rate of the operation within a desired range.

[0066] The power management system 22 can also control the power generation assembly 16 to respond to signals from a pumping control system of the operation. For example, if there is an event at the pressure pumping side of the wellbore operation, that necessitates an emergency shutdown of the fracturing pumps 26, the pumping control system can notify the power management system 22 of the anticipated shutdown, and the management system 22 can reduce the output

of the power generation assembly 16 by reducing the throttle of the turbines 12 to eliminate the need for resistor banks to "receive" excess generated power.

[0067] Typically, output of the generators 14 is controlled by manipulating the field voltage thereof, and if the field voltage is removed, the generator output drops to approximately zero without the need to stop the rotation of the generator 14. As such, if the electrical load (i.e. the power demand of the operation) is reduced to zero in a short period of time, such as for a shutdown, the field voltage of the generators 14 can be reduced to zero to reduce their output to zero, and the speed of the turbines 12 can be reduced in a controlled manner. Thus, there is no need to engage a hard stop on the turbines 12 in the event the load is suddenly reduced to zero. There may be residual voltage generated due to inductance and impedance effects of the windings, but the relative output of the generators 14 will be approximately zero.

Electric Powertrain

[0068] In another embodiment, the powertrain can be a completely electric powertrain 30 wherein the power bank 20 is the only means to provide power to the motor 24. The power bank 20 is preferably brought to the wellsite in a charged condition such that they are ready to be used immediately. The power bank 20 can be charged by any suitable power source 32, such as a prime mover 12 and generator 14, hydro, wind, or solar power, or a nearby utility. Use of renewable

power sources is preferred, such that the entire wellsite pressure pumping operation is carbon emission free. Alternatively, onsite sources of fuel, such as natural gas, can be supplied to the prime mover 12 to generate power to replenish the energy of the power bank 20.

[0069] Such a battery-only powertrain 10 can otherwise have a similar arrangement as the above-described hybrid powertrain 10, with a power source 32 replacing the power generation assembly 16. The power management system 22 can be configured to operate the battery-only powertrain 10 in an electric-only mode, a charge-electric mode, or a charge-only mode.

[0070] In alternative embodiments, no power source 32 is provided onsite, and discharged battery packs 18 of the power bank 20 are removed therefrom and transported offsite to be charged, such as at a base facility, before being transported back to the wellsite and reconnected to the power bank 20. Such embodiments can take advantage of lower overnight electricity rates at the base facility to charge the battery packs 18. In such embodiments, the powertrain 10 operates in the electric-only mode at all times.

[0071] The required size of the power bank 20 can be determined based on estimates of the HHP demands of the wellsite operation. Battery-only powertrains 10 are suitable for smaller operations where the cost of transporting, operating, and maintaining the battery packs 18 on site are lower than those of a hybrid powertrain

10. Otherwise, the above-described hybrid powertrain 10 can be used to supply power for the wellsite operation.

WE CLAIM:

1. A powertrain for a wellbore pumping operation having a power demand and a peak power demand, comprising:

a power source producing a first power capacity at less than the peak power demand ;

a power bank having a second power capacity;

at least one electric motor coupled to at least one pump; and

a power management system electrically connected to the power source, the power bank, and each motor, and configured to selectably direct electrical current from one or both of the power source and the power bank to one or both of the power bank and each motor,

wherein the power management system directs the electrical current to meet the power demand of the wellbore pumping operation.

2. The powertrain of claim 1, wherein:

the power management system is configured to selectably operate the powertrain in one of a hybrid mode or one or more non-hybrid modes, the power management system selecting the hybrid mode when the power demand of the wellbore pumping operation exceeds the first power capacity; and

in the hybrid mode, a first electrical current is directed from the power source to each motor, and a second electrical current is directed from the power bank to each motor.

3. The powertrain of claim 2, wherein;

the one or more non-hybrid modes comprise at least an electric-only mode, a turbine-only mode, a charge-pump mode, and a charge-only mode;

in the electric-only mode, the second electrical current is directed from the power bank to each motor;

in the turbine-only mode, the first electrical current is directed from the power source to each motor;

in the charge-pump mode, the first electrical current is directed from the power source to each motor, and a third electrical current is directed from the power source to the power bank; and

in the charge-only mode, the third electrical current is directed from the power source to the power bank.

4. The powertrain of any one of claims 1 to 3, wherein the second power capacity is equal to at least a difference between the peak power demand of the pumping operation and an average power demand of the pumping operation, and

the first power capacity is equal to at least the average power demand of the pumping operation.

5. The powertrain of any one of claims 1 to 4, wherein the power source comprises at least one prime mover operatively coupled to at least one generator.

6. The powertrain of claim 5, wherein the at least one prime mover comprises at least one turbine.

7. The powertrain of any one of claims 1 to 6, wherein the power bank comprises at least one battery.

8. The powertrain of any one of claims 1 to 7, wherein the power management system directs electrical current further based on a fuel efficiency of the power source.

9. A powertrain for a wellbore pumping operation, comprising:

a power bank;

at least one electric motor coupled to at least one pump; and

a power management system electrically coupled to the power bank and the at least one motor, and configured to direct electrical current from the power bank to each motor.

10. The powertrain of claim 9, further comprising a power source electrically connected to the power management system;

wherein the power management system is further configured to selectably direct electrical current from the power source to the power bank.

11. The powertrain of claim 9 or 10, wherein the power bank is comprised of a plurality of battery packs, each of the plurality of battery packs interchangeable with a plurality of replacement battery packs.

12. A method of operating a powertrain for a wellbore pumping operation having at least one electrical motor, comprising:

determining a power demand of the wellbore pumping operation;

directing electrical current from a power source that produces power to each motor to meet a portion of the power demand, and

directing electrical current from a power bank to each motor to meet a balance of the power demand;

wherein the power source has a first power capacity and the power bank has a second power capacity.

13. The method of claim 12, further comprising:

determining a state of charge of the power bank of the powertrain; and

directing electrical current from the power source to each motor and, based on the state of charge of the power bank, directing electrical current to the power bank and to each motor.

14. The method of claim 13, wherein the step of directing electrical current further comprises:

selecting, based on the power demand and the state of charge, an operating mode of the powertrain out of a hybrid mode and one or more non-hybrid modes; and wherein in the hybrid mode comprises:

directing a first electrical current from the power source to each motor, and,

directing a second electrical current from the power bank to each motor.

15. The method of claim 14, wherein the one or more non-hybrid modes comprise at least an electric-only mode, a turbine-only mode, a charge-pump mode, and a charge-only mode; wherein in the non-hybrid modes:

in the electric-only mode, directing the second electrical current from the power bank to each motor;

in the turbine-only mode, directing the first electrical current from the power source to each motor;

in the charge-pump mode, directing the first electrical current from the power source to each motor, and directing a third electrical current from the power source to the power bank to charge the power bank; and

in the charge-only mode, directing the third electrical current from the power source to the power bank.

16. The method of claim 14 or 15, wherein the hybrid mode is selected when the power demand exceeds the first power capacity and the state of charge is greater than zero.

17. The method of claim 15 or 16, wherein the turbine-only mode is selected when the power demand is equal to or less than the first power capacity and the state of charge is above an upper threshold.

18. The method of any one of claims 15 to 17, wherein the charge-pump mode is selected when the power demand is less than the first power capacity and the stage of charge is below 100%.

19. The method of any one of claims 15 to 18, wherein the electric-only mode is selected when the power demand is equal to or less than the second power capacity and the state of charge is above zero.

20. The method of any one of claims 15 to 19, wherein the charge-only mode is selected when the power demand is zero and the state of charge is below 100%.

21. The method of any one of claims 14 to 20, wherein the step of selecting an operating mode further comprises selecting an operating mode that enables the power source to operate at about a peak fuel efficiency.

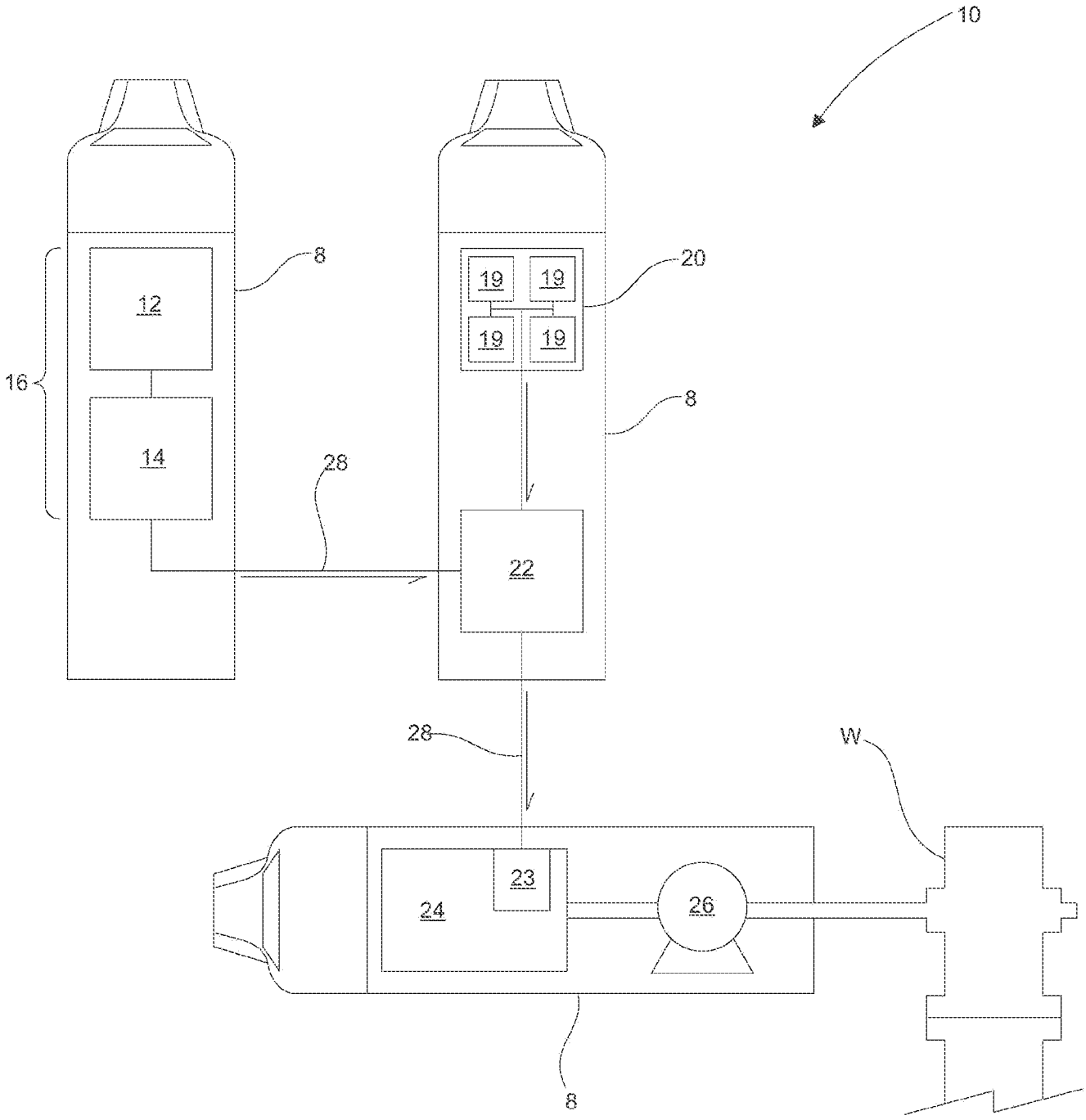


Fig. 1A

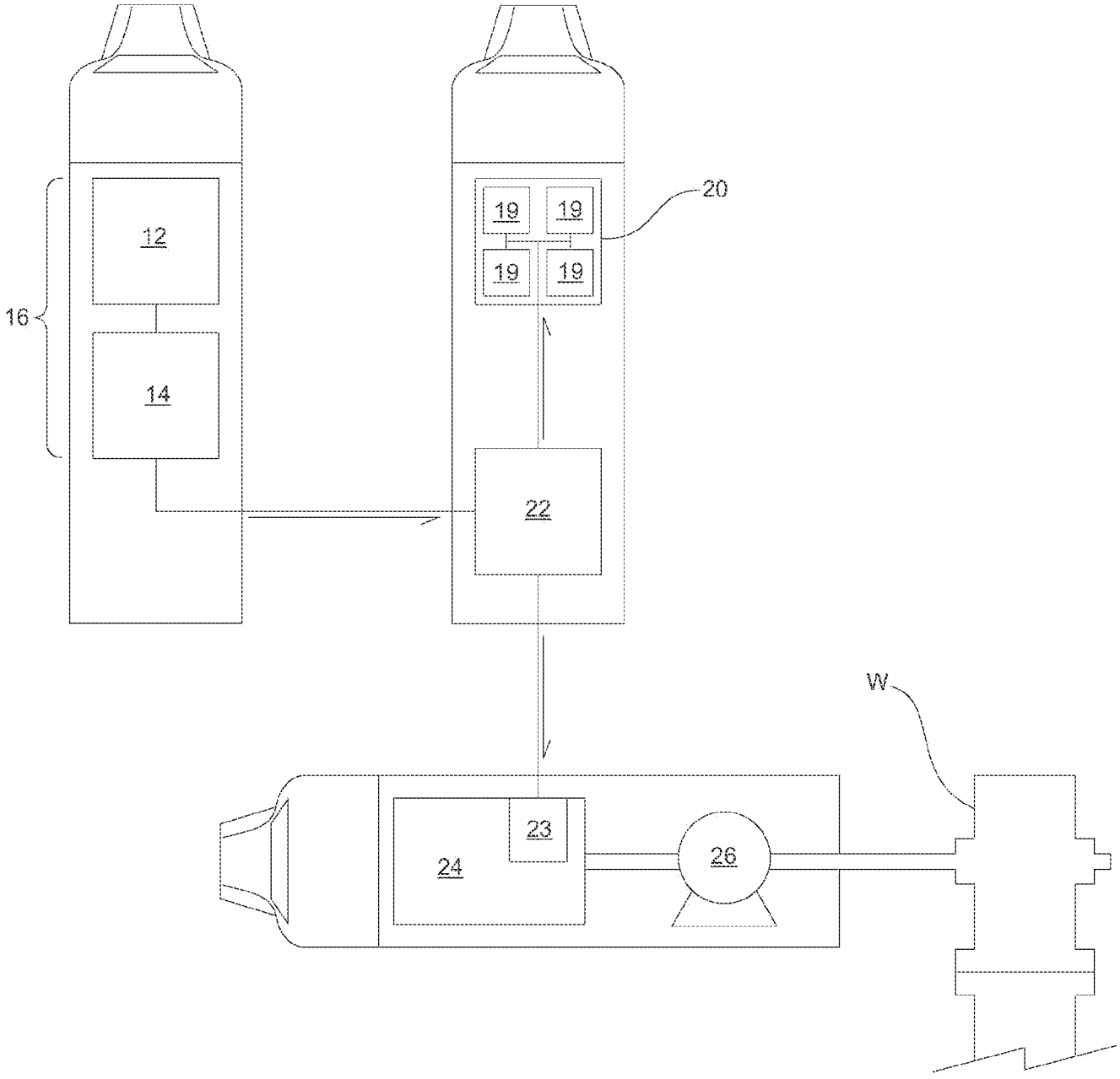


Fig. 1B

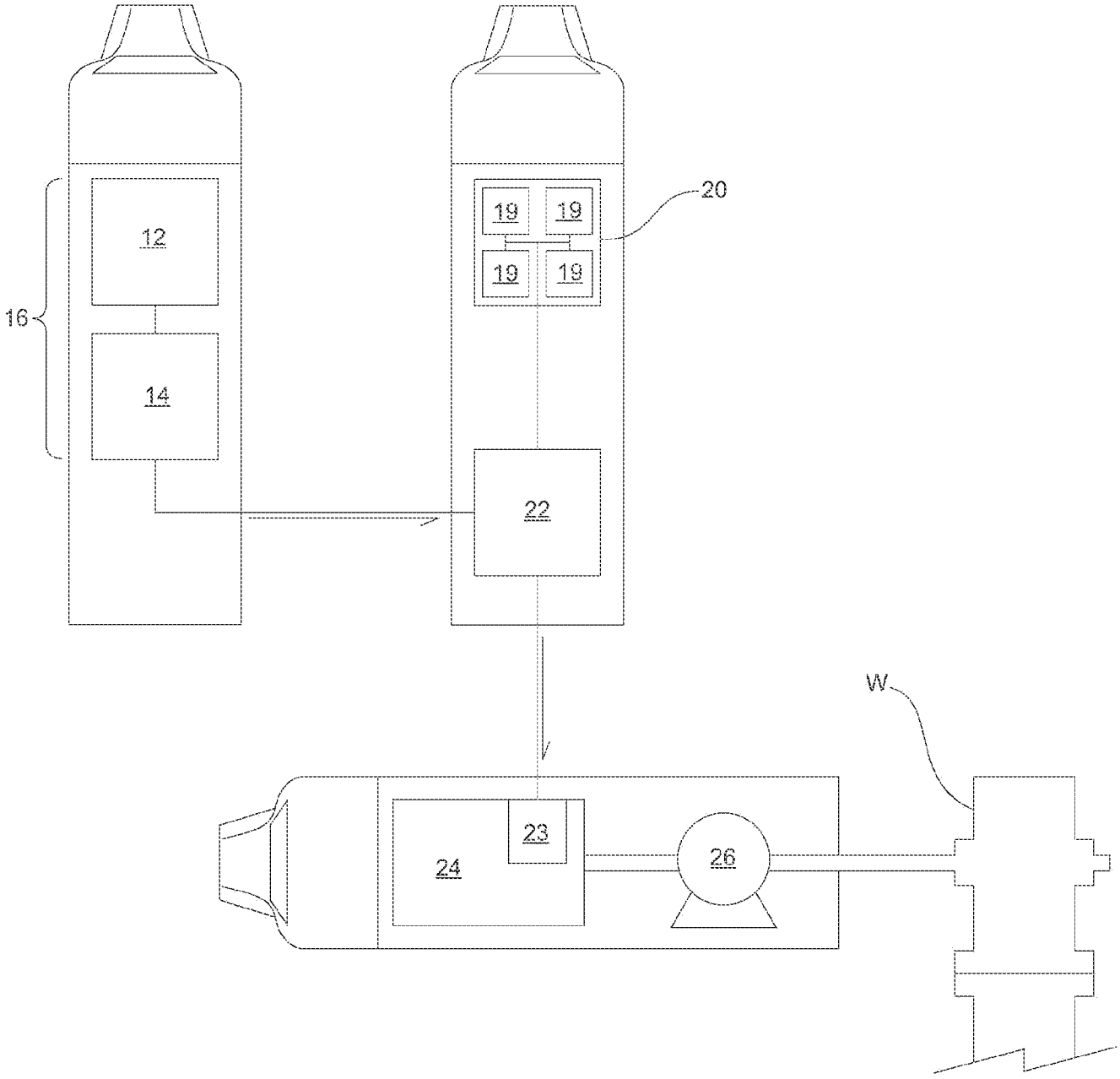


Fig. 1C

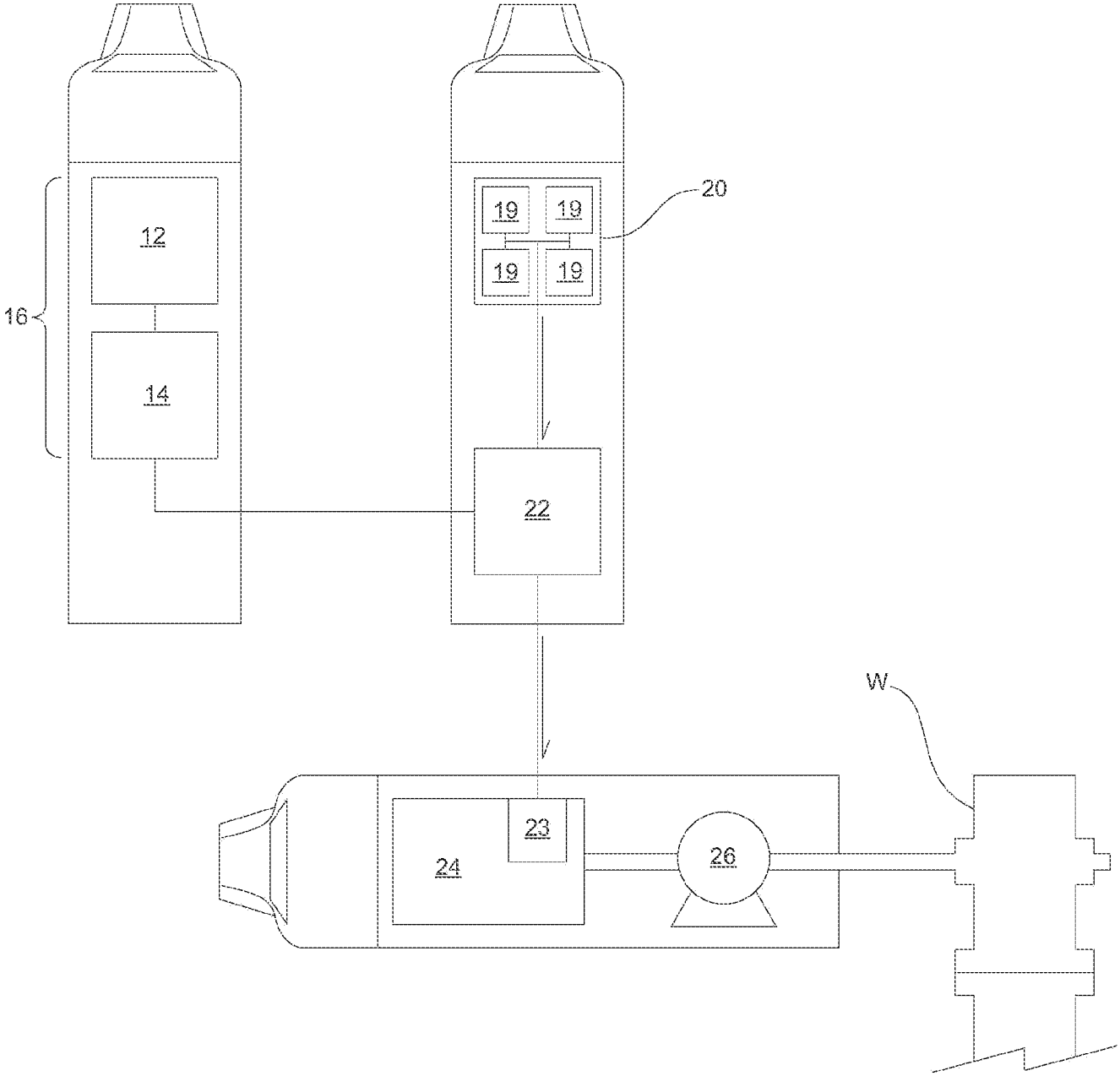


Fig. 1D

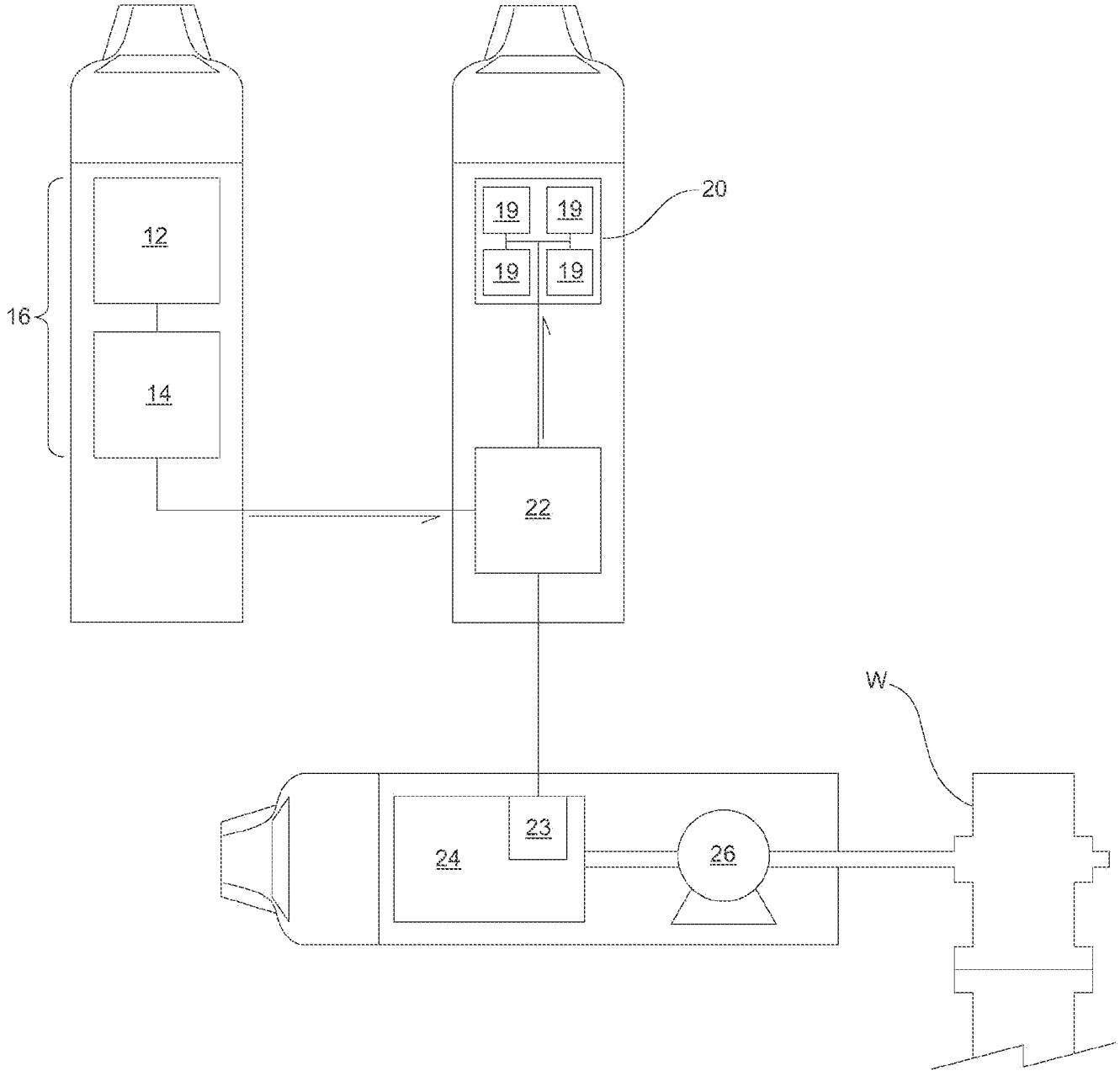


Fig. 1E

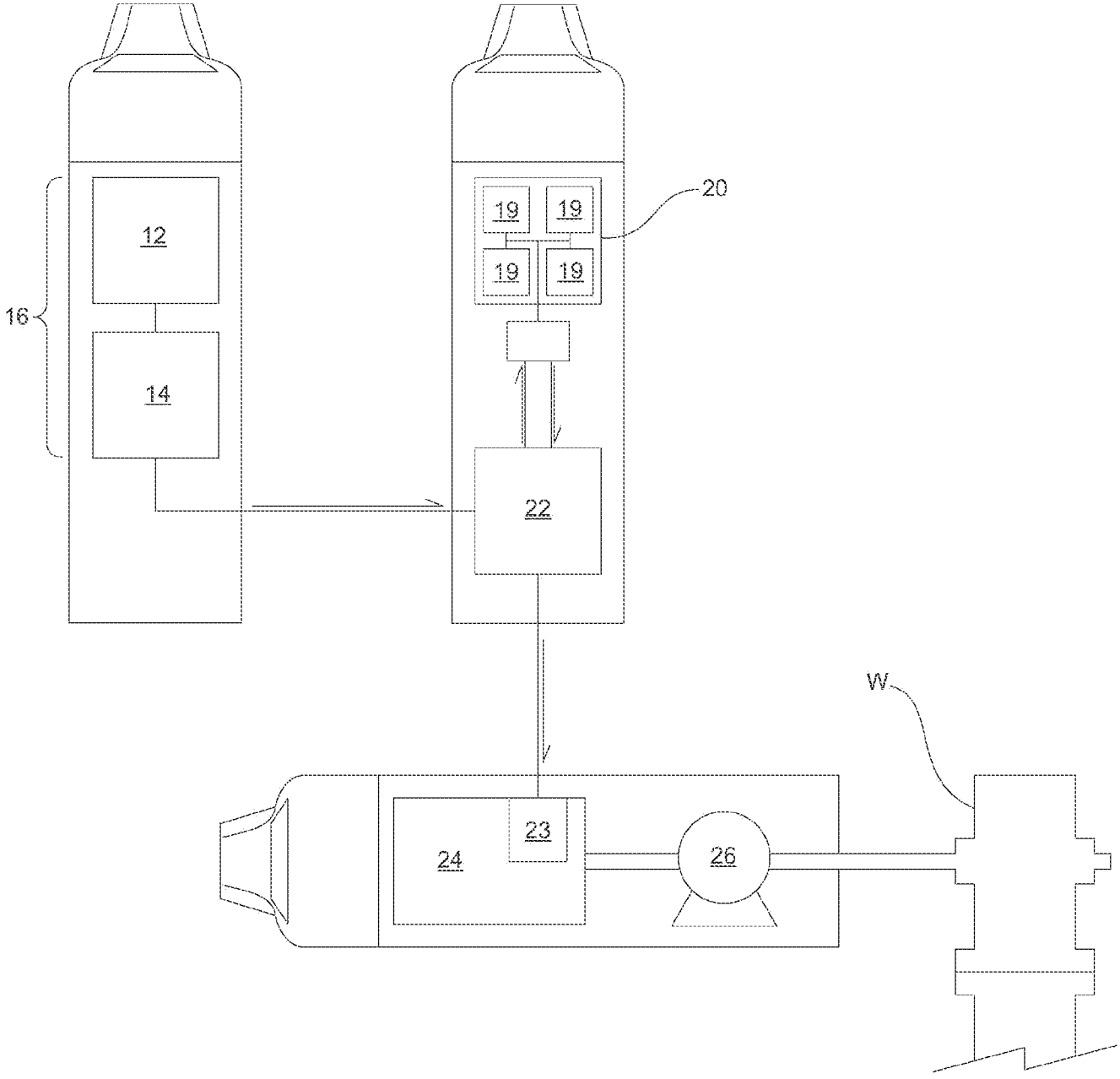


Fig. 1F

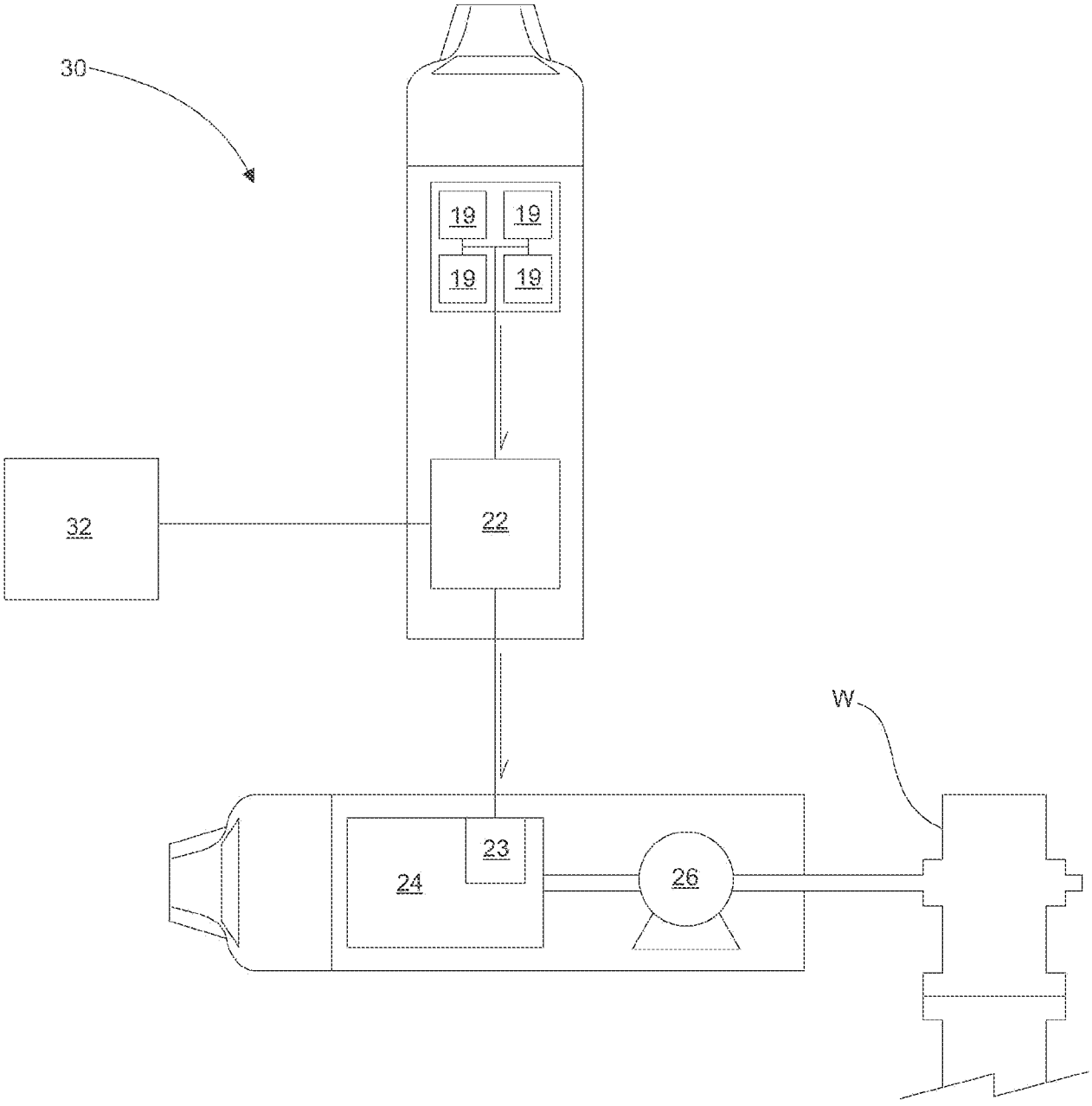


Fig. 2A

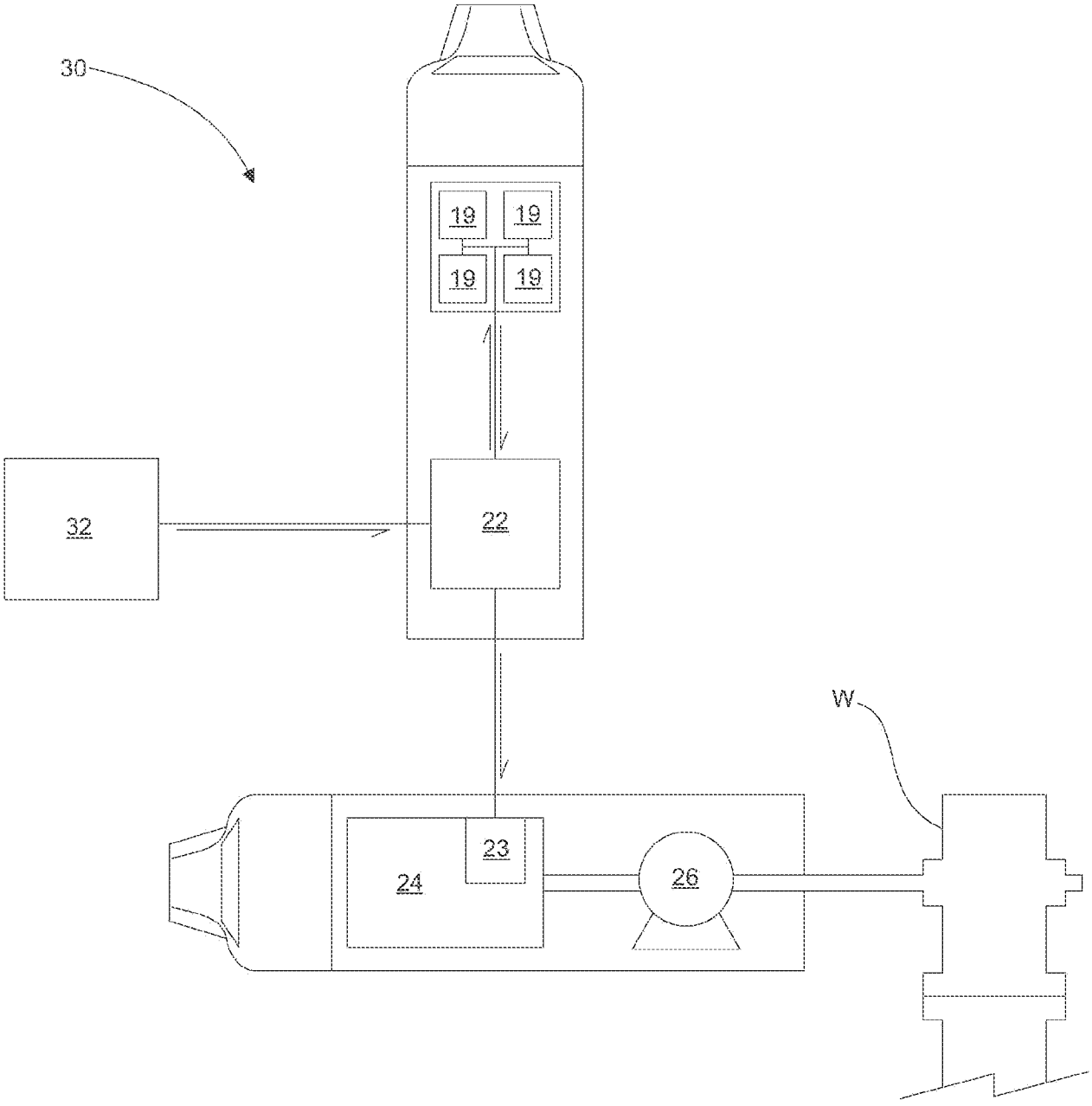


Fig. 2B

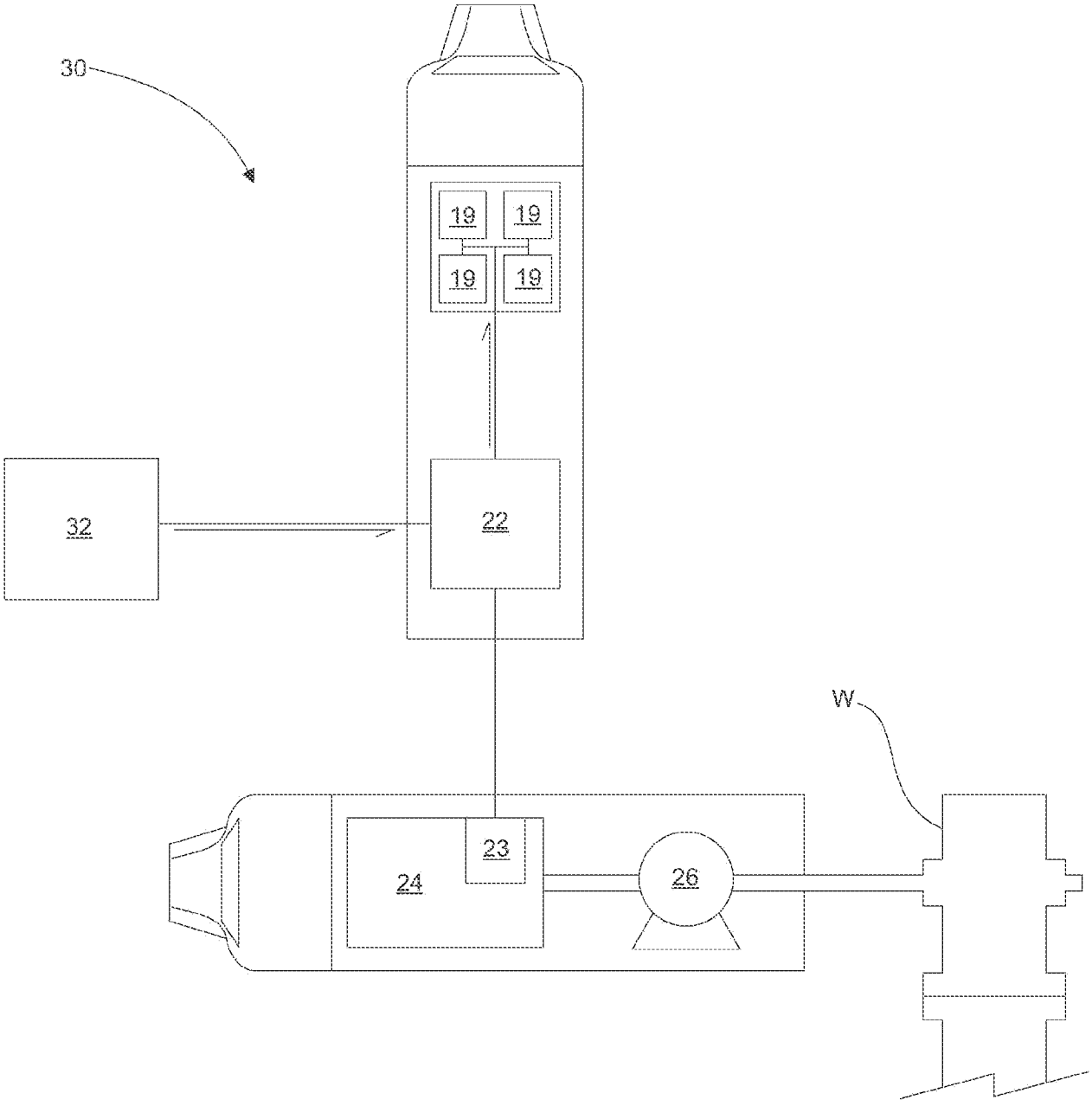


Fig. 2C

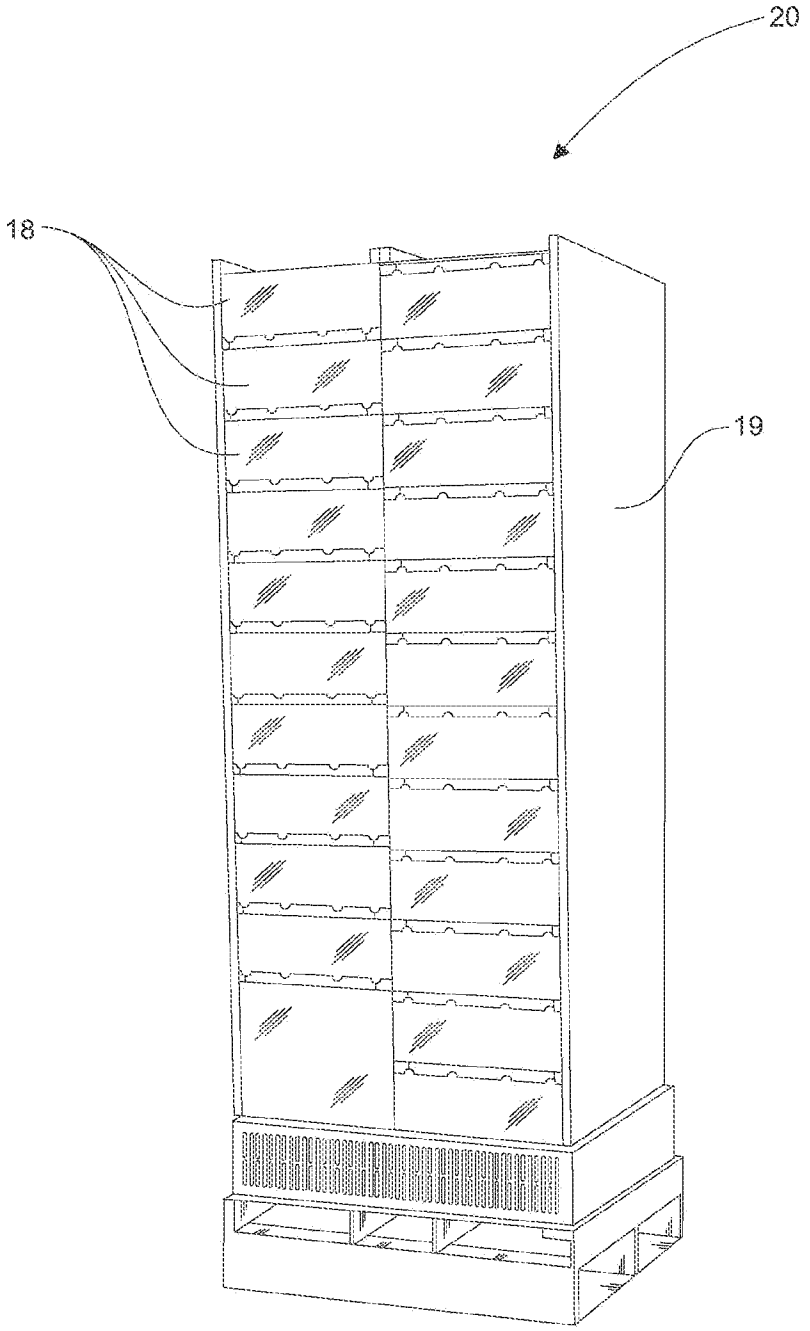


Fig. 3

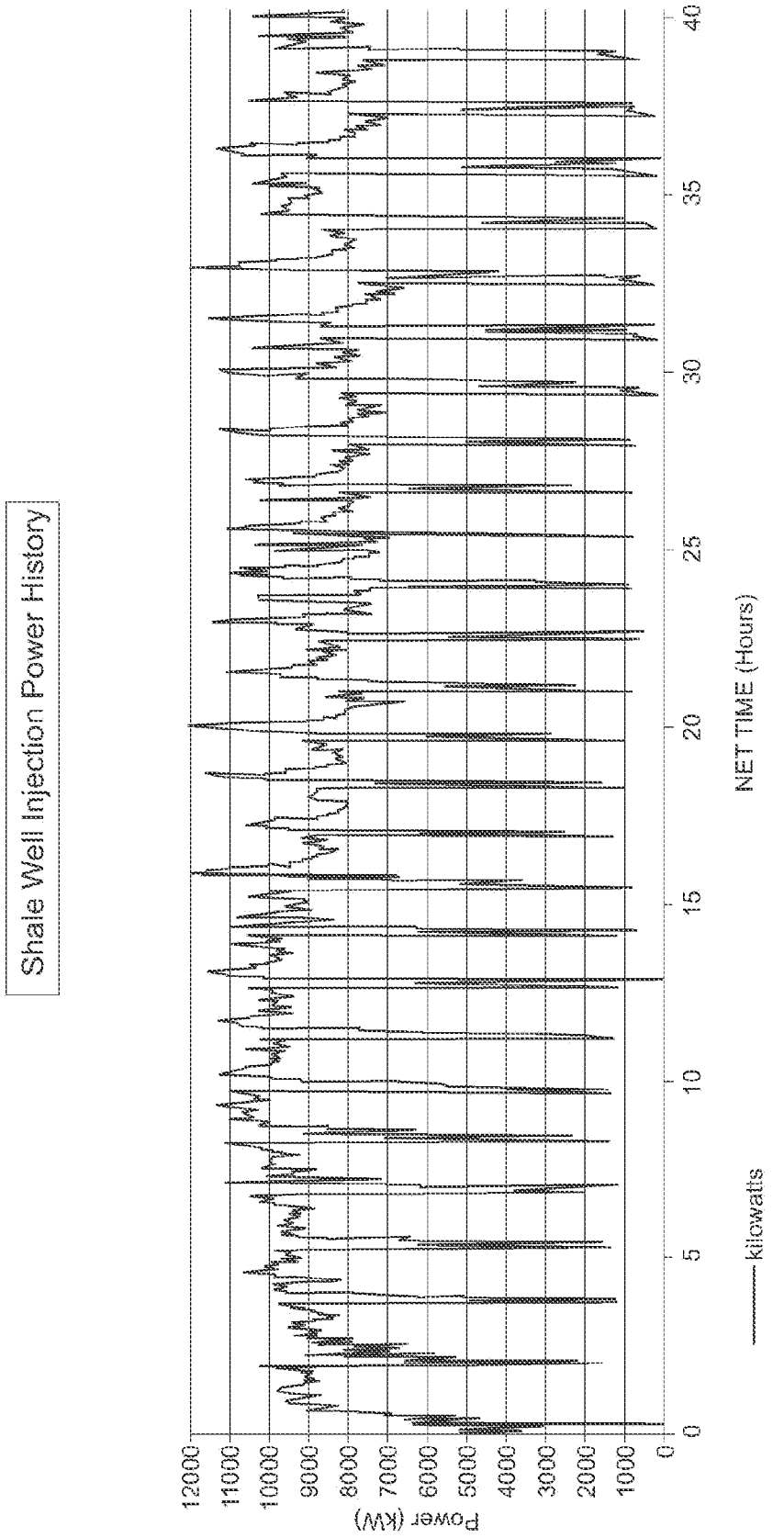

Shale Well Injection Power History
Power (kW)
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11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
0
5
10
15
20
25
30
35
40
NET TIME (Hours)
kilowatts

Fig. 4A

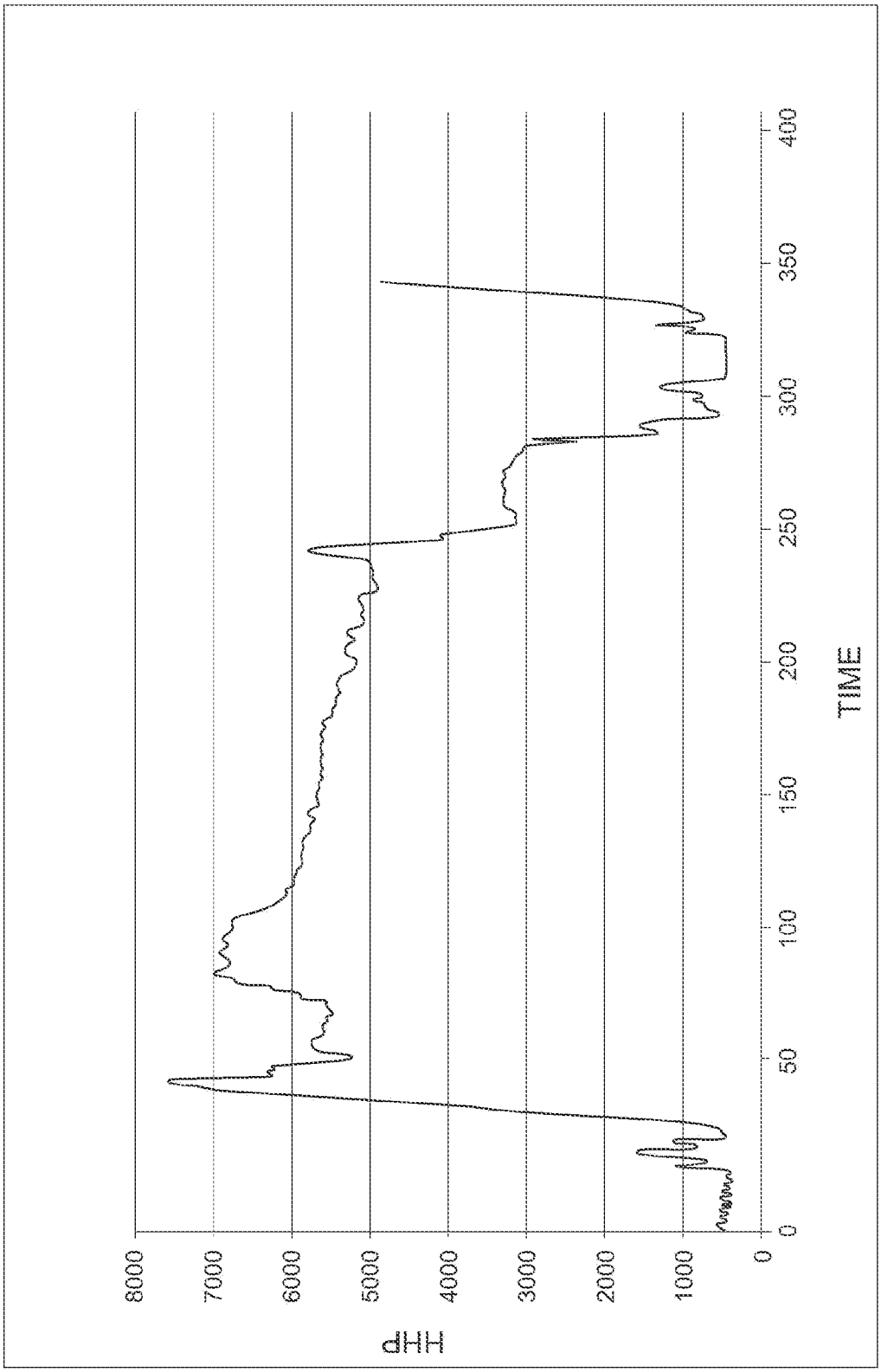

HHP
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TIME
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50
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300
350
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Fig. 4B

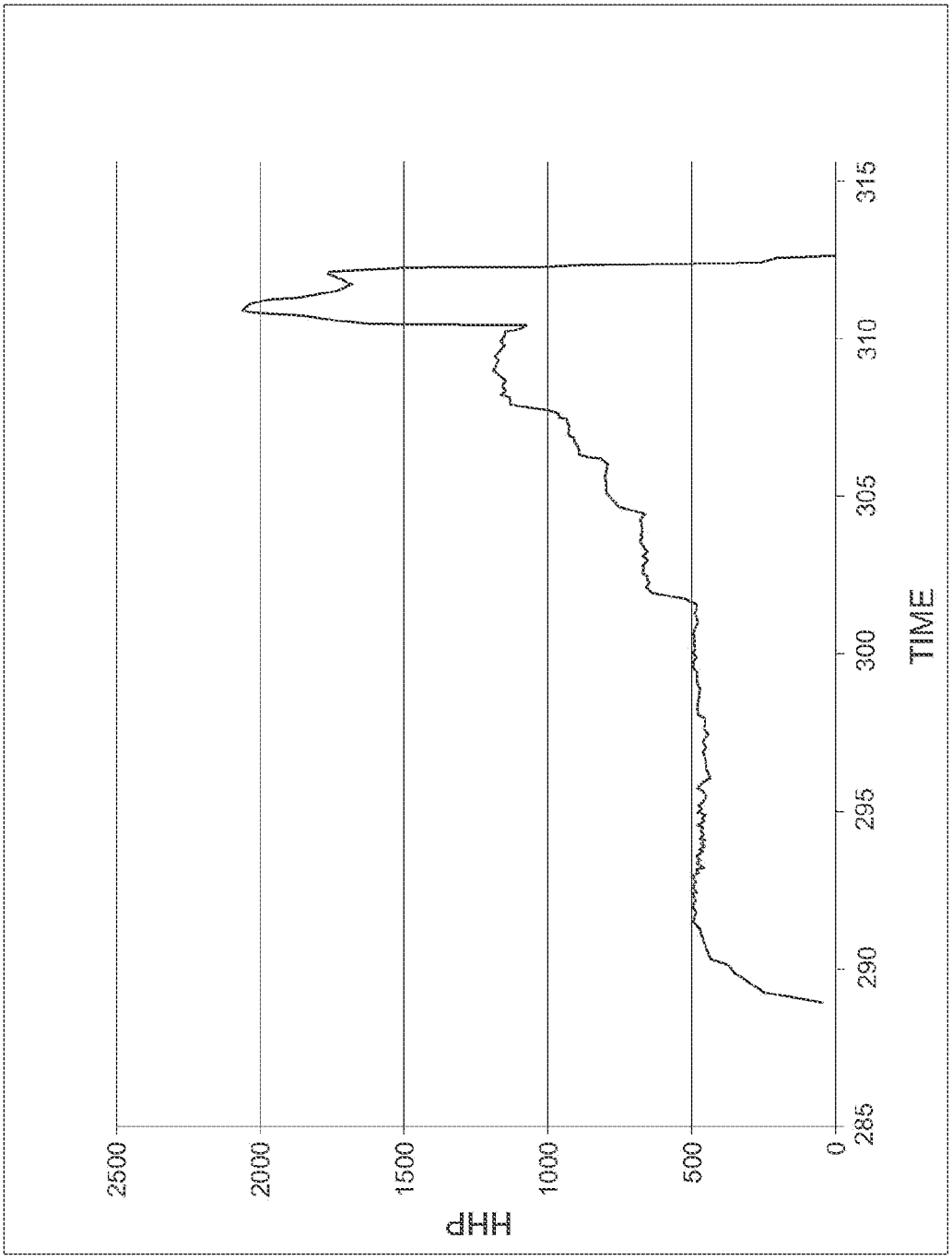


Fig. 4C

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2019/050575

A. CLASSIFICATION OF SUBJECT MATTER
IPC: ***E21B 41/00*** (2006.01), ***E21B 43/12*** (2006.01), ***F04B 17/00*** (2006.01), ***F04B 47/00*** (2006.01), ***F04D 13/00*** (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 43/12*** (2006.01), ***F04B 17/00*** (2006.01), ***F04B 47/00*** (2006.01), ***F04D 13/00*** (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)
Databases: Questel Orbit (FAMPAT), Canadian Patents Database

Keywords: power, peak, demand, electric, motor, pump, wellbore, load, current, management

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	CA 2935772 A1 (BUTTEL, B. et al.) 13 August 2015 (13-08-2015) *Entire document*	1-21
A	CA 2964593 A1 (OEHRING, J. et al.) 15 October 2017 (15-10-2017) *Entire document*	

☐ 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 10 July 2019 (10-07-2019)	Date of mailing of the international search report 08 August 2019 (08-08-2019)
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 Chau Tran (819) 639-9942

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Continuation of Patent Family Annex

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US2019055826A1	21 February 2019 (21-02-2019)

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 17/321,936

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	320
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	700
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	800
TOTAL CLAIMS (37 CFR 1.16(i))	20 minus 20 =	*			OR	x 100 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	*				x 480 =	0.00
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).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	1820

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)		RATE($)	ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** 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 found in the appropriate box in column 1.

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
17/321,936	05/17/2021		1980	047158.100090	20	2

CONFIRMATION NO. 4613

UPDATED FILING RECEIPT

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

OC000000130709148

Date Mailed: 12/28/2021

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

Jared Oehring, Houston, TX;
Brandon Hinderliter, Houston, TX;
Lon Robinson, Houston, TX;
Alexander James Christinzio, Houston, TX;

Applicant(s)

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

Assignment For Published Patent Application

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

Power of Attorney: The patent practitioners associated with Customer Number 132858

Domestic Priority data as claimed by applicant

This application is a CON of 16/728,359 12/27/2019 PAT 11009162

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 05/24/2021
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 17/321,936**
Projected Publication Date: 04/07/2022
Non-Publication Request: No
Early Publication Request: No
Title

SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE

Preliminary Class

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

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I hereby certify that this correspondence is being filed via EFS-Web with the United States Patent and Trademark Office on December 23, 2021.

HOGAN LOVELLS US LLP

By: /Stephanie McDonough/

PATENT
Attorney Docket No.: 047158.100090

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	Confirmation No.: 4613
Jared Oehring	Examiner: Unknown
Application No.: 17/321,936	Art Unit: Unknown
Filed: May 17, 2021	TRANSMITTAL LETTER – RESPONSE TO NOTICE TO FILE MISSING PARTS
For: SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE	
Customer No.: 132858	

Commissioner:

Pursuant to the Notice to File Missing Parts of Nonprovisional Application dated May 25, 2021, the following fees associated with this filing have been charged to the firm's deposit account:

Large Entity:	(a)	Filing Fee	$320
	(b)	Search Fee	$700
	(c)	Examination Fee	$800
	(d)	Missing Parts Surcharge	$160
	(e)	Five Month Extension of Time	$3,160
	TOTAL FEES TO BE CHARGED		$5,140

The Commissioner is hereby authorized to charge any additional fees associated with this paper or during the pendency of this application, or credit any overpayment, to Deposit Account No. 50-1349, referencing Attorney Docket No. 047158.100090.

Respectfully submitted,

/Joe Grdinovac/
Joe Grdinovac
Registration No. 72,224
HOGAN LOVELLS US LLP
609 Main Street, Suite 4200
Houston, Texas 77002
Tel: 713-632-1400
Fax: 713-632-1401

I hereby certify that this correspondence is being filed via EFS-Web with the United States Patent and Trademark Office on December 23, 2021.

HOGAN LOVELLS US LLP

By: /Stephanie McDonough/

PATENT
Attorney Docket No.: 047158.100090

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	Confirmation No.: 4613
Jared Oehring	Examiner: Unknown
Application No.: 17/321,936	Art Unit: Unknown
Filed: May 17, 2021	PRELIMINARY AMENDMENT
For: SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE	
Customer No.: 132858	

Commissioner:

Prior to examination of the above-referenced application, please enter the following amendments and remarks:

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this paper.

Remarks/Arguments begin on page 7 of this paper.

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings of claims in the application:

Listing of Claims:

1. (Cancelled)

2. (New) A hydraulic fracturing system for fracturing a subterranean formation, comprising:

an electric powered multi-plunger hydraulic fracturing pump having an inlet and an outlet, the outlet coupled to a well associated with the subterranean formation and powered by at least one electric motor;

a fluid source, coupled to the inlet of the electric powered multi-plunger hydraulic fracturing pump, the fluid source providing a slurry for injection into the subterranean formation;

a hose extending between the fluid source and the electric powered multi-plunger hydraulic fracturing pump, the hose comprising:

a first end, for coupling to the fluid source, having a first diameter;

a second end, for coupling to the inlet of the electric powered multi-plunger hydraulic fracturing pump, having a second diameter; and

a body between the first end and the second end having a third diameter, the third diameter being less than both the first diameter and the second diameter; and

a pair of fittings, a first fitting forming the first end and a second fitting forming the second end, each fitting of the pair of fittings having a shank end for receiving at least a portion of the body and a union for engaging the respective fluid source and electric powered multi-plunger hydraulic fracturing pump.

3. (New) The system of claim 2, wherein the third diameter is approximately 5 inches and the second diameter is approximately 6 inches.

4. (New) The system of claim 2, wherein each fitting of the pair of fittings further comprises:

a reducer between the union and the shank end.

5. (New) The system of claim 4, wherein at least a portion of the reducer extends into a groove formed in the union, the union extending farther laterally than the reducer.

6. (New) The system of claim 4, wherein each fitting of the pair of fittings is formed as an integral piece with at least one rigid coupling between at least one of the union, the shank end, and the reducer.

7. (New) The system of claim 2, wherein the third diameter is particularly selected based at least in part on a threshold, the threshold corresponding to a drop out rate for the slurry.

8. (New) The system of claim 2, wherein the third diameter is particularly selected based at least in part on a pressure drop rate, a damage accumulation rate, or a suggested flow rate.

9. (New) The system of claim 2, wherein the third diameter is associated with a second threshold, corresponding to a maximum suggested flow rate, an operating window for the electric powered multi-plunger hydraulic fracturing pump exceeding the maximum suggested flow rate.

10. (New) The system of claim 2, further comprising:

a plurality of electric powered multi-plunger hydraulic fracturing pumps, each electric powered multi-plunger hydraulic fracturing pump receiving fluid from the fluid source;

a plurality of hoses having the third diameter; and

a plurality of fittings between respective hoses of the plurality of the hoses and respective electric powered multi-plunger hydraulic fracturing pumps of the plurality of electric powered multi-plunger hydraulic fracturing pumps, each of the electric powered multi-plunger hydraulic fracturing pumps having a connection having the second diameter.

11. (New) The system of claim 2, further comprising:

a distribution system, positioned between the well and the electric powered multi-plunger hydraulic fracturing pump, the distribution system collecting the slurry from electric powered multi-plunger hydraulic fracturing pump for injection into the subterranean formation.

12. (New) A hydraulic fracturing system for fracturing a subterranean formation, comprising:

an electric powered multi-plunger hydraulic fracturing pump having an inlet and an outlet, the outlet coupled to a well associated with the subterranean formation and powered by at least one electric motor;

a fluid source, coupled to the inlet of the electric powered multi-plunger hydraulic fracturing pump, the fluid source providing a slurry for injection into the subterranean formation;

a hose extending between the fluid source and the electric powered multi-plunger hydraulic fracturing pump, the hose comprising:

a first end, for coupling to the fluid source, having a first diameter;

a second end, for coupling to the inlet of the electric powered multi-plunger hydraulic fracturing pump, having a second diameter; and

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a body between the first end and the second end having a third diameter, the third diameter being less than both the first diameter and the second diameter; and

a pair of fittings, wherein a first fitting of the pair of fittings is at the first end and a second fitting of the pair of fittings is at the second end, each fitting of the pair of fittings comprising:

a union arranged at a first fitting end, the union having a union diameter, larger than the first diameter;

a shank end at a second fitting end, the shank end configured to receive at least a portion of the hose, the shank end being securable to at least the portion of the hose, the shank end including an opening to receive the hose; and

a reducer positioned between the union and the shank end, the reducer being welded to the respective union and shank end at each end, the reducer having an increasing diameter along its axial length, the reducer extending at least partially into the union.

13. (New) The system of claim 12, wherein the third diameter is approximately 5 inches and the second diameter is approximately 6 inches.

14. (New) The system of claim 12, wherein at least a portion of the reducer extends into a groove formed in the union, the union extending farther laterally than the reducer.

15. (New) The system of claim 12, wherein each fitting of the pair of fittings is formed as an integral piece with at least one rigid coupling between at least one of the union, the shank end, and the reducer.

16. (New) The system of claim 12, wherein the third diameter is particularly selected based at least in part on a threshold, the threshold corresponding to a drop out rate for the slurry.

17. (New) The system of claim 12, wherein the third diameter is particularly selected based at least in part on a pressure drop rate, a damage accumulation rate, or a suggested flow rate.

18. (New) The system of claim 12, wherein the third diameter is associated with a second threshold, corresponding to a maximum suggested flow rate, an operating window for the electric powered multi-plunger hydraulic fracturing pump exceeding the maximum suggested flow rate.

19. (New) The system of claim 12, further comprising:

a plurality of electric powered multi-plunger hydraulic fracturing pumps, each electric powered multi-plunger hydraulic fracturing pump receiving fluid from the fluid source;

a plurality of hoses having the third diameter; and

a plurality of fittings between respective hoses of the plurality of the hoses and respective electric powered multi-plunger hydraulic fracturing pumps of the plurality of electric powered multi-plunger hydraulic fracturing pumps, each of the electric powered multi-plunger hydraulic fracturing pumps having a connection having the second diameter.

20. (New) The system of claim 12, further comprising:

a distribution system, positioned between the well and the electric powered multi-plunger hydraulic fracturing pump, the distribution system collecting the slurry from electric powered multi-plunger hydraulic fracturing pump for injection into the subterranean formation.

21. (New) The system of claim 12, further comprising:

a third fitting positioned on a third end of the hose for coupling to a second electric powered multi-plunger hydraulic fracturing pump, having the second diameter.

REMARKS/ARGUMENTS

In this preliminary amendment, claim 1 has been canceled, and claims 2-21 are newly added. Support for all amended claims can be found in the specification, and no new matter has been added by these amendments. Although there has been no examination in this application, examination has occurred in the parent application (U.S. Patent Application No. 16/728,359, now Patent No. 11,009,162).

CONCLUSION

Applicants believe all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

Further, the Commissioner is hereby authorized to charge any additional fees or credit any overpayment in connection with this paper to Deposit Account No. 50-1349.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 713-632-1400.

Respectfully submitted,

/Joe Grdinovac/
Joe Grdinovac
Registration No. 72,224
HOGAN LOVELLS US LLP
609 Main Street, Suite 4200
Houston, Texas 77002
Tel: 713-632-1400
Fax: 713-632-1401

Electronic Patent Application Fee Transmittal

Application Number:	17321936
Filing Date:	17-May-2021
Title of Invention:	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE
First Named Inventor/Applicant Name:	Jared Oehring
Filer:	Joe Grdinovac/Stephanie McDonough
Attorney Docket Number:	047158.100090

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY APPLICATION FILING	1011	1	320	320
UTILITY SEARCH FEE	1111	1	700	700
UTILITY EXAMINATION FEE	1311	1	800	800
Pages:				
Claims:				
Miscellaneous-Filing:				
LATE FILING FEE FOR OATH OR DECLARATION	1051	1	160	160
Petition:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Extension - 5 months with $0 paid	1255	1	3160	3160
Miscellaneous:				
		Total in USD ($)		**5140**

Electronic Acknowledgement Receipt

EFS ID:	44600342
Application Number:	17321936
International Application Number:	
Confirmation Number:	4613
Title of Invention:	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE
First Named Inventor/Applicant Name:	Jared Oehring
Customer Number:	132858
Filer:	Joe Grdinovac/Stephanie McDonough
Filer Authorized By:	Joe Grdinovac
Attorney Docket Number:	047158.100090
Receipt Date:	23-DEC-2021
Filing Date:	17-MAY-2021
Time Stamp:	12:53:12
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$5140
RAM confirmation Number	E2021BMC53330099
Deposit Account	501349
Authorized User	Stephanie McDonough

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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	Applicant Response to Pre-Exam Formalities Notice	100090-Response-to-NFMP.pdf	114039 04b5fc1da6150866c45e0f419535f95b8d3ed1d6	no	2
Warnings:					
Information:					
2		100090-Preliminary-Amendment.pdf	119552 1fec3ed2d4c324cca3edc320bdda1b78564336b3	yes	7

Multipart Description/PDF files in .zip description

Document Description	Start	End
Preliminary Amendment	1	1
Claims	2	6
Applicant Arguments/Remarks Made in an Amendment	7	7

Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	49249 4c95ac6a6a4d3e5d65b3e189e36d24434bc00638	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	282840		

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.

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	17321936
Filing Date	2021-05-17
First Named Inventor	Jared OEHRING
Art Unit	
Examiner Name	Not Yet Assigned
Attorney Docket Number	047158.100090

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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	Art Unit	
	Examiner Name	Not Yet Assigned
	Attorney Docket Number	047158.100090

	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	

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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							

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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	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17321936
	Filing Date	2021-05-17
	First Named Inventor	Jared OEHRING
	Art Unit	
	Examiner Name	Not Yet Assigned
	Attorney Docket Number	047158.100090

	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

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	17321936
Filing Date	2021-05-17
First Named Inventor	Jared OEHRING
Art Unit	
Examiner Name	Not Yet Assigned
Attorney Docket Number	047158.100090

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)	2021-09-30
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.

Electronic Acknowledgement Receipt

EFS ID:	43919884
Application Number:	17321936
International Application Number:	
Confirmation Number:	4613
Title of Invention:	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE
First Named Inventor/Applicant Name:	Jared Oehring
Customer Number:	132858
Filer:	Taylor P. Evans/Tina Fluharty
Filer Authorized By:	Taylor P. Evans
Attorney Docket Number:	047158.100090
Receipt Date:	30-SEP-2021
Filing Date:	17-MAY-2021
Time Stamp:	18:07:46
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	047158-100090-IDS.pdf	1035167 d30e2a75609e0f5b62c97616625effaae459ea81	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:					
			Total Files Size (in bytes):	34616246	

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New Applications Under 35 U.S.C. 111

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New International Application Filed with the USPTO as a Receiving Office

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

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	17321936
Filing Date	2021-05-17
First Named Inventor	Jared Oehring, et al.
Art Unit	--
Examiner Name	Unknown
Attorney Docket Number	047158.100090

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	17321936
	Filing Date	2021-05-17
	First Named Inventor	Jared Oehring, et al.
	Art Unit	--
	Examiner Name	Unknown
	Attorney Docket Number	047158.100090

	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)		
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	Filing Date	2021-05-17
	First Named Inventor	Jared Oehring, et al.
	Art Unit	--
	Examiner Name	Unknown
	Attorney Docket Number	047158.100090

	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	☐

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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)		
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	Filing Date	2021-05-17
	First Named Inventor	Jared Oehring, et al.
	Art Unit	--
	Examiner Name	Unknown
	Attorney Docket Number	047158.100090

	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		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.

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Attorney Docket Number	047158.100090

CERTIFICATION STATEMENT

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OR

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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)	2021-06-10
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 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.

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

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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.

Espacenet

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

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

Inventor(s): ZHANG TIEJUN; FEI JIEGAO; LIU RUNCAI; JIA HAIPING; BAI MINGWEI; ZHONG XINRONG; YANG TAO; YANG XIAOPENG; YAN JUN; LI ZHIQUN; LI HONGHONG; LEI ZONGXIAN; WANG ZENGYUAN; MA LINCHANG; ZHAO ENWEI; MENG SHENGKAI ± (张铁军, ; 费节高, ; 刘润才, ; 贾海平, ; 白明伟, ; 钟新荣, ; 杨韬, ; 杨小朋, ; 晏军, ; 李志群, ; 李宏宏, ; 雷宗贤, ; 王增元, ; 马林昌, ; 赵恩维, ; 孟生凯)

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)

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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.

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(71)申请人 中国石油天然气集团有限公司
地址 100007 北京市东城区东直门北大街9号中国石油大厦
申请人 中国石油集团川庆钻探工程有限公司

(72)发明人 张铁军 费节高 刘润才 贾海平 白明伟 钟新荣 杨韬 杨小朋 晏军 李志群 李宏宏 雷宗贤 王增元 马林昌 赵恩维 孟生凯

(74)专利代理机构 西安吉盛专利代理有限责任公司 61108
代理人 鲍燕平

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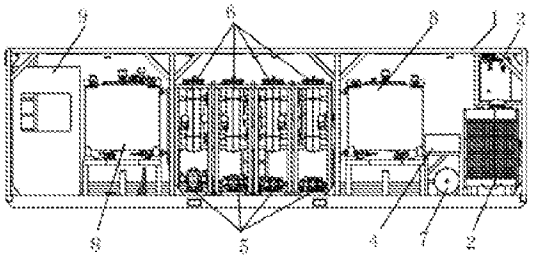
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(54)发明名称

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。



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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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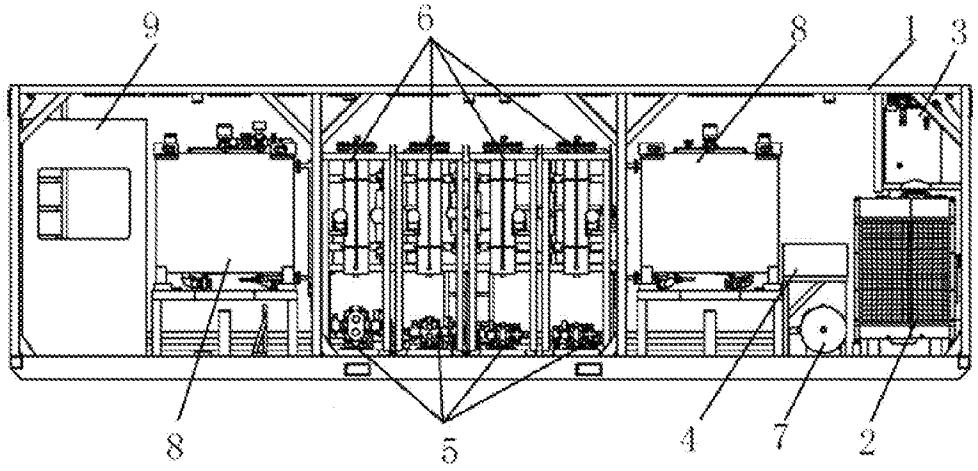


图1

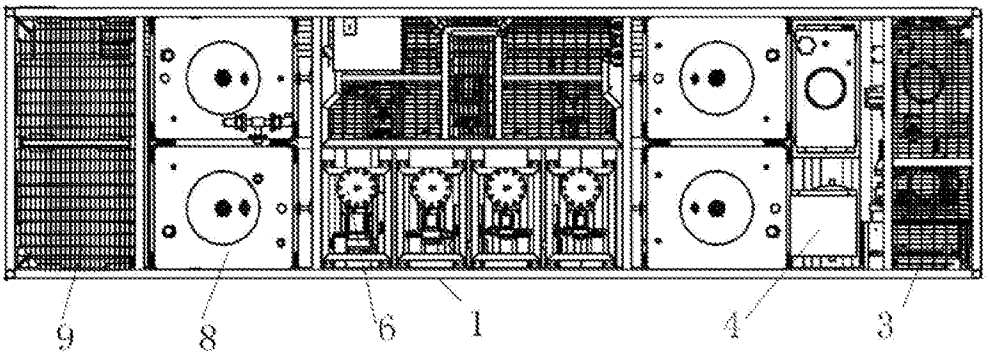


图2

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Espacenet

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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:

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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.

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(71)申请人 丹阳市海信涂料化工厂
地址 212354 江苏省镇江市丹阳市陵口镇312国道214公里处

(72)发明人 黄新良

(74)专利代理机构 南京正联知识产权代理有限公司 32243
代理人 沈志海

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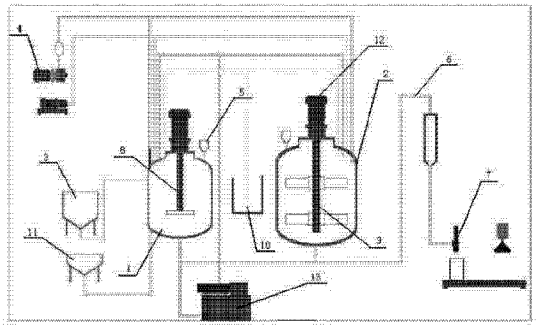
权利要求书1页 说明书2页 附图1页

(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。



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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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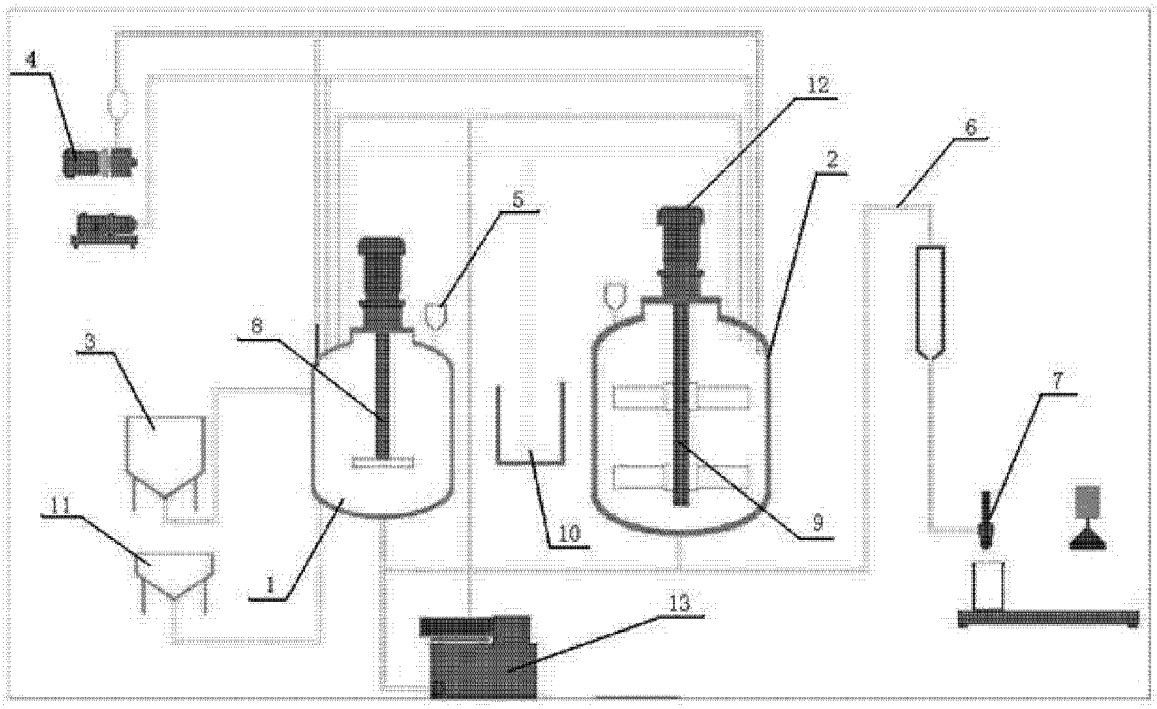


图 1

LIBERTY EXHIBIT 1003, Page 440

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:

- ☒ 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, 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.

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 2019/0128104 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:

- ☒ 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 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)

Date of mailing *(day/month/year)*	MAR 22 2021
Applicant's or agent's file reference 047158.500073	**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:

- ☒ 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	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. 3-8 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. 8);
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)

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 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 20/67146

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:

- ☒ 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	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 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); 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)

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 2018/0181830 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 recciving, 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 recciving, 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)*	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 (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.

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.

Electronic Acknowledgement Receipt

EFS ID:	42950523
Application Number:	17321936
International Application Number:	
Confirmation Number:	4613
Title of Invention:	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE
First Named Inventor/Applicant Name:	Jared Oehring
Customer Number:	132858
Filer:	Taylor P. Evans/Karyn Hines
Filer Authorized By:	Taylor P. Evans
Attorney Docket Number:	047158.100090
Receipt Date:	10-JUN-2021
Filing Date:	17-MAY-2021
Time Stamp:	11:48:24
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	047158-100090-IDS-as-filed-2021-06-10.pdf	1534394 5a182aa305a8163abf3fa97cb2d4596b0f0b9d27	no	6

Warnings:

Information:					
This is not an USPTO supplied IDS fillable form					
2	Foreign Reference	NPL-Ref1-CN112196508A.pdf	1793230 a6148b8849529d95eae4dd32461df682352cf45c	no	12
Warnings:					
Information:					
3	Foreign Reference	NPL-Ref2-CN104117308A.pdf	631560 1c3672ae036fce64127f65a79432565616c9f15a	no	6
Warnings:					
Information:					
4	Non Patent Literature	2021-03-11-International-Search-Report-and-Written-Opinion-047158-500076.pdf	418055 11a799456ef32b1f4824afb8edc0b72a2a358f2c	no	7
Warnings:					
Information:					
5	Non Patent Literature	2021-03-19-International-Search-Report-and-Written-Opinion-047158-500078.pdf	493789 95fafb3f7431308028814 2271329cbd9af55c0f4	no	8
Warnings:					
Information:					
6	Non Patent Literature	2021-03-22-International-Search-Report-and-Written-Opinion-047158-500073.pdf	468912 038db9a92570e4d937ce1580935396d5446a00fd	no	8
Warnings:					
Information:					
7	Non Patent Literature	2021-03-29-International-Search-Report-and-Written-Opinion-047158-500072.pdf	684371 3b9cfb2eae4aca5feaaf0753b1a2f040d2edbcb7	no	9
Warnings:					
Information:					
8	Non Patent Literature	2021-03-30-International-Search-Report-and-Written-Opinion-047158-500077.pdf	522007 6f81bb7c4cb7368c67a57367d9c452e416ca331d	no	9
Warnings:					
Information:					

9	Non Patent Literature	2021-05-06-International-Search-Report-and-Written-Opinion-047158-500074.pdf	573529 96c762b22d48a02d6ee9cff803d0607bd7cfb505	no	10

Warnings:	
Information:	
Total Files Size (in bytes):	7119847

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.

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 17/321,936

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	320
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	700
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	800
TOTAL CLAIMS (37 CFR 1.16(i))	1 minus 20 =	*			OR	x 100 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	1 minus 3 =	*				x 480 =	0.00
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).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	1820

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)		RATE($)	ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** 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 found in the appropriate box in column 1.

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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 NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
17/321,936	05/17/2021	Jared Oehring	047158.100090

CONFIRMATION NO. 4613

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

FORMALITIES LETTER

OC000000125813477

Date Mailed: 05/25/2021

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

Filing Date Granted

Items Required To Avoid Abandonment:

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The statutory basic filing fee is missing.
- The application search fee must be submitted.
- The application examination fee must be submitted.
- Surcharge as set forth in 37 CFR 1.16(f) must be submitted.
  The surcharge is due for any one of:
  - late submission of the basic filing fee, search fee, or examination fee,
  - late submission of inventor's oath or declaration,
  - filing an application that does not contain at least one claim on filing, or
  - submission of an application filed by reference to a previously filed application.

SUMMARY OF FEES DUE:

The fee(s) required within **TWO MONTHS** from the date of this Notice to avoid abandonment is/are itemized below. No entity status discount is in effect. If applicant is qualified for small entity status, a written assertion of small entity status must be submitted to establish small entity status. (See 37 CFR 1.27). If applicant is qualified for micro entity status, an acceptable Certification of Micro Entity Status must be submitted to establish micro entity status. (See 37 CFR 1.29 and forms PTO/SB/15A and 15B.)

- $ **320** basic filing fee.
- $ **160** surcharge.
- $ **700** search fee.
- $ **800** examination fee.
- $(**0**) previous unapplied payment amount.
- $ **1980** TOTAL FEE BALANCE DUE.

Replies must be received in the USPTO within the set time period or must include a proper Certificate of Mailing or Transmission under 37 CFR 1.8 with a mailing or transmission date within the set time period. For more information and a suggested format, see Form PTO/SB/92 and MPEP 512.

Replies should be mailed to:

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Registered users of EFS-Web may alternatively submit their reply to this notice via EFS-Web, including a copy of this Notice and selecting the document description "Applicant response to Pre-Exam Formalities Notice". https://sportal.uspto.gov/authenticate/AuthenticateUserLocalEPF.html

For more information about EFS-Web please call the USPTO Electronic Business Center at 1-866-217-9197 or visit our website at http://www.uspto.gov/ebc.

If you are not using EFS-Web to submit your reply, you must include a copy of this notice.

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**.

/rnegga/

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UNITED STATES DEPARTMENT OF COMMERCE
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
17/321,936	05/17/2021		0.00	047158.100090	1	1

CONFIRMATION NO. 4613

FILING RECEIPT

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

OC000000125813478

Date Mailed: 05/25/2021

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

Jared Oehring, Houston, TX;
Brandon Hinderliter, Houston, TX;
Lon Robinson, Houston, TX;
Alexander James Christinzio, Houston, TX;

Applicant(s)

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

Assignment For Published Patent Application

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

Power of Attorney: The patent practitioners associated with Customer Number 132858

Domestic Priority data as claimed by applicant

This application is a CON of 16/728,359 12/27/2019 PAT 11009162

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 05/24/2021
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 17/321,936**
Projected Publication Date: To Be Determined - pending completion of Missing Parts
Non-Publication Request: No
Early Publication Request: No
Title

SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE

Preliminary Class

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

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Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

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

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Application Number	
Filing Date	2021-05-17
First Named Inventor	Jared Oehring
Title	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE
Art Unit	
Examiner Name	
Attorney Docket Number	047158.100090

SIGNATURE of Applicant or Patent Practitioner

Signature	/Joe Grdinovac/	Date (Optional)	2021-05-17
Name	Joe Grdinovac	Registration Number	72224
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)	U.S. Well Services, LLC		

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Application Number	Filing Date

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U.S. Well Services, LLC

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☐ 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)

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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		

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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	047158.100090
First Named Inventor	Jared Oehring
Title	SYSTEM AND METHOD FOR INTERGRATED..
Priority Mail Express® Label No.	

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. ☐ **Fee Transmittal Form** (PTO/SB/17 or equivalent)
2. ☐ **Applicant asserts small entity status.** See 37 CFR 1.27
3. ☐ **Applicant certifies micro entity status.** See 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent.
4. ☑ **Specification** [*Total Pages* 13] Both the claims and abstract must start on a new page. *(See MPEP § 608.01(a) for information on the preferred arrangement)*
5. ☑ **Drawing(s)** (35 U.S.C. 113) [*Total Sheets* 3]
6. **Inventor's Oath or Declaration** [*Total Pages* 4] *(including substitute statements under 37 CFR 1.64 and assignments serving as an oath or declaration under 37 CFR 1.63(e))*
   a. ☐ Newly executed (original or copy)
   b. ☑ A copy from a prior application (37 CFR 1.63(d))
7. ☑ **Application Data Sheet** ** See note below.* See 37 CFR 1.76 (PTO/AIA/14 or equivalent)
8. **CD-ROM or CD-R** in duplicate, large table, or Computer Program (*Appendix*)
   ☐ Landscape Table on CD
9. **Nucleotide and/or Amino Acid Sequence Submission** (*if applicable, items a. – c. are required*)
   a. ☐ Computer Readable Form (CRF)
   b. ☐ Specification Sequence Listing on:
      i. ☐ CD-ROM or CD-R (2 copies); or
      ii. ☐ Paper
   c. ☐ Statements verifying identity of above copies

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ACCOMPANYING APPLICATION PAPERS

10. ☑ **Assignment Papers** (cover sheet & document(s))
    Name of Assignee U.S. Well Services, LLC
11. ☐ **37 CFR 3.73(c) Statement** (*when there is an assignee*) ☑ **Power of Attorney**
12. ☐ **English Translation Document** (*if applicable*)
13. ☐ **Information Disclosure Statement** (PTO/SB/08 or PTO-1449)
    ☐ Copies of citations attached
14. ☐ **Preliminary Amendment**
15. ☐ **Return Receipt Postcard** (*MPEP § 503*) (*Should be specifically itemized*)
16. ☐ **Certified Copy of Priority Document(s)** (*if foreign priority is claimed*)
17. ☐ **Nonpublication Request** Under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent.
18. ☐ **Other:**

***Note**: (1) Benefit claims under 37 CFR 1.78 and foreign priority claims under 1.55 **must** be included in an Application Data Sheet (ADS).
(2) For applications filed under 35 U.S.C. 111, the application must contain an ADS specifying the applicant if the applicant is an assignee, person to whom the inventor is under an obligation to assign, or person who otherwise shows sufficient proprietary interest in the matter. See 37 CFR 1.46(b).

19. CORRESPONDENCE ADDRESS

☑ The address associated with Customer Number: 132858 **OR** ☐ Correspondence address below

Name					
Address					
City		State		Zip Code	
Country		Telephone		Email	

Signature	/Joe Grdinovac/	Date	2021-05-17
Name (Print/Type)	Joe Grdinovac	Registration No. (Attorney/Agent)	72224

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

[0035] A hydraulic fracturing system for fracturing a subterranean formation includes an electric powered pump having an inlet and an outlet, the outlet coupled to a well associated with the subterranean formation and powered by at least one electric motor. The system also includes a fluid source, coupled to the inlet of the electric powered pump, the fluid source providing a slurry for injection into the subterranean formation. The system further includes a hose extending between the fluid source and the electric powered pump, the hose being flexible and having a first diameter. The system includes a fitting between the hose and the electric powered pump, the fitting having a first end for receiving the hose at the first diameter and a second end for coupling to the electric powered pump at a second diameter, the second diameter being larger than the first diameter.

CLAIMS

1. A hydraulic fracturing system for fracturing a subterranean formation, comprising:

an electric powered, multi-plunger pump having an inlet and an outlet, the outlet coupled to a well associated with the subterranean formation and powered by at least one electric motor, the electric powered pump configured to pump fluid into a wellbore associated with the well at a high pressure so that the fluid passes from the wellbore into the subterranean formation and fractures the subterranean formation;

a fluid source, coupled to the inlet of the electric powered pump, the fluid source providing a slurry for injection into the subterranean formation;

a hose extending between the fluid source and the electric powered pump, the hose being flexible and having a first diameter;

a fitting between the hose and the electric powered pump, the fitting having a first end for receiving the hose at the first diameter and a second end for coupling to the electric powered pump at a second diameter, the second diameter being larger than the first diameter; and

a distribution system, positioned between the wellbore and the electric powered pump, the distribution system collecting the slurry from electric powered pumps for injection into the subterranean formation.

SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application is a continuation of U.S. Patent Application No. 16/728,359 filed December 27, 2019, titled SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE, the entirety of the disclosure of which is incorporated by reference herein.

BACKGROUND

1. Technical Field

[0002] This disclosure relates generally to hydraulic fracturing and more particularly to systems and methods for fluid supply lines utilized in hydraulic fracturing.

2. Background

[0003] With advancements in technology over the past few decades, the ability to reach unconventional sources of hydrocarbons has tremendously increased. Horizontal drilling and hydraulic fracturing are two such ways that new developments in technology have led to hydrocarbon production from previously unreachable shale formations. Hydraulic fracturing (fracturing) operations typically require powering numerous components in order to recover oil and gas resources from the ground. For example, hydraulic fracturing usually includes pumps that inject fracturing fluid down the wellbore, blenders that mix proppant into the fluid, cranes, wireline units, and many other components that all must perform different functions to carry out fracturing operations.

[0004] Hydraulic fracturing operations often try to increase flow rates through fracturing pumps in order to reduce operational times and save costs. However, typical fracturing systems have established component sizes and non-standard components are challenging to incorporate and may

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lead to errors, as operators may be unfamiliar with the new components. One such instance is in fluid flow lines (e.g., hoses) utilize to supply fracturing fluid to the pumps. Many flow lines utilized in the industry have a 4 inch diameter. However, this flow diameter limits fluid inlet into the pumps, which may be undesirable, because pumps operating at lower flow rates and/or pressures than desired may experience premature wear and failures. Moreover, merely increasing hose sizes is not practical because of component fittings on the pump and potential problems with flow rates, as flow rates that drop below a threshold may experience drop out of particulates, leading to blockages and other problems at the well site.

SUMMARY

[0005] Applicant recognized the problems noted above herein and conceived and developed embodiments of systems and methods, according to the present disclosure, for operating electric fracturing pumps.

[0006] In an embodiment, a hydraulic fracturing system for fracturing a subterranean formation includes an electric powered, multi-plunger pump having an inlet and an outlet, the outlet coupled to a well associated with the subterranean formation and powered by at least one electric motor, the electric powered pump configured to pump fluid into a wellbore associated with the well at a high pressure so that the fluid passes from the wellbore into the subterranean formation and fractures the subterranean formation. The system also includes a fluid source, coupled to the inlet of the electric powered pump, the fluid source providing a slurry for injection into the subterranean formation. The system further includes a hose extending between the fluid source and the electric powered pump, the hose being flexible and having a first diameter. The system includes a fitting between the hose and the electric powered pump, the fitting having a first end for receiving the hose at the first diameter and a second end for coupling to the electric powered pump at a second diameter, the second diameter being larger than the first diameter. The system also includes a distribution system,

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positioned between the wellbore and the electric powered pump, the distribution system collecting the slurry from electric powered pumps for injection into the subterranean formation.

[0007] In an embodiment, a hydraulic fracturing system for fracturing a subterranean formation includes an electric powered, multi-plunger pump having an inlet and an outlet, the outlet coupled to a well associated with the subterranean formation and powered by at least one electric motor, the electric powered pump configured to pump fluid into a wellbore associated with the well at a high pressure so that the fluid passes from the wellbore into the subterranean formation and fractures the subterranean formation. The system also includes a fluid source, coupled to the inlet of the electric powered pump, the fluid source providing a slurry for injection into the subterranean formation. The system includes a hose extending between the fluid source and the electric powered pump, the hose including a first end, for coupling to the fluid source, having a first diameter, a second end, for coupling to the inlet of the electric powered pump, having a second diameter, and a body between the first end and the second end having a third diameter, the third diameter being less than both the first diameter and the second diameter. The system further includes a pair of fittings, a first fitting forming the first end and a second fitting forming the second end, each fitting of the pair of fittings having a shank end for receiving at least a portion of the body and a union for engaging the respective fluid source and electric powered pump.

[0008] In an embodiment, a method for selecting a hose diameter for a flow line utilized in fracturing operations includes determining a first end connection size is a first diameter. The method also includes determining a second end connection size is a second diameter. The method further includes determining a first flow rate, associated with a first hose diameter, is below a threshold. The method includes determining a second flow rate, associated with a second hose diameter, exceeds the threshold. The method also includes forming the flow line using the second hose diameter.

BRIEF DESCRIPTION OF DRAWINGS

[0009] Some of the features and benefits of the present disclosure having been stated, others will become apparent as the description proceeds when taken in conjunction with the accompanying drawings, in which:

[0010] FIG. 1 is a schematic plan view of an embodiment of a fracturing operation, in accordance with embodiments of the present disclosure;

[0011] FIG. 2 is a side view of an embodiment of a fitting, in accordance with embodiments of the present disclosure;

[0012] FIG. 3 is a schematic perspective view of an embodiment of a flow line, in accordance with embodiments of the present disclosure; and

[0013] FIG. 4 is a graphical representation of suction pipe flow rates, in accordance with embodiments of the present disclosure.

[0014] While the disclosure will be described in connection with the preferred embodiments, it will be understood that it is not intended to limit the disclosure to that embodiment. On the contrary, it is intended to cover all alternatives, modifications, and equivalents, as may be included within the spirit and scope of the disclosure as defined by the appended claims.

DETAILED DESCRIPTION

[0015] The method and system of the present disclosure will now be described more fully hereinafter with reference to the accompanying drawings in which embodiments are shown. The method and system of the present disclosure may be in many different forms and should not be construed as limited to the illustrated embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey its scope to those skilled in the art. Like numbers refer to like elements throughout. In an embodiment, usage of

the term "about" includes +/- 5% of the cited magnitude. In an embodiment, usage of the term "substantially" includes +/- 5% of the cited magnitude.

[0016] It is to be further understood that the scope of the present disclosure is not limited to the exact details of construction, operation, exact materials, or embodiments shown and described, as modifications and equivalents will be apparent to one skilled in the art. In the drawings and specification, there have been disclosed illustrative embodiments and, although specific terms are employed, they are used in a generic and descriptive sense only and not for the purpose of limitation.

[0017] When introducing elements of various embodiments of the present disclosure, the articles "a", "an", "the", and "said" are intended to mean that there are one or more of the elements. The terms "comprising", "including", and "having" are intended to be inclusive and mean that there may be additional elements other than the listed elements. Any examples of operating parameters and/or environmental conditions are not exclusive of other parameters/conditions of the disclosed embodiments. Additionally, it should be understood that references to "one embodiment", "an embodiment", “certain embodiments”, or “other embodiments” of the present disclosure are not intended to be interpreted as excluding the existence of additional embodiments that also incorporate the recited features. Furthermore, reference to terms such as “above”, “below”, “upper”, “lower”, “side”, “front”, “back”, or other terms regarding orientation or direction are made with reference to the illustrated embodiments and are not intended to be limiting or exclude other orientations or directions. Additionally, recitations of steps of a method should be understood as being capable of being performed in any order unless specifically stated otherwise. Furthermore, the steps may be performed in series or in parallel unless specifically stated otherwise. Particular dimensions may be referred to herein along with their accompanying abbreviations, including but not limited to: inches (in, ”), meters (m), centimeters (cm), pounds per square inch (PSI), pascals (Pa), feet per second (ft/s), barrels per minute (BPM), and the like.

[0018] Embodiments of the present disclosure include specialty-sized hoses developed in order to allow greater flow/supply to frac pumps (e.g., positive displacement, multi plunger pumps). This increased flow capability reduces cavitation events and prolongs equipment life. Specially selecting a 5" (0.127 m) diameter hose allows for fluid velocity to be maintained above a threshold at which sand particles would begin to fall out and eventually cause a blockage (sand off) the hose itself. In order to utilize this diameter/size hose in a large-scale function, a connection point was developed to enable use of standard 6" (0.1524 m) components, such as but not limited to hammer unions, butterfly valves, and other 6" steel pipe components. Embodiments include a hybrid of 5" hose and 6" end connectors. This then results in an improvement to existing methods of supplying fluid to a positive displacement pump.

[0019] Embodiments of the present disclosure present an improvement over existing systems by removing the standard 4" (0.1016 m) supply hoses while maintaining standard 6" connection types by utilizing a particularly designed ferrule. The standard 4" supply hose provides an insufficient volume of fracturing fluid to a pump utilizing in hydraulic fracturing operation. These problems may be compounded when 4" connections are also used. Using a 5" diameter hose supplies more volume, reduces pressure drop, and reduces cavitation and other poor conditions pumps can experience when not supplied adequately.

[0020] FIG. 1 is a plan schematic view of an embodiment of a hydraulic fracturing system 10 positioned at a well site 12. In the illustrated embodiment, pump units 14, which make up a pumping system 16, are used to pressurize a slurry solution for injection into a wellhead 18. An optional hydration unit 20 receives fluid from a fluid source 22 via a line, such as a tubular, and also receives additives from an additive source 24. In an embodiment, the fluid is water and the additives are mixed together and transferred to a blender unit 26 where proppant from a proppant source 28 may be added to form the slurry solution (e.g., fracturing slurry) which is transferred to the pumping

system 16. The pump units 14 may receive the slurry solution at a first pressure (e.g., 80 psi to 160 psi) and boost the pressure to around 15,000 psi for injection into the wellhead 18. In certain embodiments, the pump units 14 are powered by electric motors.

[0021] After being discharged from the pump system 16, a distribution system 30, such as a missile, receives the slurry solution for injection into the wellhead 18. The distribution system 30 consolidates the slurry solution from each of the pump units 14 and includes discharge piping 32 coupled to the wellhead 18. In this manner, pressurized solution for hydraulic fracturing may be injected into the wellhead 18.

[0022] In the illustrated embodiment, one or more sensors 34, 36 are arranged throughout the hydraulic fracturing system 10 to measure various properties related to fluid flow, vibration, and the like.

[0023] It should be appreciated that while various embodiments of the present disclosure may describe electric motors powering the pump units 14, in embodiments, electrical generation can be supplied by various different options, as well as hybrid options. Hybrid options may include two or more of the following electric generation options: Gas turbine generators with fuel supplied by field gas, CNG, and/or LNG, diesel turbine generators, diesel engine generators, natural gas engine generators, batteries, electrical grids, and the like. Moreover, these electric sources may include a single source type unit or multiple units. For example, there may be one gas turbine generator, two gas turbines generators, two gas turbine generators coupled with one diesel engine generator, and various other configurations.

[0024] In various embodiments, equipment at the well site may utilize 3-phase, 60 Hz, 690V electrical power. However, it should be appreciated that in other embodiments different power specifications may be utilized, such as 4160V or at different frequencies, such as 50 Hz. Accordingly, discussions herein with a particular type of power specification should not be

interpreted as limited only the particularly discussed specification unless otherwise explicitly stated. Furthermore, systems described herein are designed for use in outdoor, oilfield conditions with fluctuations in temperature and weather, such as intense sunlight, wind, rain, snow, dust, and the like. In embodiments, the components are designed in accordance with various industry standards, such as NEMA, ANSI, and NFPA.

[0025] FIG. 2 is a side view of an embodiment of a fitting 200 (e.g., ferrule) that may be utilized with embodiments of the present disclosure to incorporate 5" hoses into systems using 4" hoses and 6" fittings. In the illustrated embodiment, the fitting 200 includes a cutaway region 202 illustrating a coupling location 204 between a union 206 and a stem assembly 208. In the illustrated embodiment, the union 206 is configured to couple to a 6" coupling, for example on a pump. However, as illustrated, the stem assembly 208 includes a reducer 210 and a shank end 212 to receive a 5" hose (not pictured). For example, an end of the hose may be inserted into the shank end 212 and crimped, thereby joining the hose to the fitting 200. As a result, 5" hoses may be utilized in embodiments that include 6" fittings without significantly overhauling and/or modifying existing equipment. As discussed herein, 5" hoses provide numerous advantages including reduced pressure drop, greater capacity, and flow velocities greater than a threshold level corresponding to particulate drop out.

[0026] In the illustrated embodiment, various rigid couplings 214 are included along the fitting 200, for example, as welds utilizing to secure one or more components together. For example, there is a rigid coupling 214 between the union 206 and the reducer 210, as well as a rigid coupling 214 between the reducer 210 and the shank end 214. Accordingly, the components forming the fitting 200 may be particularly selected, based on one or more properties, for use with fracturing operations. For example, different fittings 200 may include different components. By way of example only, the union 206 may be replaced with a flanged end connection or the like.

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[0027] Embodiments of the present disclosure that utilize the fitting 200 provide improved operations at a well site at least because greater volumes of fluid may be provided to fracturing pumps while maintaining flow rates above a threshold amount where particulates begin to drop out of the flow. For example, a 5" hose may meet rate demands while maintaining flow velocities at sufficient levels to reduce the likelihood of drop out. In contrast, a 4" hose may not meet rate demands and a 6" hose may not maintain flow velocities above the threshold for drop out. Moreover, the fitting 200 provides easy integration into existing systems without overhauling expensive equipment. For example, it may be costly to overhaul inlet piping on a fracturing pump, so much so, that it may be cost prohibitive to do so. Additionally, existing field equipment may be configured with certain specifications and include sunk costs, leading producers and operators to be reluctant to change. However, utilizing the fitting 200 enables existing equipment to remain in operation while providing improved operations.

[0028] FIG. 3 is a schematic perspective view of an embodiment of a portion of a flow line 300 including the fitting 200. In the illustrated embodiment, the flow line 300 includes connections 302 for coupling to mating 6" connections. However, due to the inclusion of the fitting 200, a 5" flow line may be incorporated into the design. The fitting 200, as noted above includes a transition from the 5" line to a 6" connection, thereby enabling use with the illustrated flow line 300. Advantageously, the flow line 300 may continue to be used in wellbore operations without modifications, which may reduce costs to operators with respect to obtaining new equipment for jobs.

[0029] As noted above, embodiments of the present disclosure provide advantages over existing systems that either utilize flow lines having diameters that are too small to provide sufficient capacity or are too large to maintain fluid velocities above threshold levels. Embodiments of the present disclosure overcome these problems by providing more volume, reducing drop in pressure,

and reducing a likelihood of cavitation and other unhealthly pump conditions, such as starving. By way of example, frac slurry often consists of sand media also known as proppant, at low fluid velocities this proppant can begin to fall out of suspension. Some industry data notes that sand fall out begins at 2.21ft/sec, which equates to 3.2 BPM in a 5" hose. Sand fall out is substantial at 1.72 ft/sec, which equates to 2.2 BPM in a 5" hoses. As a result, systems may be deployed to ensure that flow rates are maintained above these levels (which may be set as the thresholds) during operation.

[0030] Furthermore, embodiments of the present disclosure improve existing systems by reducing damage accumulation rates due to the improved flow characteristics associated with the 5" hose when compared to the 4" hose of existing systems. For example, a damage accumulate rate associated with the 5" hose may be less than the 4" hose and may increase at a lower rate as flow rate increases. Damage accumulation may be a factor, at least in part, on flow velocities, where a small diameter pipe will have greater velocities than a larger diameter pipe.

[0031] FIG. 4 is a graphical representation 400 illustrating pump flow rates and respective suction piping sizes. The x-axis 402 corresponds to suction pipe diameter (in inches) and the y-axis 404 corresponds to flow rate (in BPM). An operational window 406 is provided indicative of typical ranges where fracturing operations may occur. In this embodiment, the operational widow 406 extends from approximately 1 BPM to approximately 7 BPM.

[0032] Each respective suction pipe diameter includes a threshold flow rate, which may be obtained through experimental procedures and/or reference materials. For example, a 4" suction pipe illustrated at 408 has a threshold 410 of approximately 4.3 BPM, a 5" suction pipe illustrated at 412 has a threshold 414 of approximately 5.5 BPM, and a 6" suction pipe illustrated at 416 has a threshold 418 of approximately 6.5 BPM. The operational window 406 includes a portion that exceeds each of the illustrated thresholds 410, 414, 418.

[0033] Operations using the 4" suction pipe 408 include an operating range that is approximately 40% larger than the threshold 410. As a result, there is a high likelihood that operations will exceed the threshold due to demands to supply additional fluid for fracturing operations. Similarly, operations using the 5" suction pipe 412 and the 6" suction pipe 416 also exceed threshold 414, 418 by approximately 22% and 7%, respectively. The instant application has identified that while the 6" suction pipe 416 enables the largest flow rate, that problems associated with fluid velocities and drop out make the 6" suction pipe 416 undesirable. Accordingly, embodiments may incorporate the 5" suction pipe 412, which provides significant improvements over the 4" suction pipe 408 while also reducing the likelihood of drop out. The 5" suction pipe 412 also has less pressure drop, when compared to the 4" suction pipe 408, providing an additional improvement over existing configurations.

[0034] The present disclosure described herein, therefore, is well adapted to carry out the objects and attain the ends and advantages mentioned, as well as others inherent therein. While a presently preferred embodiment of the disclosure has been given for purposes of disclosure, numerous changes exist in the details of procedures for accomplishing the desired results. These and other similar modifications will readily suggest themselves to those skilled in the art, and are intended to be encompassed within the spirit of the present disclosure disclosed herein and the scope of the appended claims.

Electronic Acknowledgement Receipt

EFS ID:	42738293
Application Number:	17321936
International Application Number:	
Confirmation Number:	4613
Title of Invention:	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE
First Named Inventor/Applicant Name:	Jared Oehring
Customer Number:	132858
Filer:	Joe Grdinovac/Stephanie McDonough
Filer Authorized By:	Joe Grdinovac
Attorney Docket Number:	047158.100090
Receipt Date:	17-MAY-2021
Filing Date:	
Time Stamp:	14:28:52
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	WebADS.pdf	146506 b514e61d80d0caf815eff5af35a00190cb5ec455	no	8

Warnings:

Information:					
2	Oath or Declaration filed	100090_Declarations.pdf	379547 9f496a52be23266094207fe06cebda70f43763d7	no	4
Warnings:					
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Information:					
3	Drawings-only black and white line drawings	100090_Figures.pdf	101597 794bf7478ccde0ef07c6bfb343e9dd6986f21ecc	no	3
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4	Power of Attorney	100090_POA.pdf	454743 f528c4a4e1313695e496eb5ff81d141292202e46	no	2
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Information:					
5	Transmittal of New Application	100090_Utility-tml.pdf	288118 b234734b4e14ea7c0ae6bb210659fb749f64272c	no	2
Warnings:					
Information:					
6		100090-Specification.pdf	144547 6fc3524c7d38fe7b3df374012fa262f361c131f7	yes	13

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Abstract	13	13
	Claims	12	12
	Specification	1	11

Warnings:

Information:	
Total Files Size (in bytes):	1515058

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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.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	047158.100090
	Application Number	
Title of Invention	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Jared		Oehring	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Houston	State/Province	TX	Country of Residence i	US

Mailing Address of Inventor:

Address 1	c/o U.S. Well Services, LLC		
Address 2	1360 Post Oak Blvd., Suite 1800		
City	Houston	State/Province	TX
Postal Code	77056	Country i	US

Inventor 2

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Brandon		Hinderliter	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Houston	State/Province	TX	Country of Residence i	US

Mailing Address of Inventor:

Address 1	c/o U.S. Well Services, LLC		
Address 2	1360 Post Oak Blvd., Suite 1800		
City	Houston	State/Province	TX
Postal Code	77056	Country i	US

Inventor 3

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Lon		Robinson	

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	047158.100090
	Application Number	
Title of Invention	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE	

Residence Information (Select One)	(•) US Residency	( ) Non US Residency	( ) Active US Military Service	
City	Houston	**State/Province**	TX	**Country of Residence** i US

Mailing Address of Inventor:

Address 1	c/o U.S. Well Services, LLC		
Address 2	1360 Post Oak Blvd., Suite 1800		
City	Houston	**State/Province**	TX
Postal Code	77056	**Country** i	US

Inventor 4

Legal Name

Prefix	**Given Name**	**Middle Name**	**Family Name**	**Suffix**
	Alexander	James	Christinzio	

Residence Information (Select One)	(•) US Residency	( ) Non US Residency	( ) Active US Military Service	
City	Houston	**State/Province**	TX	**Country of Residence** i US

Mailing Address of Inventor:

Address 1	c/o U.S. Well Services, LLC		
Address 2	1360 Post Oak Blvd., Suite 1800		
City	Houston	**State/Province**	TX
Postal Code	77056	**Country** i	US

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	132858		
Email Address	hlusdocketing@hoganlovells.com	Add Email	Remove Email

Application Information:

Title of the Invention	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE		
Attorney Docket Number	047158.100090	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	3	**Suggested Figure for Publication (if any)**	

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	047158.100090
	Application Number	
Title of Invention	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	132858		

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix	Remove
Registration Number					
Prefix	**Given Name**	Middle Name	**Family Name**	Suffix	Remove
Registration Number					

Additional Representative Information blocks may be generated within this form by selecting the **Add** button.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	047158.100090
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Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Patented	Remove			
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
	Continuation of	16728359	2019-12-27	11009162	2021-05-18

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX) the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Application Number	Country	Filing Date (YYYY-MM-DD)	Access Code (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	047158.100090
	Application Number	
Title of Invention	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	047158.100090
	Application Number	
Title of Invention	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

◉ Assignee	○ Legal Representative under 35 U.S.C. 117	○ Joint Inventor
○ Person to whom the inventor is obligated to assign.	○ Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:	

If the Applicant is an Organization check here. ☒

Organization Name	U.S. Well Services, LLC

Mailing Address Information For Applicant:

Address 1	1360 Post Oak Boulevard, Suite 1800		
Address 2			
City	Houston	**State/Province**	TX
Country[i]	US	Postal Code	77056
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	047158.100090
	Application Number	
Title of Invention	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE	

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

If the Assignee or Non-Applicant Assignee is an Organization check here. ☒

Organization Name	U.S. Well Services, LLC

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1	1360 Post Oak Boulevard, Suite 1800		
Address 2			
City	Houston	**State/Province**	TX
Country i	US	Postal Code	77056
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	047158.100090
	Application Number	
Title of Invention	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE	

Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e. g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Joe Grdinovac/			Date (YYYY-MM-DD)	
First Name	Joe	Last Name	Grdinovac	Registration Number	72224

Additional Signature may be generated within this form by selecting the Add button.

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

Title of Invention	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE

As the below named inventor, I hereby declare that:

This declaration is directed to:

☐ The attached application, or

☒ United States application or PCT international application number 16/728,359

filed on 12-27-2019.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Alexander James Christinzio Date (Optional): 02.08.2021

Signature: Alexander Christinzio

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Title of Invention	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE

As the below named inventor, I hereby declare that:

This declaration is directed to:

☐ The attached application, or

☒ United States application or PCT international application number 16/728,359 filed on December 27, 2019.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

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LEGAL NAME OF INVENTOR

Inventor: Brandon HINDERLITER Date (Optional): 4/23/20

Signature: [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.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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

Title of Invention	SYSTEM AND METHOD FOR INTEGRATED FLOW SUPPLY LINE

As the below named inventor, I hereby declare that:

This declaration is directed to:

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☒ United States application or PCT international application number 16/728,359 filed on December 27, 2019.

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LEGAL NAME OF INVENTOR

Inventor: Jared OEHRING Date (Optional) :

Signature:

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LEGAL NAME OF INVENTOR

Inventor: Lon Robinson Date (Optional) :

Signature:

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

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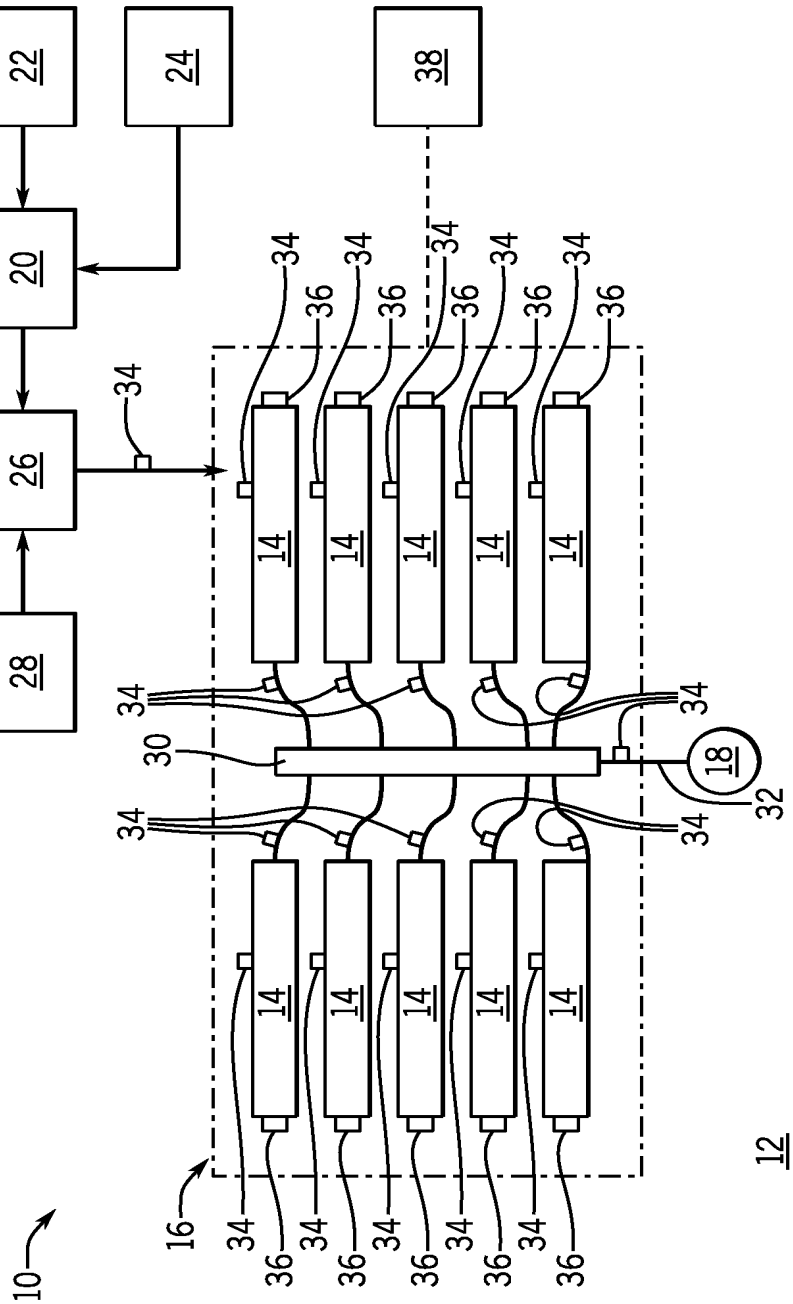


FIG. 1

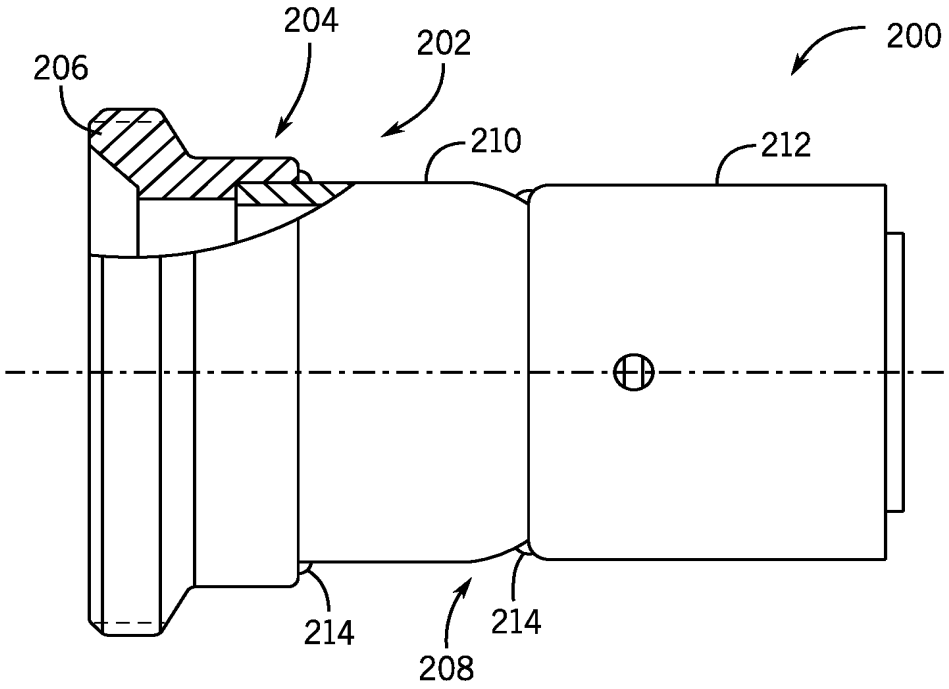


FIG. 2

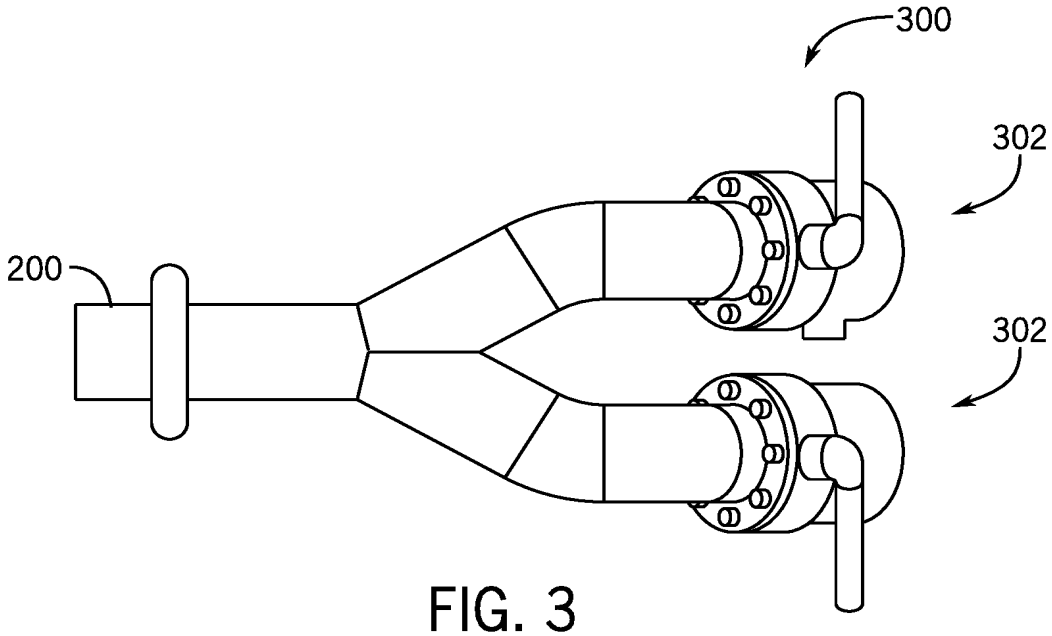


FIG. 3

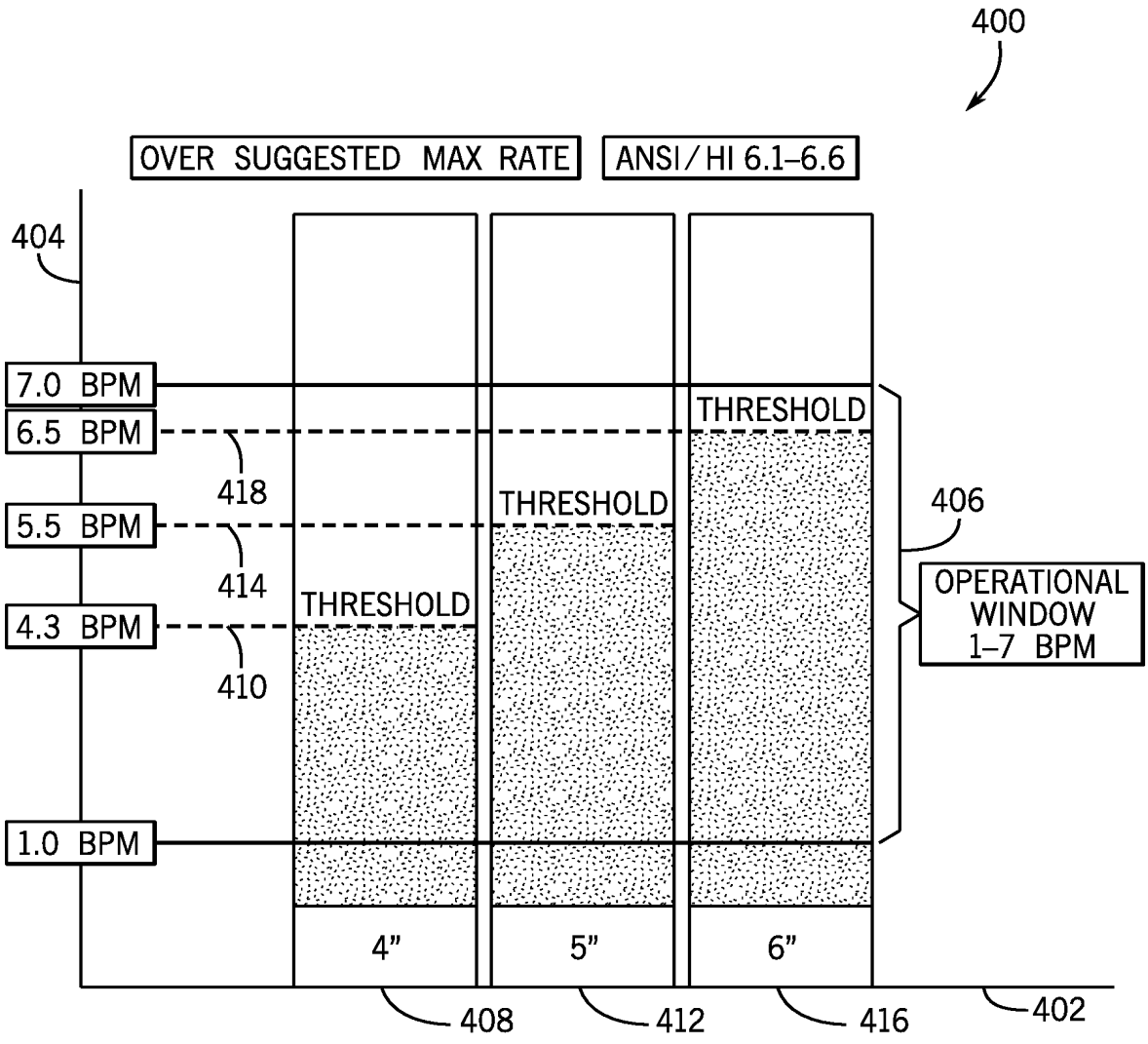

400
OVER SUGGESTED MAX RATE
ANSI / HI 6.1–6.6
404
7.0 BPM
6.5 BPM
5.5 BPM
4.3 BPM
1.0 BPM
418
414
410
THRESHOLD
THRESHOLD
THRESHOLD
406
OPERATIONAL WINDOW 1–7 BPM
4"
5"
6"
408
412
416
402

FIG. 4