

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	16597014
	Filing Date	2019-10-09
	First Named Inventor	Jared OEHRING
	Art Unit	3746
	Examiner Name	Christopher S. BOBISH
	Attorney Docket Number	047158-100048

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	3	9482086	B2	2016-11-01	Richardson et al.	
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	2	20170138171	A1	2017-05-18	Richards et al.	

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

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2	108049999	CN	A	2018-05-18	Kailong High Tech Co. Ltd.	English-Language Translation
3	205986303	CN	U	2017-02-22	Zhenjiang Daqo Secheron Traction Power Co. Ltd.	English-Language Abstract

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	1	Non-Final Office Mailed October 26, 2020 in US Patent Application 15/356,436	
	2	Non-Final Office Mailed October 5, 2020 in US Patent Application No.16/443,273	
	3	Non-Final Office Action Mailed September 29, 2020 in US Patent Application No. 16/943,727	
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8	International Search Report and Written Opinion Mailed September 3, 2020 in PCT/US2020/36932
9	"Process Burner" (https://www.cebassrt.com/products/loii-gas/process-burner) 06 September 6, 2018 (06.09.2018), entire document, especially para (Burners for refinery Heaters]
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13	Canadian Office Action issued August 31, 2020 in Canadian Patent Application No. 2,944,980
14	International Search Report and Written Opinion Mailed August 28, 2020 in PCT/US20/23821

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Signature	/Taylor P. Evans/	Date (YYYY-MM-DD)	2020-11-19
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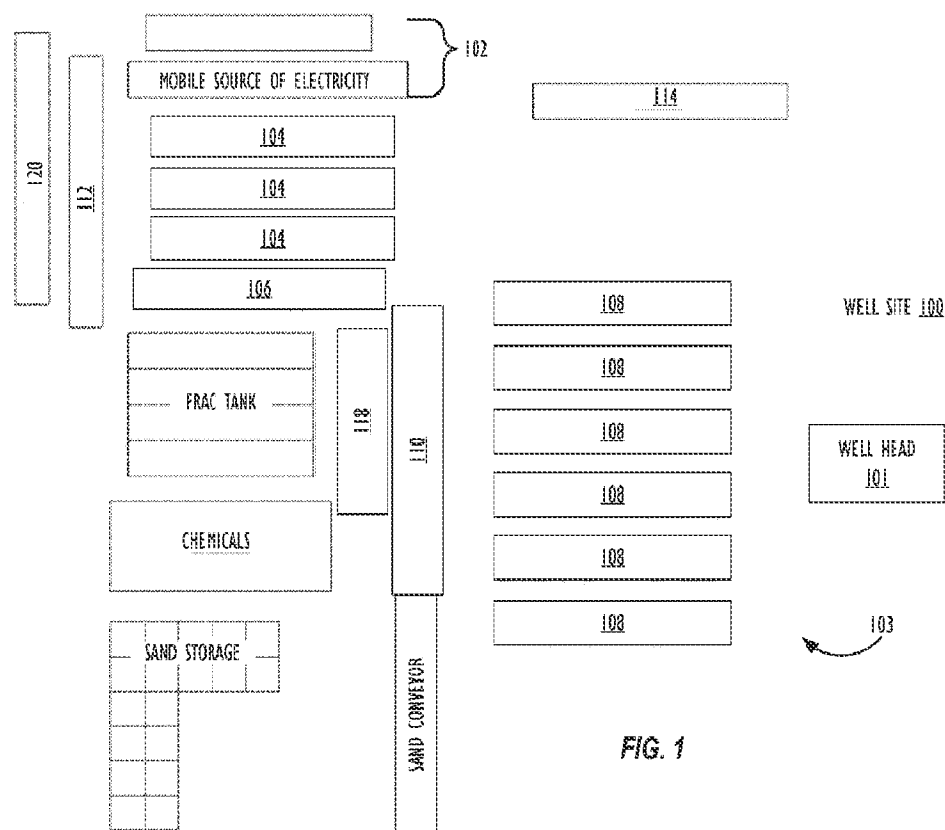
(71) Demandeur/Applicant:
EVOLUTION WELL SERVICES, LLC, US

(72) Inventeurs/Inventors:
MORRIS, JEFFREY G., US;
BODISHBAUGH, ADRIAN BENJAMIN, US;
JENSEN, NEAL, US

(74) Agent: RIDOUT & MAYBEE LLP

(54) Titre : DISTRIBUTION D'ENERGIE ELECTRIQUE POUR OPERATION DE FRACTURATION

(54) Title: ELECTRIC POWER DISTRIBUTION FOR FRACTURING OPERATION



(57) **Abrégé/Abstract:**

Providing electric power distribution for fracturing operations comprising receiving, at a transport, electric power from a mobile source of electricity at a first voltage level and supplying, from the transport, the electric power to a fracturing pump transport at the

(57) Abrégé(suite)/Abstract(continued):

first voltage level using only a first, single cable connection. The first voltage level falls within a range of 1,000 V to 35 kilovolts. The transport also supplies electric power to a second transport at the first voltage level using only a second, single cable connection.

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3 Hughes Landing, 1780 Hughes Landing Boulevard, Ste 125, The Woodlands, TX 77380 (US). JENSEN, Neal; 7380 East Gate Road, Ste 120, Henderson, NV 89011 (US).

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(74) Agent: CHUNG, Rayhao; Blank Rome LLP, 717 Texas Avenue, Suite 1400, Houston, TX 77002 (US).

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

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(72) Inventors: MORRIS, Jeffrey, G.; 3 Hughes Landing, 1780 Hughes Landing Boulevard, Ste 125, The Woodlands, TX 77380 (US). BODISHBAUGH, Adrian Benjamin;

(54) Title: ELECTRIC POWER DISTRIBUTION FOR FRACTURING OPERATION

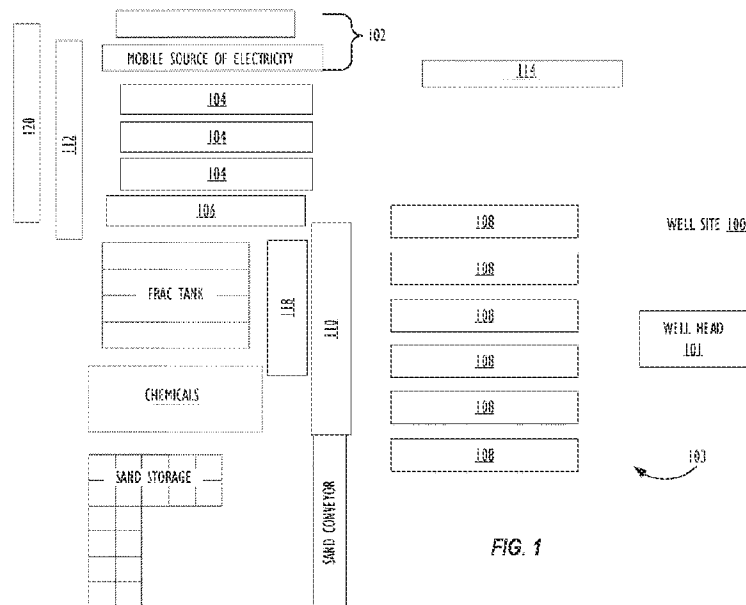


FIG. 1

(57) Abstract: Providing electric power distribution for fracturing operations comprising receiving, at a transport, electric power from a mobile source of electricity at a first voltage level and supplying, from the transport, the electric power to a fracturing pump transport at the first voltage level using only a first, single cable connection. The first voltage level falls within a range of 1,000 V to 35 kilovolts. The transport also supplies electric power to a second transport at the first voltage level using only a second, single cable connection.

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ELECTRIC POWER DISTRIBUTION FOR FRACTURING OPERATION

BACKGROUND

[0001] Hydraulic fracturing has been commonly used by the oil and gas industry to stimulate production of hydrocarbon producing wells, such as oil and/or gas wells. Hydraulic fracturing, sometimes called “fracing” or “fracking” is the process of injecting fracturing fluid into a wellbore to fracture the subsurface geological formations and release hydrocarbons. The fracturing fluid is pumped into a wellbore at a pressure sufficient to cause fissures within the underground geological formations. Once inside the wellbore, the fracturing fluid fractures the underground formation. The fracturing fluid may include water, various chemical additives, and proppants that promote the extraction of the hydrocarbon reserves, such as oil and/or gas. Proppants, such as fracturing sand, prevent fissures and fractures in the underground formation from closing; thereby, allowing the formation to remain open so that hydrocarbons flow through the hydrocarbon wells.

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

SUMMARY

[0003] The following presents a simplified summary of the disclosed subject matter in order to provide a basic understanding of some aspects of the subject matter disclosed herein. This summary is not an exhaustive overview of the technology disclosed herein, and it is not intended to identify key or critical elements of the

invention or to delineate the scope of the invention. Its sole purpose is to present concepts in a simplified form as a prelude to the more detailed description that is discussed later.

[0004] In one embodiment, an apparatus comprising a hydration tank, a fracturing blender, and an internal manifold system. The internal manifold system couples the hydration tank and the fracturing blender to route fluid between the hydration tank and the fracturing blender. The apparatus also comprises a single transport frame that couples the hydration tank, the fracturing blender, and the internal manifold system to form a single transport.

[0005] In another embodiment, a method for producing fracturing fluid, comprising receiving source fluid from one or more inlet manifolds of a single transport and driving a first pump mounted on the single transport to route the source fluid from the inlet manifolds into a hydration tank mounted on the single transport. The method also drives second pump mounted on the single transport to route hydrated fluid produced by the hydration tank to a blending tub mounted on the single transport and discharges fracturing fluid produced by the blending tub to one or more outlet manifolds of the single transport.

[0006] In yet another embodiment, a transport comprising a transport frame, an internal manifold system coupled to the transport frame, and a hydration tank coupled to the transport frame. The hydration tank is configured to receive a source fluid from the internal manifold system, produce a hydrated fluid with a target viscosity based on the source fluid, and output the hydrated fluid to the internal manifold system. The transport also comprises a blender coupled to the transport frame, where the blender is configured to receive the hydrated fluid from the internal manifold system, produce a fracturing fluid based on the hydrated fluid, and discharge the hydrated fluid to the internal manifold system. The delivery rate of the hydrated fluid for the hydration tank corresponds to an amount of fracturing fluid the blender provides to one or more fracturing pump transports.

[0007] In another embodiment, an electric fracturing system comprises a switch gear transport electrically connected to a power generation source to provide electric power at a first voltage level. The electric fracturing system also comprises an electrical cable that supplies electric power at the first voltage level and a fracturing

pump transport electrically connected to the switch gear transport via only the electrical cable. The fracturing pump transport comprises a transformer that steps down the electric power received at the first voltage level to a lower voltage level. The fracturing pump transport is not electrically connected to the switch gear transport via another electrical cable at a voltage level that differs from the first voltage level.

[0008] In another embodiment, a transport that comprises a single transport frame and an electric prime mover mounted on the single transport frame. The pump is coupled to the electric prime mover and mounted on the single transport frame and a transformer coupled to the electric prime mover and mounted on the single transport frame. The transformer is configured to receive electric power at a first voltage level from a power source via a single cable assembly and step down the electric power at the first voltage level to a lower voltage level. The transformer is also configured to supply the electric power at the lower voltage level to the electric prime mover, where the transport is not connected to any other cable assemblies that supply electric power at the first voltage level and other voltage levels.

[0009] In yet another embodiment, a method for electric power distribution used for fracturing operations. The method comprises receiving, at a transport, electric power from a mobile source of electricity at a first voltage level, where the first voltage level falls within a range of 1,000 V to 35 kilovolts and supplying, from the transport, the electric power to a fracturing pump transport at the first voltage level using only a first, single cable connection. The method also includes supplying, from the transport, the electric power to a second transport at the first voltage level using only a second, single cable connection.

[0010] In yet another embodiment, each of the above described embodiments and variations thereof, may be implemented as a method, apparatus, and/or system.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] For a more complete understanding of this disclosure, reference is now made to the following brief description, taken in connection with the accompanying drawings and detailed description, wherein like reference numerals represent like parts.

[0012] FIG. 1 is a schematic diagram of an embodiment of a well site that comprises a wellhead and a mobile fracturing system.

[0013] FIG. 2 is a schematic diagram of an embodiment of a medium-low voltage power distribution system for the mobile fracturing system.

[0014] FIG. 3 is a schematic diagram of another embodiment of a medium voltage power distribution system for the mobile fracturing system.

[0015] FIG. 4A illustrates a side view of an embodiment of a hydration-blender transport.

[0016] FIG. 4B illustrates an under tank cross sectional view of the hydration-blender transport.

[0017] FIG. 4C illustrates a cross sectional view of the hydration-blender transport that depicts the inside of the hydration tank.

[0018] FIG. 4D illustrates a top view the hydration-blender transport that depicts the top of the hydration tank.

[0019] FIG. 4E illustrates a cross sectional view of the hydration-blender transport that corresponds to section cut A-A shown in FIG. 4D.

[0020] FIG. 4F illustrates an under tank cross sectional view of another embodiment of a hydration-blender transport.

[0021] FIG. 5 illustrate an embodiment of a hydration-blender transport that includes a single blending tub.

[0022] FIG. 6 is a flow chart of an embodiment of a method to provide fracturing fluid using a single hydration-blender transport.

[0023] FIG. 7 is a flow chart of an embodiment of a method to provide electric power to fracturing equipment.

[0024] While certain embodiments will be described in connection with the illustrative embodiments shown herein, the invention is not limited to those embodiments. On the contrary, all alternatives, modifications, and equivalents are included within the spirit and scope of the invention as defined by the claims. In the drawing figures, which are not to scale, the same reference numerals are used throughout the description and in the drawing figures for components and elements having the same structure, and primed reference numerals are used for components

and elements having a similar function and construction to those components and elements having the same unprimed reference numerals.

DETAILED DESCRIPTION

[0025] The term “fracturing sand” is used in this disclosure to serve as a non-limiting example of a proppant used as a component of fracturing fluid. “Fracturing sand” is also used herein to collectively refer to both wet and dry fracturing sand. Embodiments in this disclosure are not limited to fracturing sand and any other type of proppant, such as man-made ceramics, aluminum beads and sintered bauxite, can be used with the various embodiments presented in the disclosure. Unless otherwise specified within the disclosure, the term “fracturing sand” can be interchanged throughout this disclosure with the term “proppants.”

[0026] As used herein, the term “wet fracturing sand” refers to a quantity of fracturing sand that contains a moisture content of about one percent or more, which is typically determined based on weight. “Dry fracturing sand” refers to quantities of fracturing sand that contain a moisture content of less than about one percent. As used herein, the term “liquefying wet fracturing sand” refers to enhancing and transforming the flow properties of wet fracturing sand to be substantially similar to dry fracturing sand in order to accurately control the amount of metered fracturing sand. Wet fracturing sand can liquefy and flow when shaken with force.

[0027] As used herein, the term “transport” refers to any transportation assembly, including, but not limited to, a trailer, truck, skid, rail car, and/or barge used to transport relatively heavy structures and/or other types of articles, such as fracturing equipment and fracturing sand. A transport could be independently movable from another transport. For example, a first transport can be mounted or connected to a motorized vehicle that independently moves the first transport while an unconnected second transport remains stationary.

[0028] As used herein, the term “trailer” refers to a transportation assembly used to transport relatively heavy structures and/or other types of articles (such as fracturing equipment and fracturing sand) that can be attached and/or detached from a transportation vehicle used to pull or tow the trailer. As an example, the transportation vehicle is able to independently move and tow a first trailer while an unconnected second trailer remains stationary. In one or more embodiments, the

trailer includes mounts and manifold systems to connect the trailer to other fracturing equipment within a fracturing system or fleet. The term “lay-down trailer” refers to a specific embodiment of a trailer that includes two sections with different vertical heights. One of the sections or the upper section is positioned at or above the trailer axles and another section or the lower section is positioned at or below the trailer axles. In one embodiment, the main trailer beams of the lay-down trailer may be resting on the ground when in operational mode and/or when uncoupled from a transportation vehicle, such as a tractor.

[0029] As used herein, the term “low voltage” refers to a voltage range from about 50 volts (V) to 1,000 V for alternating current (AC) electric power. The term “medium voltage” refers to a voltage range from about 1,000 V to about 35 kilovolts (kV) for AC electric power, and the term “high voltage” refers to a voltage range greater than 35 kV for AC electric power. Although the terms “low voltage,” “medium voltage,” and “high voltage” generally refer to voltage ranges in AC electric power, the disclosure is not limited to AC electric power and could also utilize current (DC) voltage.

[0030] Unless otherwise specified within the disclosure, the term “electrical connection” refers to connecting one transport to another transport using one or more electrical cables. The term “electrical cable” can be interchanged throughout this disclosure with the term “power cable” “power cable connection,” “cable connection,” or “electrical cable connection.” The terms “electrical cable,” “power cable” “power cable connection,” “cable connection,” and “electrical cable connection” refer to a single cable assembly that bundles together one or more wires (e.g., copper wires) that carry AC or DC electric current to provide electric power. In one or more embodiments, the single cable assembly also includes other wire types, such as fiber optic wires that perform other functions besides providing electric power. For example, the fiber optic wires are able to carry light for the purposes of transferring communication signals.

[0031] Various example embodiments are disclosed herein for performing mobile fracturing operations using a hydration-blender transport. Rather than having a hydration transport that is separate and independent from a blender transport, a fracturing fleet may replace two or more different transports with a single hydration-

blender transport. The hydration-blender transport includes a hydration tank and a blender unit (e.g., a single configuration blender or a dual configuration blender) interconnected with each other using the hydration-blender transport's internal manifold system. The internal manifold system directly couples the hydration tank and blender unit such that the hydration tank is able to provide fracturing fluid to the blender unit without requiring manifolds or other fluid connections (e.g., piping or hoses) that are external to the hydration-blender transport. To draw in source fluid, such as water or a fluid mixture (e.g., water with chemical additives), via one or more inlet manifolds, the hydration-blender transport comprises a plurality of electric prime movers that drive a plurality of pumps. Based on how an operator configures the inlet valves of the internal manifold system, the hydration-blender transport can transfer the source fluid to the hydration tank and blender unit, or completely by-pass the hydration tank and blender unit and transport the source fluid directly to one or more outlet manifolds. By doing so, the hydration-blender transport is able to perform a variety of operations that include, but are not limited to straight through operations, hydration-blender operations, and split stream operations.

[0032] Also disclosed are various example embodiments that distribute electric power from a mobile source of electricity. In one embodiment for fracturing operations, a power distribution system positions the voltage step down operation downstream and in close proximity to the fracturing equipment within a mobile fracturing system. As an example, a fracturing pump transport and a hydration-blender transport both include transformers that step down a supplied voltage level to one or more lower voltage levels that the fracturing equipment (e.g., electric prime movers) utilizes. The transports could also include drives (e.g., variable frequency drives (VFDs)) to control and monitor the electric prime movers. By doing so, the mobile fracturing system is able to reduce the number of transports by eliminating the use of an auxiliary unit transport (e.g., auxiliary unit transport 106 in FIG. 2) and/or drive power transports (e.g., drive power transports 104 in FIG. 2). A switch gear transport within the mobile fracturing system is then able to directly provide to the other transports, such as a hydration-blender transport and the fracturing pump transport, electric power at a relatively high medium voltage level (e.g., 13.8 kV); thereby, reducing the number of electrical cables to power fracturing equipment.

For example, the switch gear transport may connect to each fracturing pump transport using a single electrical cable that supplies electric power at 13.8 kV. Each transformer mounted on the fracturing pump transport is then able to step down the supplied electric power to different voltage levels (e.g., 4.2 kV and 480 V) and provide enough electric current to power fracturing equipment.

[0033] FIG. 1 is a schematic diagram of an embodiment of a well site 100 that comprises a wellhead 101 and a mobile fracturing system 103. Generally, a mobile fracturing system 103 may perform fracturing operations to complete a well and/or transform a drilled well into a production well. For example, the well site 100 may be a site where operators are in the process of drilling and completing a well. Operators may start the well completion process with vertical drilling, running production casing, and cementing within the wellbore. The operators may also insert a variety of downhole tools into the wellbore and/or as part of a tool string used to drill the wellbore. After the operators drill the well to a certain depth, a horizontal portion of the well may also be drilled and subsequently encased in cement. The operators may subsequently pack the rig and move a mobile fracturing system 103 onto the well site 100 to perform fracturing operations that force relatively high pressure fracturing fluid through wellhead 101 into subsurface geological formations to create fissures and cracks within the rock. The mobile fracturing system 103 may then be moved off the well site 100 once the operators complete fracturing operations. Typically, fracturing operations for well site 100 may last several days or weeks.

[0034] As shown in FIG. 1, the mobile fracturing system 103 includes a mobile source of electricity 102 configured to generate electricity by converting hydrocarbon fuel, such as natural gas, obtained from one or more other sources (e.g., a producing wellhead, gathering pipe systems and/or pipelines) at well site 100, from a remote offsite location, and/or another relatively convenient location near the mobile source of electricity 102. The mobile source of electricity 102 supplies the generated electricity to fracturing equipment to power fracturing operations at one or more well sites. In particular, the mobile source of electricity 102 may supply electric power to fracturing equipment within the mobile fracturing system 103 that includes, but is not limited to, the switch gear transport 112, drive power transports 104, auxiliary unit transport 106, blender transport 110, data van 114, hydration transport 118, auxiliary

power transport 120, and fracturing pump transports 108 in order to deliver fracturing fluid through wellhead 101 to subsurface geological formations.

[0035] The switch gear transport 112 may receive the electricity generated from the mobile source of electricity 102 via one or more electrical connections. In one embodiment, the switch gear transport 112 uses 13.8 kilovolts (kV) electrical connections to receive power from the mobile source of electricity 102. The switch gear transport 112 may comprise a plurality of electrical disconnect switches, fuses, transformers, and/or circuit protectors to protect other fracturing equipment within the mobile fracturing system 103. The switch gear transport 112 may then transfer the electricity received from the mobile source of electricity 102 to the drive power transports 104 and auxiliary unit transports 106. The power distribution system to supply power from the mobile source of electricity 102 to the mobile fracturing system 103 is discussed in more detail in FIG. 2.

[0036] The auxiliary unit transport 106 may comprise a transformer and a control system to control, monitor, and provide power to the electrically connected fracturing equipment. In one embodiment, the auxiliary unit transport 106 receives a relatively higher medium voltage (e.g., 13.8 kV) electrical connection and steps down the electric power to a lower voltage. For example, the auxiliary unit transport 106 steps down the voltage level from 13.8 kV to 480 V. The auxiliary unit transport 106 may then provide the stepped down voltage to other fracturing equipment, such as the blender transport 110, sand storage and conveyor, data van 114, and lighting equipment.

[0037] The drive power transports 104 may be configured to monitor and control one or more electric prime movers located on the fracturing pump transports 108 via a plurality of connections, such as electrical connections (e.g., copper wires), fiber optics, wireless, and/or combinations thereof. The drive power transports 104 may also receive power from the switch gear transport 112 and step down the 13.8 kV electrical connection to lower voltages. In one embodiment, the drive power transports 104 may step down the voltage to 4.2 kV rather than other lower voltage levels, such as 600 V, in order to reduce cable size of the electrical cable and the number of electrical cables used to connect the mobile fracturing system 103. In FIG. 1, the fracturing pump transport 108 utilizes the electric power received from the

drive power transport 104 to power one or more electric prime movers that convert electric power to mechanical power in order to drive one or more pumps.

[0038] To form fracturing fluid, the hydration transport 118 combines a fluid, such as water from a frac tank, with a polymer-based slurry to produce a hydrated fluid with a target viscosity. The polymer-based slurry may be a viscous slurry concentrate that contains hydratable polymers that include, but are not limited to guar gum, hydroxypropyl guar (HPG), carboxymethyl HPG, carboxymethyl hydroxyethyl cellulose, and combinations thereof. Because the polymer-based slurry has a specified hydration rate, the viscosity level of the hydrated fluid after initially combining the polymer-based slurry with the fluid may not equal the target viscosity. Typically, the hydrated fluid requires a certain amount of mixing time (also known as residence time) to hydrate the polymer-based slurry so that the hydrated fluid reaches the target viscosity. For example, after combining the source fluid with the polymer-based slurry, the viscosity of the hydrated fluid increases as the degree of hydration of the polymer-based slurry increases.

[0039] In one embodiment, the blender transport 110 receives electric power from the auxiliary unit transport 106 to power a plurality of electric prime movers to perform a variety of blending operations. For instance, some of the electric prime movers may drive one or more pumps to route source fluid to the blender transport 110 to produce fracturing fluid. Non-limiting examples include directing source fluid (e.g., hydrated fluid from the hydration transport 118) received at one or more inlet manifolds into one or more blending tubs and/or discharging fracturing fluid via one or more outlet manifolds to supply fracturing fluid to the fracturing pump transports 108. Other electric prime movers may power other blending operations, such as metering the fracturing sand into the blending tubs and mixing hydrated fluid with fracturing sand to form the fracturing fluid.

[0040] The data van 114 may be part of a control network system, where the data van 114 acts as a control center configured to monitor and provide operating instructions in order to remotely operate the hydration transport 118, the blender transport 110, the mobile source of electricity 102, fracturing pump transport 108 and/or other fracturing equipment within the mobile fracturing system 103. For example, the data van 114 may communicate via the control network system with the

VFDs located within the drive power transports 104 that operate and monitor the health of the electric motors used to drive the pumps on the fracturing pump transports 108. Other fracturing equipment shown in FIG. 1, such as gas conditioning transport, frac tanks, chemical storage of chemical additives, sand conveyor, and sand container storage are known by persons of ordinary skill in the art, and therefore are not discussed in further detail.

[0041] In one embodiment, rather than having a separate hydration transport 118 and blender transport 110, the mobile fracturing system 103 could include a single hydration-blender transport (not shown in FIG. 1). Using FIG. 1 as an example, the hydration-blender transport receives electric power from the auxiliary unit transport 106 to power a plurality of electric prime movers to perform a variety of hydration and blending operation. As an example, the hydration tank of the hydration-blender transport could be configured to perform a continuous hydration process to hydrate a polymer-based slurry with the source fluid to reach the target viscosity. Implementing a continuous hydration process rather than a batch process allows the hydration tank to produce hydrated fluid as needed or in real-time, where the rate of hydrated fluid production corresponds to the amount of fracturing fluid the blender unit provides to the fracturing pump transport 108. To provide an adequate amount of residence time to hydrate the polymer-based slurry, the hydration tank may direct the hydrated fluid to travel a torturous flow path that delays supplying the hydrated fluid to the blender unit.

[0042] The torturous flow path may be configured to provide a minimal amount of residence time for a given flow rate to produce hydrated fluid with the target viscosity. Moreover, the torturous flow path is configured to hold a targeted volume of hydrated fluid to sustain a delivery rate of the hydrated fluid to the blender unit. For example, to provide a targeted flow rate of about 80 to 100 barrels per minute (bpm) and a residence time of about three minutes, the torturous flow path or volume of the hydration tank would need to hold at least about 240 barrels. As the hydrated fluid travels through the torturous flow path, the torturous flow path may also be configured to further mix, agitate, and apply shear forces that enhance hydration of the polymer-based slurry. The torturous flow path for the hydration tank may be

implemented using a variety of methods known by persons of ordinary skill in the art.

[0043] One or more pumps on the hydration-blender transport may then direct the hydrated fluid with the target viscosity to the blender unit to mix fracturing sand with the hydrated fluid. In one embodiment, the hydration-blender transport may include a dual configuration blender that comprises electric prime movers (e.g., electric motors) for the rotating machinery. The dual configuration blender may have two separate blending tubs configured to be independent and redundant, where any one or both of the blending tubs may receive hydrated fluid that originated from any of the inlet manifolds. In other words, source fluid received from any of the inlet manifolds may subsequently be hydrated and then blended by any one or both of the blending tubs. Afterwards, the blended fracturing fluid is discharged out of any of the outlet manifolds. In one embodiment, when both blending tubs are operational, the dual configuration blender may have a blending capacity of up to about 240 bpm. Other embodiments of the hydration-blender transport may utilize a single configuration blender that only has a single blending tub.

[0044] Combining the hydration tank and blender into a single hydration-blender transport also allows the hydration-blender transport to support a variety of operation modes, such as straight through operation mode, hydration operation mode, and/or split stream operation mode. In a straight through operation mode, the hydration-blender transport receives the source fluid from one or more inlet manifolds and directly discharges the source fluid to one or more outlet manifolds by having the source fluid bypass both the hydration tank and blending tubs of the blender unit. By doing so, the hydration-blender transport supplies source fluid, which can also be referred to as clean fluid, to one or more fracturing pump transports 108. In hydration operation mode, the hydration-blender transport directs the source fluid into the hydration tank, pumps the hydrated fluid into the blending tubs to form fracturing fluid and discharges the fracturing fluid, which can also be referred to as dirty fluid, to one or more outlet manifolds. In a split stream operation mode, the hydration-blender transport is able to discharge both clean fluid and dirty fluid to different outlet manifolds. To supply a split stream to the fracturing pump transports, a portion of the source fluid bypasses both the hydration tank and blending tubs and directly flows

out to the outlet manifolds, and a remaining portion of the source fluid is directed into the hydration tank to generate the dirty fluid.

[0045] Having a hydration-blender transport with different operation modes provides operators flexibility in utilizing a variety of fracturing fluids. Specifically, the hydration-blender transport is flexible enough to provide clean fluid, dirty fluid, or both based on an operator's desired fracturing operation. Using FIG. 1 as an example, the mobile fracturing system 103 may have some of the fracturing pump transports 108 pump clean fluid and other fracturing pump transports 108 pump dirty fluid as fracturing fluid. An operator may desire to utilize clean fluid as fracturing fluid because of the potential benefits of increasing and enhancing the life of fracturing pumps. Because of additional wear fracturing sand and the polymer-based slurry may cause, pumps and manifold equipment exposed to dirty fluid are often susceptible to higher maintenance costs and/or decreases in useful life when compared to pumps and manifold equipment operating with clean fluid. As such, by having some of the fracturing pump transports 108 pump clean fluid, an operator may reduce fracturing operating costs.

[0046] Power Distribution from a Mobile Source of Electricity

[0047] FIG. 2 is a schematic diagram of an embodiment of a medium-low voltage power distribution system for the mobile fracturing system 103. Although the voltage and current levels referenced in FIG. 2 generally refer to AC electric power, other embodiments could have the mobile fracturing system 103 configured to be powered using DC electric power. As shown in FIG. 2, the mobile source of electricity 102 provides power by connecting to the switch gear transport 112 using three medium voltage (e.g., 13.8 kV) cable connections. In one or more embodiments, the mobile source of electricity 102 includes a turbine-electric generator transport that compresses and mixes combustion air with hydrocarbon gas to spin and generate mechanical energy and then converts the mechanical energy to electricity. The mobile source of electricity 102 could also include an inlet and exhaust transport that provides ventilation and combustion air to the turbine-electric generator transport when generating electricity. Configuring and utilizing a turbine-electric generator transport and an inlet and exhaust transport are discussed and shown in more detail in U.S. Patent 9,534,473, filed December 16, 2015 by Jeffrey G. Morris et al. and

entitled “Mobile Electric Power Generation for Hydration Fracturing of Subsurface Geological Formations,” which is hereby incorporated by reference as if reproduced in its entirety. In other embodiments, the mobile source of electricity 102 could include other transport configurations to employ a centralized source of electricity that powers fracturing equipment.

[0048] The switch gear transport 112 contains a transformer that steps down the medium voltage (e.g., 13.8 kV) electric power to a low voltage level (e.g., 480 V) and provides a low voltage (e.g., 480 V) electrical connection to other transports. Using FIG. 2 as an example, the switch gear transport 112 connects to the drive power transports 104 and the auxiliary unit transport 106 using the 480 V electrical connection. FIG. 2 also illustrates that the switch gear transport 112 utilizes four 480 V cable connections from an auxiliary power transport 120 that provides electric power to ignite, start, or power on the mobile source of electricity 102 and/or provide ancillary power where peak electric power demand exceeds the electric power output of mobile source of electricity 102. Although not shown in FIG. 2, in other embodiments, the switch gear transport 112 may also include a transformer to step down the electric power from a medium voltage level (e.g., 13.8 kV) to a relatively lower medium voltage level (e.g., 4.2 kV) and provide the relatively lower medium voltage level (e.g., 4.2 kV) directly to the drive power transports 104.

[0049] As shown in FIG. 2, both the hydration transport 118, blender transport 110, and fracturing pump transports 108 do not contain transformers to step down the voltage for the switch gear transport's 112 electric power. Instead, the voltages supplied to power the fracturing equipment (e.g., the electric prime movers) are stepped down upstream at different transports within the mobile fracturing system 103. As an example, the drive power transports 104 may be operable to step down a medium voltage level (e.g., 13.8 kV) that the switch gear transport 112 supplies to a relatively lower medium voltage level (e.g., 4.2 kV), and the auxiliary unit transport 106 may be able to step down a medium voltage level (e.g., 13.8 kV) that the switch gear transport 112 supplies to a low voltage level (e.g., 480 V). In other examples, switch gear transport 112 may include other transformers that step down the voltage to other voltages. The drive power transports 104 and auxiliary unit transport 106 then supply the stepped down voltages to power electric prime movers mounted on

transports (e.g., blender transport 110 and fracturing pump transports 108) and other fracturing equipment. In one or more embodiments, the transformers and/or drives (e.g., VFDs) for controlling the electric prime movers may be placed on drive power transports 104 and/or auxiliary unit transport 106 because the fracturing pump transports 108 and/or blender transports 110 may not have enough space or may exceed a specific weight limit.

[0050] In FIG. 2, the switch gear transport 112 provides a medium voltage (e.g., 13.8 kV) electrical connection and a low voltage (e.g., 480 V) electrical connection to the drive power transports 104. Specifically, each drive power transport 104 receives a single medium voltage (e.g., 13.8 kV) cable connection from the switch gear transport 112 and utilizes transformers to step down the voltage level of the received electric power from the medium voltage level (e.g., 13.8 kV) to a relatively lower medium voltage level (e.g., 4.2 kV). Each drive power transport 104 also receives a single low voltage (e.g., 480 V) cable connection from the switch gear transport 112. After the drive power transports 104 receives electric power from the switch gear transport 112, each drive power transport 104 provides electric power to two different fracturing pump transports 108. In other words, the mobile fracturing system 103 implements a 2:1 ratio regarding the number of fracturing pump transports 108 that receive electric power from a drive power transport 104. Other embodiments could have different ratios where the drive power transport 104 supply power to a single fracturing pump transport 108 (e.g., 1:1 ratio) or more than two fracturing pump transport 108 (e.g., 3:1 or 4:1 ratio).

[0051] As shown in FIG. 2, each drive power transport 104 supplies a low voltage (e.g., 480 V) cable connection and two relatively lower medium voltage (e.g., 4.2 kV) cable connections to power each fracturing pump transport 108. The low voltage cable connection may supply electric power to drives (e.g., VFDs) and/or other electrical equipment (e.g., sensors) mounted on the fracturing pump transport 108. The two medium voltage (e.g., 4.2 kV) cable connections supply electric power to one or more electric prime movers that drive one or more pumps that pump fracturing fluid into a wellbore. As an example, the fracturing pump transport 108 contains a 5,000 horsepower (HP) dual-shaft electric motor that utilizes about 600 amperes (A) of electric current to operate. The dual-shaft electric motor could be a dual-shaft

electric motor that is discussed and shown in more detail in U.S. Patent 9,534,473, filed December 16, 2015 by Jeffrey G. Morris et al. and entitled “Mobile Electric Power Generation for Hydration Fracturing of Subsurface Geological Formations.” To supply enough electric power, each of the medium voltage (e.g., 4.2 kV) cable connections could provide about 300 A of electric current. Having a single medium voltage (e.g., 4.2 kV) electrical cable that provides 600 A of electric current to the dual-shaft electric motor may not be desirable because of safety concerns with the relatively high current flow. Besides safety concerns regarding the relatively high current (e.g., 600 A) flow, having a single electrical cable could also cause connection and/or disconnections issues because of the thicker cable size used to support relatively high current flow.

[0052] FIG. 2 also illustrates that the switch gear transport 112 supplies a single medium voltage (e.g., 13.8 kV) cable connection and a single low voltage (e.g., 480 V) cable connection to an auxiliary unit transport 106. The auxiliary unit transport 106 includes at least one transformer to step down the voltage from the medium voltage level (13.8 kV) to the low voltage level (e.g., 480 V). The auxiliary unit transport 106 supplies a low voltage level (e.g., 480 V) electrical connection to both the hydration transport 118 and blender transport 110. In FIG. 2, the hydration transport 118 and blender transport 110 are separate and independent from each other, where the hydration transport 118 receives two low voltage (e.g., 480 V) cable connections and the blender transport 110 receives eight low voltage (e.g., 480 V) cable connections from the auxiliary unit transport 106. Other embodiments of the power distribution system may have the auxiliary unit transport 106 provide a low voltage (e.g., 480 V) electrical connection (e.g., ten cable connections) to a single hydration-blender unit transport for embodiments when the blender transport 110 and hydration transport 118 are integrated into a single transport.

[0053] FIG. 3 is a schematic diagram of another embodiment of a medium voltage power distribution system for the mobile fracturing system 302. In contrast to FIG. 2, the power distribution system moves the voltage step down further downstream by placing transformers 310 and/or 312 on the fracturing pump transports 304 and hydration-blender transport 306. As shown in FIG. 3, the mobile fracturing system 302 reduces the number of transports by eliminating the need for

an auxiliary unit transport (e.g., auxiliary unit transport 106 in FIG. 2) and/or drive power transports (e.g., drive power transports 104 in FIG. 2). Instead, the drives (e.g., VFDs) to control and monitor the electric prime movers of the fracturing pump transports 304 and transformers 310 and/or 312 for stepping down the voltage for the electric power are mounted on the fracturing pump transport 304 and the hydration-blender transport 306.

[0054] FIG. 3 illustrates that switch gear transport 308 connects to a mobile source of electricity 102 with six medium voltage (e.g., 13.8 kV) cable connections. The switch gear transport also connects to an auxiliary power transport 120 with one medium voltage (e.g., 13.8 kV) cable connection. The switch gear transport 308 also includes a transformer 312 that steps down electric power received at a medium voltage level (e.g., 13.8 kV) from the auxiliary power transport 120 to a low voltage level (e.g., 480 V). The low voltage level (e.g., 480 V) connection may provide electric power to ignite, start, or power on the mobile source of electricity 102. In contrast to FIG. 2, the switch gear transport 308 does not output or provide low voltage (e.g., 480 V) electrical connections to other transports. Specifically, the switch gear transport 308 outputs and supplies medium voltage (e.g., 13.8 kV) cable connections directly to the hydration-blender transport 306 and the fracturing pump transport 304 without connecting to any intermediate transports (e.g., drive power transport 104 and auxiliary unit transport 106 in FIG. 2). FIG. 3 depicts that the switch gear transport 308 generates a total seven medium voltage (e.g., 13.8 kV) cable connection, where each fracturing pump transports 304 is directly connected to the switch gear transport 308 with a single medium voltage (e.g., 13.8 kV) cable connection. The switch gear transport 308 also directly connects to the hydration-blender transport 306 using a single medium voltage (e.g., 13.8 kV) cable connection.

[0055] The medium voltage power distribution system shown in FIG. 3 is able to reduce the number of electrical cables used to supply electric power to the fracturing pump transport 304 and hydration-blender transport 306 when compared to the medium-low power distribution system shown in FIG. 2. Specifically, when compared to the medium-low power distribution system shown in FIG. 2, the medium voltage power distribution system in FIG. 3 is able to reduce the number of electrical cables that provide power to each fracturing pump transport 304. As shown in FIG.

3, the mobile fracturing system 302 reduces the number of electrical cables from three electrical cables to one electrical cable for each fracturing pump transport 304. A further reduction of electrical cables is shown by supplying one electrical cable to the hydration-blender transport 306 instead of the ten electrical cables used to power both the blender transport 110 and hydration transport 118. One reason the medium voltage power distribution system is able to utilize less electrical cables is that each electrical cable does not need to supply a relatively high current (e.g., 600 A) to each of the fracturing pump transports 304 and hydration-blender transport 306. Supplying electric power at relatively lower current levels avoids the safety concerns and/or connection/disconnection issues associated with using a single electrical cable that supplies relatively high current (e.g., 600 A).

[0056] Each fracturing pump transport 304 may include one or more transformers to step down the voltage received from the switch gear transport 308 to different voltage levels. Using FIG. 3 as an example, each fracturing pump transport 304 may include two separate and independent transformers, a first transformer 310 to step down to a voltage level of 4.2 kV and a second transformer 312 to step down to a voltage level of 480 V. In other examples, each fracturing pump transport 304 could include a single transformer that produces multiple voltages levels. For example, the fracturing pump transport 304 may mount a three phase or three winding transformer to step down the voltage to two different voltage levels. Recall that the 4.2 kV voltage level supplies electric power to one or more electric prime movers that drive one or more pumps and the 480 V supplies electric power to the drives and/or other control instrumentation mounted on the fracturing pump transport 304. Transformers 310 and 312 are configured to supply enough electric current to power the prime movers, drivers, and/or other control instrumentation.

[0057] FIG. 3 also illustrates that the hydration-blender transport 306 may include a transformer that steps down the voltage level to 480 V. The hydration-blender transport 306 can use the stepped down voltages levels to provide electric power to the electric prime movers for the hydration-blender transport 306, drives, and/or other control instrumentation mounted on the hydration-blender transport 306. The hydration-blender transport 306 may also be configured to provide electric power at the 480 V voltage level to other downstream fracturing equipment, such as the sand

conveyor. In FIG. 3, the medium voltage power distribution system may utilize two electrical connections to provide electric power to the sand conveyor. Although FIG. 3 illustrates that switch gear transport 308 provides electric power to a hydration-blender transport 306, other embodiments could have the switch gear transport 308 separately connect to a hydration transport and a blender transport. In such an embodiment, the switch gear transport 308 may connect to the hydration transport using a single medium voltage (e.g., 13.8 kV) cable connection and another single medium voltage (e.g., 13.8 kV) cable connection to connect to the blender transport.

[0058] By mounting the drives and transformers 310 and/or 312 onto the fracturing pump transport 304 and hydration-blender transport 306, the transports become individually autonomous by removing the need for other separate support-based trailers, such as the auxiliary unit transport and drive power transports that provide power conversion and/or drive control. Having autonomous trailers allows the mobile fracturing system 302 to become scalable and flexible, where each fracturing pump transport may be interchangeable with each other. For example, if the well is relatively small, the mobile fracturing system 302 may have a reduced number of fracturing pump transports 304 (e.g., four transports instead of six transports). Conversely, if the well is large and/or the well site is located at high elevations and/or high temperatures, more fracturing pump transports 304 can be stacked to increase pumping capacity without utilizing additional support-based transports (e.g., drive power transports 104 shown in FIGS. 1 and 2).

[0059] Although FIGS. 2 and 3 illustrates specific embodiments of mobile fracturing system 103 and 302 that utilize electric power for operations, the disclosure is not limited to these particular embodiments. For instance, with reference to FIG. 3, the disclosure describes a switch gear transport 308 receiving electric power from a mobile source of electric. However, other embodiments could have the switch gear transport 308 receive electric power from other types of power sources, such as a power grid or a stationary power source. Additionally or alternatively, the mobile fracturing system 302 shown in FIG. 3 may utilize a separate hydration transport and blender transport instead of the hydration-blender transport 306. The use and discussion of FIGS. 2 and 3 are only examples to facilitate ease of description and explanation.

[0060] Hydration-Blender Transport

[0061] FIG. 4A illustrates a side view of an embodiment of a hydration-blender transport 400 that comprises a hydration tank 402, a blender unit 404, an electric prime mover 406, a pump 408, and multiple manifold groups 410, 412, and 414. FIG. 4A also depicts that the hydration-blender transport 400 as a trailer that includes four axles. Other embodiments of the hydration-blender transport 400 may vary the number of axles depending on the weight of the fracturing equipment and/or the size of the hydration tank 402. For example, the hydration-blender transport 400 may include three axles to allow for mounting of a hydration tank 402 with larger volume. By removing the axle 401 from the trailer, the hydration-blender transport 400 has more available space to mount a larger hydration tank 402.

[0062] Depending on the operation modes, the manifold groups 410, 412, and 414 may be configured as inlet manifolds that receive source fluid and/or outlet manifolds that supply fracturing fluid to one or more fracturing pump transports. The manifold groups 410, 412, and 414 are coupled to the hydration-blender transport's 400 internal manifold system to route fluid within the hydration-blender transport 400. The electric prime movers 406 (e.g., electric motors) may drive the pumps 408 to draw in and deliver source fluid to the hydration tank 402, blender unit 404, and/or directly to another manifold group based on the configuration of the internal manifold system. To implement a variety of operation modes, the internal manifold system includes a plurality of valves (not shown in FIG. 4A) configured to isolate different sections of the internal manifold system.

[0063] The internal manifold system may comprise a hydration tank manifold system 416, a hydration-blender manifold system 418, a blender output manifold system 420, an interconnector manifold system 424, and an under tank manifold system 430. The interconnector manifold system 424 may connect the manifold groups 410, 412, and 414, the pumps 408, the hydration tank manifold system 416, the hydration-blender manifold system 418, and the under tank manifold system 430 to each other. To connect the interconnector manifold system 424 to the manifold groups 410 and 412, connection points 426 and 432, respectively, may be used to connect the interconnector manifold system 424 to the under tank manifold system 430. The hydration tank manifold system 416 may be configured to receive source

fluid from one or more of the manifold groups 410, 412, and 414 via the interconnector manifold system 424 to transport the source fluid within the hydration tank 402.

[0064] After the hydration tank 402 hydrates the polymer-based slurry with the source fluid, the hydration-blender manifold system 418 transports the hydrated fluid from the hydration tank 402 to blending tubs 454. Once the blending tubs 454 mix fracturing sand with the hydrated fluid to form fracturing fluid, the blender output manifold system 420 may then transport the fracturing fluid from the blender unit 404 to one or more manifold groups 410, 412, and 414. A feedback manifold system 428 may be configured to feedback liquid within the hydration tank 402 to maintain a desired level of hydrated fluid. The under tank manifold system 430 may be configured to connect the manifold groups 410, 412, and 414 to each other. Although not illustrated, the internal manifold system shown in FIG. 4 may include other components known by persons of ordinary skill in the art to monitor fluid properties and/or direct fluids within the hydration-blender transport 400, such as flow meters, densitometers, and valves.

[0065] As shown in FIG. 4A, the hydration-blender transport 400 may include a power and control system 436. In one embodiment, the power and control system 436 may include a drive (e.g., a VFD) to control the electric prime movers 406 and a transformer to step down incoming voltage. For example, the transformer is configured to receive a relative higher voltage (e.g., 13.8 kV) and step down the voltage level to 480 V. The power and control system 436 may also be configured to provide electric power at the 480 V voltage level to other downstream fracturing equipment, such as the sand conveyor. In another embodiment, the power and control system 436 may include the drive to control the electric prime movers 406, but may not include the transformer and instead receives power at the stepped down voltage (e.g., 480 V) from another transport.

[0066] FIG. 4A illustrates that the blender unit 404 is a dual configuration blender that includes two separate blending modules to produce fracturing fluid. Each blending module includes a blending tub 454, a hopper 450 (also known as surge tanks), and a metering component 452 (e.g., an auger). To power the blending operations, the blender unit 404 may also include prime movers 456 and 458. As

shown in FIG. 4A, each of the blending modules includes an electric prime mover 456 to power the metering component 452 that meters fracturing sand into the blending tub 454, and an electric prime mover 458 to drive pumps to power the blending tub. The blending tub 454 mixes the fracturing sand and hydrated fluid received from the hydration-blender manifold system 418 to produce the fracturing fluid that discharges via the blender output manifold system 420. The blending tub 454 may discharge the fracturing fluid using a pump (not shown in FIG. 4A) driven by a prime mover.

[0067] In FIG. 4A, the metering component 452 is an auger positioned at an incline to meter the fracturing sand into a blending tub 454. Other embodiments of the blender unit 404 may have the metering component 452 positioned in a straight or horizontal orientation. Correctly controlling and metering fracturing sand into the blending tub 454 affects the overall proppant concentration of the fracturing fluid (e.g., weight of the slurry). Controlling the overall proppant concentration is advantageous because the overall proppant concentration could affect the proppant transport and the propped fracture dimensions of the subsurface geological formations and the realization of the hydraulic fracturing treatment.

[0068] The blender unit 404 unit may be configured to produce fracturing fluid using dry fracturing sand and/or wet fracturing sand. In one embodiment, to be able to produce fracturing fluid using wet fracturing sand, the blender unit 404 may include one or more vibrator components (e.g., mechanical vibrators, vibration screens, and acoustic generators), which are not shown in FIG. 4A, to liquefy sand and enhance the flow properties of the wet fracturing sand. The vibrator components may be powered by a variety of power sources that include, but are not limited to, air pressure, hydraulics, and/or electricity. When powering the vibrator components by electricity, the blender unit 404 includes electric motors to drive hydraulic pumps that operate the vibrator components. By controlling the electric motors, an operator is able to indirectly control one or more vibrator components via the hydraulic pressure. In another example, operators are able to control the one or more vibrator components directly by connecting one or more electric motors to one or more vibrator components. Adjusting the electric motors' attributes, such as frequency, voltage, and/or amperage could vary operation of the vibrator components. To reduce

vibration and disturbances to other components of the hydration-blender transport 400, the blender unit 404 may include a vibration isolation system that include springs, air bags, rubber-based dampeners (e.g., rubber bushings), and/or other vibration isolation components. In embodiments where a vibration screen and/or acoustic waves are used to directly liquefy sand without vibrating the blending tub, the vibration isolation system may dampen and reduce the amount of vibration experienced by the blending tub. Processing and liquefying wet fracturing sand is discussed in more detail in U.S. Patent Application No. 15/452,415, filed March 7, 2017 by Jeffrey G. Morris et al. and entitled "Utilizing Wet Fracturing Sand for Hydraulic Fracturing Operations," which is hereby incorporated by reference as if reproduced in its entirety.

[0069] FIG. 4B illustrates an under tank cross sectional view of the hydration-blender transport 400. Specifically, FIG. 4B represents the C-C cross sectional view illustrated in FIG. 4A that highlights the under tank manifold system 430. As shown in FIG. 4B, the under tank manifold system 430 includes two redundant sides that are coupled together using crossing manifolds 440 and 442. The blender output manifold system 420 discussed in FIG. 4A, connects to both sides of the under tank manifold system 430 at connection points 444 such that the output of one of the blending tubs connects to one side of the under tank manifold system 430. The crossing manifolds 440 and 442 allow fracturing fluid to be discharged to either side or both sides of the hydration-blender transport 400 and also allows the hydration tank to receive source fluid from either side of the hydration-blender transport 400. Each side of the under tank manifold system 430 also includes the manifold groups 410, 412, and 414, where each manifold group can be isolated using valves (not shown in FIG. 4B). The crossing manifolds 440 and 442 may include valves to allow or prevent fluid from flowing to both sides of the under tank manifold system 430.

[0070] FIG. 4B also illustrates that the under tank manifold system 430 includes three pump connection points 446, connection points 426, and a connection point 432. The three pump connection points 446 interconnect the under tank manifold system 430 to the pumps 408 shown in FIG. 4A. FIG. 4A illustrates that the electric prime movers 406 are positioned above the pumps 408 such that one or more of the electric prime movers 406 may drive one or more pumps 408. The pumps 408 are

then able to direct source fluid and/or fracturing fluid into and out of the under tank manifold system 430. For instance, the pumps 408 may be able to pump source fluid received from one or more manifold groups 410, 412, and 414 to the interconnector manifold system 424 via connection points 426. One or more valves can be set according to the operation mode for the hydration-blender transport 400. For example, to implement split streaming operation, a valve associated with the connection point 432 may be set to an open position such that source fluid received from the manifold groups 410, 412, and 414 is sent directly to another manifold groups 410, 412, and 414 (e.g., manifold group 412) and bypasses the hydration tank 402. In other words, the connection point 432 may be used to bypass the hydration tanks 402 and blending tubs 454 and directly pump source fluid received from one or more manifold groups 410, 412, and 414 back out to other manifold groups 410, 412, and 414.

[0071] FIG. 4C illustrates a cross sectional view of the hydration-blender transport 400 that depicts the inside of the hydration tank 402. As shown in FIG. 4C, the inside of the hydration tank 402 includes the interconnector manifold system 424 that allows the pumps, driven by electric prime movers 406, to direct fluid to different sections of the internal manifold system. In particular, the interconnector manifold system 424 connects to the hydration tank manifold system 416 via connection points 462 and 438 and connects to the hydration-blender manifold system 418 via connection point 464. Using the interconnector manifold system 424, the pumps are able to direct source fluid received at one or more manifold groups 410, 412, and 414 to the hydration tank via the hydration tank manifold system 416 and/or pump hydrated fluid to the blending tubs 454 via the hydration-blender manifold system 418.

[0072] FIG. 4D illustrates a top view of the hydration-blender transport 400 that depicts the top of the hydration tank 402. In FIG. 4D, the hydration tank manifold system 416 receives source fluid and directs that source fluid to a diffuser located at the top of the hydration tank 402. The diffuser combines the source fluid with the polymer-based slurry and feeds the hydrated fluid to a tortuous flow path within the hydration tank 402. Once the hydrated fluid travels through the tortuous flow path, the hydration-blender manifold system 418 obtains the hydrated fluid via the

interconnector manifold system 424 and supplies the hydrated fluid to the blending tubs 454. In one embodiment, the hydration-blender manifold system 418 includes two different manifold connections, where each manifold connection supplies hydrated fluid to one of the blending tubs 454. Afterwards, the blending tub discharges the fracturing fluid via the blender output manifold system 420.

[0073] FIG. 4E illustrates a cross sectional view of the hydration-blender transport 400 that corresponds to section cut A-A shown in FIG. 4D. In FIG. 4E, the electric prime mover 406 and pump 408 combination is mounted in an upright position such that the electric prime mover 406 is mounted on top of the pump 408. The pumps 408 are also connected to the under tank manifold system 430. Three different electric prime mover 406 and pump 408 combinations may be used to provide enough power to simultaneously pump source fluid into the hydration-blender transport 400, pump hydrated fluid into the blending tubs 454, and/or pump fluid out of the hydration-blender transport 400. In one embodiment, the pumps 408 may be centrifugal pumps.

[0074] FIG. 4F illustrates an under tank cross sectional view of another embodiment of a hydration-blender transport 400. Specifically, FIG. 4F represents the C-C cross sectional view illustration of an under tank manifold system 480 that is substantially similar to the under tank manifold system 430 shown in FIG. 4B. The under tank manifold system 480 is similar to the under tank manifold system 430 except that the under tank manifold system 480 includes a sump 482 for collecting and remove fluid from the hydration tank 402. As an example, when an operator completes a fracturing job, the operator may empty fluid stored within the hydration tank 402 before transportation. An operator is able to divert stored fluid within the hydration tank 402 to the sump 482 when discharging fluid out of the hydration tank 402.

[0075] FIG. 5 illustrates an embodiment of a hydration-blender transport 500 that includes a single blending tub. FIG. 5 illustrates a top view of the hydration-blender transport 500 that depicts the top of the hydration tank. FIG. 5 is similar to FIG. 4D except that manifolds within the hydration-blender manifold system 418 and blender output manifold system 420 that correspond to the missing blending tub have been removed. For example, in FIG. 4D, once the hydrated fluid travels through the

tortuous flow path, the hydration-blender manifold system 418 supplies the hydrated fluid to only one blending tub 454. The hydration-blender manifold system 418 includes only one manifold connection to supply hydrated fluid to the one blending tubs 454. Afterwards, the blending tub 454 discharges the fracturing fluid via the blender output manifold system 420(e.g., using a pump not shown in FIG. 5), which only has one outlet manifold connection to the blending tub 454. Although FIG. 5 illustrates that three electric prime movers 406 may be used to drive three pumps 408, other embodiments of the hydration-blender transport 500 could include two electric prime movers 406 that drive two pumps 408.

[0076] FIG. 6 is a flow chart of an embodiment of a method 600 to provide fracturing fluid using a single hydration-blender transport. Method 600 may correspond to the hydration-blender operation mode and the split-stream operation mode. The use and discussion of FIG. 6 is only an example to facilitate explanation and is not intended to limit the disclosure to this specific example. For example, although FIG. 6 illustrates that the blocks within method 600 are implemented in a sequential order, method 600 is not limited to this sequential order. For instance, one or more of the blocks, such as blocks 604 and 606, could be implemented in parallel.

[0077] Method 600 may start at block 602 by receiving source fluid from one or more inlet/outlet manifolds. To implement block 602, method 600 may configure one or more valves within the hydration-blender transport such that some of the inlet/outlet manifolds are configured to receive source fluid and some of the inlet/outlet manifolds discharge fracturing fluid. Method 600 may then move to block 604 and drive one or more pumps to route the source fluid from the inlet/outlet manifolds into a hydration tank. In one embodiment, method 600 may use electric prime movers to drive pumps to route the source fluid.

[0078] Method 600 continues to block 606 and hydrates a polymer-based slurry with the source fluid to produce hydrated fluid with a target viscosity. In one embodiment, method 600 may utilize a tortuous flow path that provides enough residence time and a flow rate to supply fracturing fluid to a blender unit. Afterwards, method 600 moves to block 608 and drives one or more pumps to route the hydrated fluid into one or more blending tubs. Method 600 then moves to block 610 and mixes the hydrated fluid with metered fracturing sand to produce fracturing fluid.

Afterwards, method 600 continues to block 612 and drives one or more pumps to discharge the fracturing fluid from the blending tubs. Prior to discharging the fracturing fluid, method 600 may configure one or more valves to direct which inlet/outlet manifolds receive the fracturing fluid.

[0079] FIG. 7 is a flow chart of an embodiment of a method 700 to supply electric power to fracturing equipment using a medium voltage power distribution system. For example the medium voltage power distribution system that includes the switch gear transport 308 and transformers 310 and 312 shown in FIG. 3 can implement method 700. The use and discussion of FIG. 7 is only an example to facilitate explanation and is not intended to limit the disclosure to this specific example. For example, although FIG. 7 illustrates that the blocks within method 700 are implemented in a sequential order, method 700 is not limited to this sequential order. For instance, one or more of the blocks, such as blocks 704 and 706, could be implemented in parallel.

[0080] Method 700 may start at block 702 by receiving electric power from a mobile source of electricity at a medium voltage level. As an example, method 700 receives electric power at 13.8 kV or at some other relatively higher medium voltage level from the mobile source of electricity. In one or more other embodiments, method 700 may receive electric power from other power sources, such as a power grid or a power plant. Method 700 may then move to block 704 and supply electric power to one or more fracturing pump transports at the medium voltage level (e.g., 13.8 kV). At block 704, method 700 does not step down the electric power received from the mobile source of electricity to a lower voltage level using transformers. Instead, method 700 at block 706 supplies electric power to one or more transports at the medium voltage level. As discussed with reference to FIG. 3, method 700 is able to reduce the number of electrical cables used to supply electric power to transports, such as fracturing pump transport 304 and hydration-blender transport 306, when compared to the medium-low power distribution system shown in FIG. 2.

[0081] Method 700 continues to block 708 and steps down the medium voltage level received at the fracturing pump transports to one or more lower voltage levels. In one embodiment, method 700 may step down the voltage level to a lower medium voltage level (e.g., 4.2 kV) or a low voltage level (e.g., 600 V or 480 V). By stepping

the voltage down at the fracturing pump transport, method 700 is able to reduce the number of transports by eliminating the drive power transports (e.g., drive power transports 104 in FIG. 2). Afterwards, method 700 moves to block 710 and steps down the medium voltage level received at other transports to one or more lower voltage levels. For example, method 700 can step down the voltage at a hydration transport, a blender transport, a hydration-blender transport, or combinations thereof. Stepping down the voltage at the different transports also reduces the number of transports by eliminating the auxiliary unit transport. Subsequently, method 700 may move to block 712 and supply electric power to one or more electric prime movers mounted on the fracturing pump transports and other transports with the lower voltage levels.

[0082] At least one embodiment is disclosed and variations, combinations, and/or modifications of the embodiment(s) and/or features of the embodiment(s) made by a person having ordinary skill in the art are within the scope of the disclosure. Alternative embodiments that result from combining, integrating, and/or omitting features of the embodiment(s) are also within the scope of the disclosure. Where numerical ranges or limitations are expressly stated, such express ranges or limitations may be understood to include iterative ranges or limitations of like magnitude falling within the expressly stated ranges or limitations (e.g., from about 1 to about 10 includes, 2, 3, 4, etc.; greater than 0.10 includes 0.11, 0.12, 0.13, etc.). The use of the term “about” means $\pm 10\%$ of the subsequent number, unless otherwise stated.

[0083] Use of the term “optionally” with respect to any element of a claim means that the element is required, or alternatively, the element is not required, both alternatives being within the scope of the claim. Use of broader terms such as comprises, includes, and having may be understood to provide support for narrower terms such as consisting of, consisting essentially of, and comprised substantially of. Accordingly, the scope of protection is not limited by the description set out above but is defined by the claims that follow, that scope including all equivalents of the subject matter of the claims. Each and every claim is incorporated as further disclosure into the specification and the claims are embodiment(s) of the present disclosure.

[0084] While several embodiments have been provided in the present disclosure, it should be understood that the disclosed systems and methods might be embodied in many other specific forms without departing from the spirit or scope of the present disclosure. The present examples are to be considered as illustrative and not restrictive, and the intention is not to be limited to the details given herein. For example, the various elements or components may be combined or integrated in another system or certain features may be omitted, or not implemented.

[0085] In addition, techniques, systems, subsystems, and methods described and illustrated in the various embodiments as discrete or separate may be combined or integrated with other systems, modules, techniques, or methods without departing from the scope of the present disclosure. Other items shown or discussed as coupled or directly coupled or communicating with each other may be indirectly coupled or communicating through some interface, device, or intermediate component whether electrically, mechanically, or otherwise.

CLAIMS

What is claimed is:

1. An electric fracturing system comprising:
 - a switch gear transport electrically connected to a power generation source to provide electric power at a first voltage level;
 - an electrical cable that supplies electric power at the first voltage level; and
 - a fracturing pump transport electrically connected to the switch gear transport via only the electrical cable,
 - wherein the fracturing pump transport comprises a transformer that steps down the electric power received at the first voltage level to at least one lower voltage level.
2. The system of claim 1, wherein the first voltage level is a medium voltage level.
3. The system of claim 1, wherein the at least one lower voltage level is a medium voltage level.
4. The system of claim 1, wherein the switch gear transport is able to provide electric power at a second voltage level.
5. The system of claim 1, wherein the electrical cable connection comprises fiber optic wires that allows for communication between the switch gear transport and the fracturing pump transport.
6. The system of claim 1, further comprising:
 - a second electrical cable that supplies electric power at the first voltage level only; and
 - a blender-hydration transport electrically connected to the switch gear transport via the second electrical cable.
7. The system of claim 6, wherein the blender-hydration transport comprises a transformer that steps down the electric power from the first voltage level to one or more other lower voltage levels.
8. The system of claim 1, further comprising:
 - a second electrical cable that supplies electric power at the first voltage level only; and

a blender transport electrically connected to the switch gear transport via the second electrical cable.

9. The system of claim 1, further comprising:

a second electrical cable that supplies electric power at the first voltage level only; and

a hydration transport electrically connected to the switch gear transport via the second electrical cable.

10. A transport for fracturing operations comprising:

a single transport frame;

an electric prime mover mounted on the single transport frame;

a pump coupled to the electric prime mover and mounted on the single transport frame; and

a transformer coupled to the electric prime mover and mounted on the single transport frame, wherein the transformer is configured to:

receive electric power at a first voltage level from a power source via a single cable assembly;

step down the electric power at the first voltage level to at least one lower voltage level; and

supply the electric power at the at least one lower voltage level to the electric prime mover,

wherein the transport is not connected to any other cable assemblies that supply electric power at the first voltage level and other voltage levels.

11. The transport of claim 10, wherein the transport is a fracturing pump transport.

12. The transport of claim 10, wherein the transport is a hydration-blender transport.

13. The transport of claim 10, wherein the electric prime mover is a dual-shaft electric motor.

14. The transport of claim 10, wherein the transformer is further configured to step down the electric power at the first voltage level to one or more other lower voltage levels.

15. The transport of claim 14, wherein the second lower voltage level is a medium voltage level and the lower voltage level is a low voltage level.

16. The transport of claim 10, wherein the power source is a switch gear transport.

17. A method for electric power distribution for fracturing operations, comprising:

receiving, at a transport, electric power from a mobile source of electricity at a first voltage level, wherein the first voltage level falls within a range of 1,000 V to 35 kilovolts;

supplying, from the transport, the electric power to a fracturing pump transport at the first voltage level using only a first, single cable connection; and

supplying, from the transport, the electric power to a second transport at the first voltage level using only a second, single cable connection.

18. The method of claim 17, further comprising receiving, at the transport, electric power from an auxiliary power transport at the first voltage level.

19. The method of claim 18, further comprising stepping down, at the transport, the electric power from the auxiliary power transport from the first voltage level to at least one lower voltage level.

20. The method of claim 19, further comprising supplying, from the transport, the electric power at the lower voltage level to the mobile source of electricity.

21. An electric fracturing system for use with at least one power generation source providing source electric power, the system comprising:

a switch gear transport electrically connected to the at least one power generation source, and configured to receive the source electric power at a first medium voltage level;

a first electrical cable connected to the switch gear transport that supplies first electric power at the first medium voltage level from the switch gear transport; and

a first fracturing pump transport comprising: at least one first transformer, at least one drive, at least one electric prime mover, and at least one pump, each being disposed on the first fracturing pump transport,

wherein the at least one first transformer is electrically connected to the switch gear transport via only the first electrical cable, wherein the at least one first

transformer is further electrically connected to the at least one electric prime mover and to the at least one drive,

wherein the at least one first transformer is configured to step down the first electric power received at the first medium voltage level to a first lower medium voltage level that powers the at least one electric prime mover,

wherein each of the at least one drive and the at least one pump is coupled to the at least one electric prime mover, and

wherein the at least one first transformer is further configured to step down the first electric power received at the first medium voltage level to a first low voltage level that is lower than the first lower medium voltage level and that powers the at least one drive.

22. The system of claim 21, wherein the first medium voltage level is set to be at 13.8 kilovolts.

23. The system of claim 21, wherein the first low voltage level falls within a range of 50 volts to 1000 volts.

24. The system of claim 21, wherein the switch gear transport comprises a second transformer electrically connected to an auxiliary source of power providing second electric power of the first medium voltage level, wherein the second transformer is configured to step down the first medium voltage level to a second low voltage level that falls within a range of 50 volts to 1000 volts.

25. The system of claim 24, further comprising a second electrical cable disposed in electrical communication with the second transformer and configured to supply the second electric power at the second low voltage level from the switch gear transport, wherein the second low voltage level is at a voltage for igniting and starting the at least one power generation source.

26. The system of claim 21, further comprising:

a second electrical cable connected to the switch gear transport that supplies second electric power at the first medium voltage level from the switch gear transport; and

a blender-hydration transport electrically connected to the switch gear transport via the second electrical cable and without having a trailer connected in between the switch gear transport and the blender-hydration transport,

wherein the blender-hydration transport comprises a hydration tank and at least one blending tub mounted on a single transport frame.

27. The system of claim 26, wherein the blender-hydration transport further comprises a second transformer that steps down the second electric power from the first medium voltage level to a second lower medium voltage level that is at a voltage less than the first medium voltage level.

28. The system of claim 21, further comprising:

a second electrical cable connected to the switch gear transport that supplies second electric power at the first medium voltage level from the switch gear transport; and

a blender transport electrically connected to the switch gear transport via the second electrical cable.

29. The system of claim 21, further comprising:

a second electrical cable connected to the switch gear transport that supplies second electric power at the first medium voltage level from the switch gear transport; and

a hydration transport electrically connected to the switch gear transport via the second electrical cable.

30. A fracturing transport for fracturing operations, the fracturing transport used with a switch gear transport providing electric power and comprising:

a single transport frame;

at least one electric prime mover mounted on the single transport frame;

a drive mounted on the single transport frame and coupled to the at least one electric prime mover;

a plurality of pumps coupled to the electric prime mover and mounted on the single transport frame; and

at least one transformer coupled through the drive to the electric prime mover and mounted on the single transport frame, wherein the transformer is configured to:

receive electric power at a first medium voltage level from the switch gear transport via a single cable assembly;

step down the electric power at the first medium voltage level to a lower medium voltage level, and supply the electric power at the lower medium

voltage level through the drive to the electric prime mover to drive the pumps; and
 step down the electric power at the first medium voltage level to a low voltage level, and supply the electric power at the low voltage level to the drive,

wherein the fracturing transport is not connected to any other cable assemblies that supply electric power at the first medium voltage level and other voltage levels.

31. The fracturing transport of claim 30, wherein the first medium voltage level is at a 13.8 kilovolt level.

32. The fracturing transport of claim 30, wherein the lower medium voltage level is at a voltage less than 13.8 kilovolts.

33. The fracturing transport of claim 30, wherein the electric prime mover is a dual-shaft electric motor.

34. The fracturing transport of claim 30, wherein the low voltage level falls within a range of 50 volts to 1000 volts.

35. The fracturing transport of claim 30, wherein the at least one transformer comprises a single transformer having a first transformer winding configured to step down the electric power at the first medium voltage level to the lower medium voltage level that falls within a first range of 1000 volts to 35 kilovolts, and having a second transformer winding configured to step down the electric power at the first medium voltage level to the low voltage level that falls within a second range of 50 volts to 1000 volts.

36. The fracturing transport of claim 30, wherein the switch gear transport receives electric power at the first medium voltage level from at least one power source.

37. The system of claim 21, wherein the first medium voltage level and the first lower medium voltage level fall within a range of 1000 volts to 35 kilovolts.

38. The system of claim 21, wherein the at least one first transformer comprises one of:

a single transformer configured to step down the first medium voltage level to the first lower medium voltage level and the first low voltage level; and

one transformer configured to step down the first medium voltage level to the first lower medium voltage level and another transformer configured to step down the first medium voltage level to the first low voltage level.

39. A method for electric power distribution for fracturing operations, the method comprising:

receiving, at a switch gear transport, source electric power from at least one mobile source of electricity at a first medium voltage level;

supplying, from the switch gear transport, first electric power at the first medium voltage level using only a first cable connection;

receiving, at a fracturing pump transport, the first electric power at the first medium voltage level supplied directly using the first cable connection;

stepping down, with at least one first transformer disposed on the fracturing pump transport, the first medium voltage level to both a lower medium voltage level and a low voltage level;

powering an electric prime mover disposed on the fracturing pump transport with the lower medium voltage level;

powering a drive disposed on the fracturing pump transport with the low voltage level; and

controlling output of the powered electric prime mover with the powered drive.

40. The method of claim 39, further comprising:

supplying, from the switch gear transport, second electric power at the first medium voltage level using only a second cable connection; and

receiving, at one of a blender transport, a hydration blender, and a blender-hydration transport, the second electric power at the first medium voltage level supplied directly using the second cable connection.

41. The method of claim 39, wherein the first medium voltage level and the lower medium voltage level fall within a range of 1000 volts to 35 kilovolts.

42. The method of claim 39, wherein the low voltage level falls within a range of 50 volts to 1000 volts.

43. The method of claim 39, further comprising:

stepping down, with a second transformer disposed on the switch gear transport, the first medium voltage level to a second low voltage level; and

supplying, from the switch gear transport, the electric power at the second

low voltage level to the mobile source of electricity to ignite and start the at least one mobile source of electricity.

44. An electric fracturing system for use with at least one power generation source providing source electric power, the system comprising:

a switch gear transport electrically connected to the at least one power generation source-and configured to receive the source electric power at a first voltage level;

a first electrical cable connected to the switch gear transport and configured to supply first electric power at the first voltage level from the switch gear transport; and

a first transport comprising: at least one first transformer, at least one first drive, and at least one first electric prime mover, each being disposed on the first transport,

wherein the at least one first transformer is electrically connected to the switch gear transport via only the first electrical cable, wherein the at least one first transformer is further electrically connected to the at least one first drive and to the at least one first electric prime mover,

wherein the at least one first transformer is configured to step down the first electric power received at the first voltage level to a second voltage level that powers the at least one first drive, the second voltage level being less than the first voltage level, and

wherein the at least one first drive is coupled to the at least one first electric prime mover.

45. The system of claim 44, wherein the first voltage level falls within a range of 1000 volts to 35 kilovolts.

46. The system of claim 45, wherein the first voltage level is set to be at 13.8 kilovolts.

47. The system of claim 44, wherein the second voltage level falls within a range of 50 volts to 1000 volts.

48. The system of claim 44, wherein the first transport is a blender-hydration transport that is electrically connected to the switch gear transport via the first electrical cable and without having a trailer connected in between the switch gear

transport and the blender-hydration transport,

wherein the blender-hydration transport comprises a hydration tank and at least one blending tub mounted on a single transport frame, and

wherein the second voltage level further powers the at least one first electric prime mover.

49. The system of claim 44, wherein the first transport is a blender transport that is electrically connected to the switch gear transport via the first electrical cable and without having a trailer connected in between the switch gear transport and the blender transport,

wherein the blender transport comprises at least one blending tub mounted on a blender transport frame, and

wherein the second voltage level further powers the at least one first electric prime mover.

50. The system of claim 49, further comprising:

a second electrical cable connected to the switch gear transport and configured to supply second electric power at the first voltage level from the switch gear transport; and

a hydration transport electrically connected to the switch gear transport via the second electrical cable and without having a transport connected in between the switch gear transport and the hydration transport,

wherein the hydration transport comprises a hydration tank mounted on a hydration transport frame.

51. The system of claim 50, wherein the hydration transport further comprises: a second transformer, at least one second drive, and at least one second electric prime mover, each being disposed on the hydration transport,

wherein the second transformer is electrically connected to the switch gear transport via only the second electrical cable, wherein the second transformer is further electrically connected to the at least one second drive and to the at least one second electric prime mover disposed on the hydration transport,

wherein the second transformer is configured to step down the second electric power received at the first voltage level to a third voltage level that powers the at least one second drive disposed on the hydration transport, the third voltage level being

less than the first voltage level, and

wherein the at least one second drive is coupled to the at least one second electric prime mover disposed on the hydration transport.

52. The system of claim 44, wherein the first transport is a first fracturing pump transport that is electrically connected to the switch gear transport via the first electrical cable and without having a trailer connected in between the switch gear transport and the first fracturing pump transport,

wherein the first fracturing pump transport further comprises at least one pump which is disposed on the first fracturing pump transport,

wherein the at least one first transformer is further configured to step down the first electric power received at the first voltage level to an intermediate voltage level that powers the at least one first electric prime mover, wherein the intermediate voltage level is lower than the first voltage level and is higher than the second voltage level, and

wherein each of the at least one first drive and the at least one pump is coupled to the at least one first electric prime mover.

53. The system of claim 44, wherein the switch gear transport comprises a third transformer electrically connected to an auxiliary source of power providing third electric power at the first voltage level, wherein the third transformer is configured to step down the first voltage level to a third voltage level that falls within a range of 50 volts to 1000 volts.

54. The system of claim 53, further comprising a third electrical cable disposed in electrical communication with the third transformer and configured to supply electric power at the third voltage level from the switch gear transport,

wherein the third voltage level is at a voltage for igniting and starting the at least one power generation source.

55. The system of claim 44, wherein the first electrical cable comprises fiber optic wires configured to communicate between the switch gear transport and the first transport.

56. A blender transport for fracturing operations, the blender transport used with a switch gear transport providing electric power and comprising:

a single transport frame;

- at least one blending tub mounted on the single transport frame;
- at least one electric prime mover mounted on the single transport frame;
- a drive mounted on the single transport frame and coupled to the at least one electric prime mover; and
- a transformer coupled through the drive to the electric prime mover and mounted on the single transport frame, wherein the transformer is configured to:
 - receive the electric power at a first voltage level from the switch gear transport via the single cable assembly,
 - step down the electric power at the first voltage level to a second voltage level less than the first voltage level, and
 - supply the electric power at the second voltage level to the drive and to the electric prime mover.

57. The blender transport of claim 56, wherein the first voltage level is at a 13.8 kilovolt level.

58. The blender transport of claim 56, wherein the second voltage level falls within a range of 50 volts to 1000 volts.

59. The blender transport of claim 56, wherein the single cable assembly comprises fiber optic wires that allow for communication between the switch gear transport and the blender transport.

60. A hydration-blender transport for fracturing operations, the hydration-blender transport used with a switch gear transport providing electric power and comprising:

- a single transport frame;
- a hydration tank mounted on the single transport frame;
- at least one blending tub mounted on the single transport frame;
- at least one electric prime mover mounted on the single transport frame;
- a drive mounted on the single transport frame and coupled to the at least one electric prime mover; and
- a transformer coupled through the drive to the electric prime mover and mounted on the single transport frame, wherein the transformer is configured to:
 - receive the electric power at a first voltage level from the switch gear transport via a single cable assembly,
 - step down the electric power at the first voltage level to a second

voltage level less than the first voltage level, and

supply the electric power at the second voltage level to the drive and to the electric prime mover.

61. The hydration-blender transport of claim 60, wherein the first voltage level is at a 13.8 kilovolt level.

62. The hydration-blender transport of claim 60, wherein the second voltage level falls within a range of 50 volts to 1000 volts.

63. The hydration-blender transport of claim 60, wherein the single cable assembly comprises fiber optic wires that allow for communication between the switch gear transport and the hydration-blender transport.

64. A transport used with a switch gear for fracturing operations, the switch gear being remote from the transport and providing electric power to the transport via a cable, the transport comprising:

a transport frame;

an electric prime mover mounted on the transport frame;

a drive mounted on the transport frame and coupled to the electric prime mover;

an electrical connection disposed on the transport frame and configured to connect to the cable of the switch gear; and

at least one transformer coupled through the drive to the electric prime mover and mounted on the transport frame, the at least one transformer being in electrical communication with the electrical connection and being configured to: receive the electric power at a first voltage level from the switch gear via the cable, step down the electric power at the first voltage level to at least one second voltage level less than the first voltage level, and supply the electric power at the at least one second voltage level to the drive and to the electric prime mover.

65. The transport of claim 64, further comprising a blending tub mounted on the transport frame and being operable with the electric prime mover.

66. The transport of claim 65, further comprising a hydration tank mounted on the transport frame and disposed in fluid communication with the blending tub.

67. The transport of claim 64, further comprising a pump mounted on the transport frame and coupled to the electric prime mover, the at least one transformer

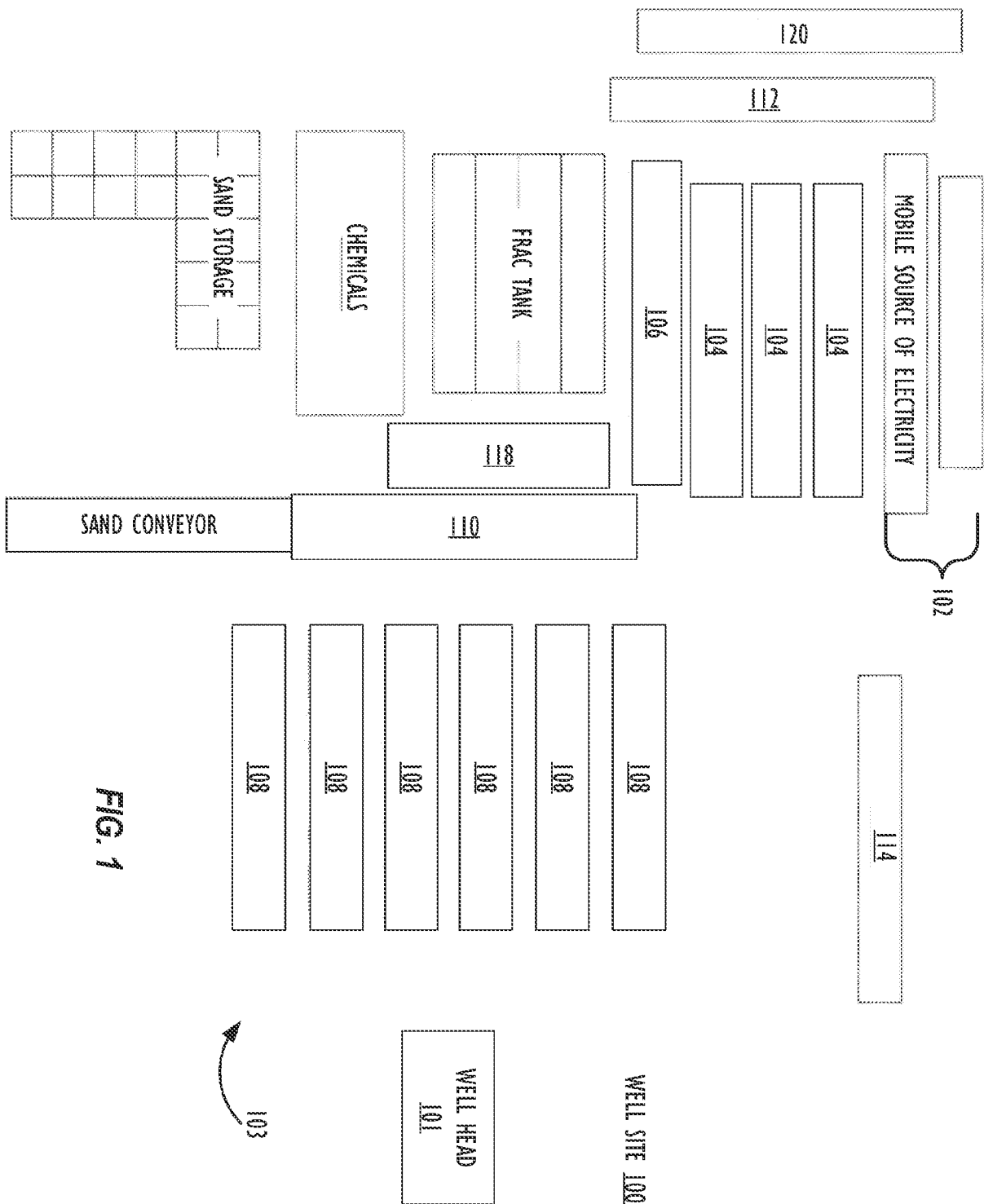
being configured to step down the electric power received at the first voltage level to an intermediate one and to a low one of the at least one second voltage level, the at least one transformer configured to supply the electric power at the low voltage level to the drive, the at least one transformer configured to supply the electric power at the intermediate voltage level through the drive to the electric prime mover to drive the pump.

68. The transport of claim 67, wherein the first voltage level is at a 13.8 kilovolt level, the low voltage level falls within a range of 50 volts to 1000 volts, the intermediate voltage level is at a voltage in a range from the low voltage level to less than the first voltage level.

69. The transport of claim 67, wherein the at least one transformer comprises one of:

- a single transformer configured to step down the first voltage level to the intermediate voltage level and the low voltage level; and

- a first transformer configured to step down to the intermediate voltage level and a second transformer configured to step down to the low voltage level.



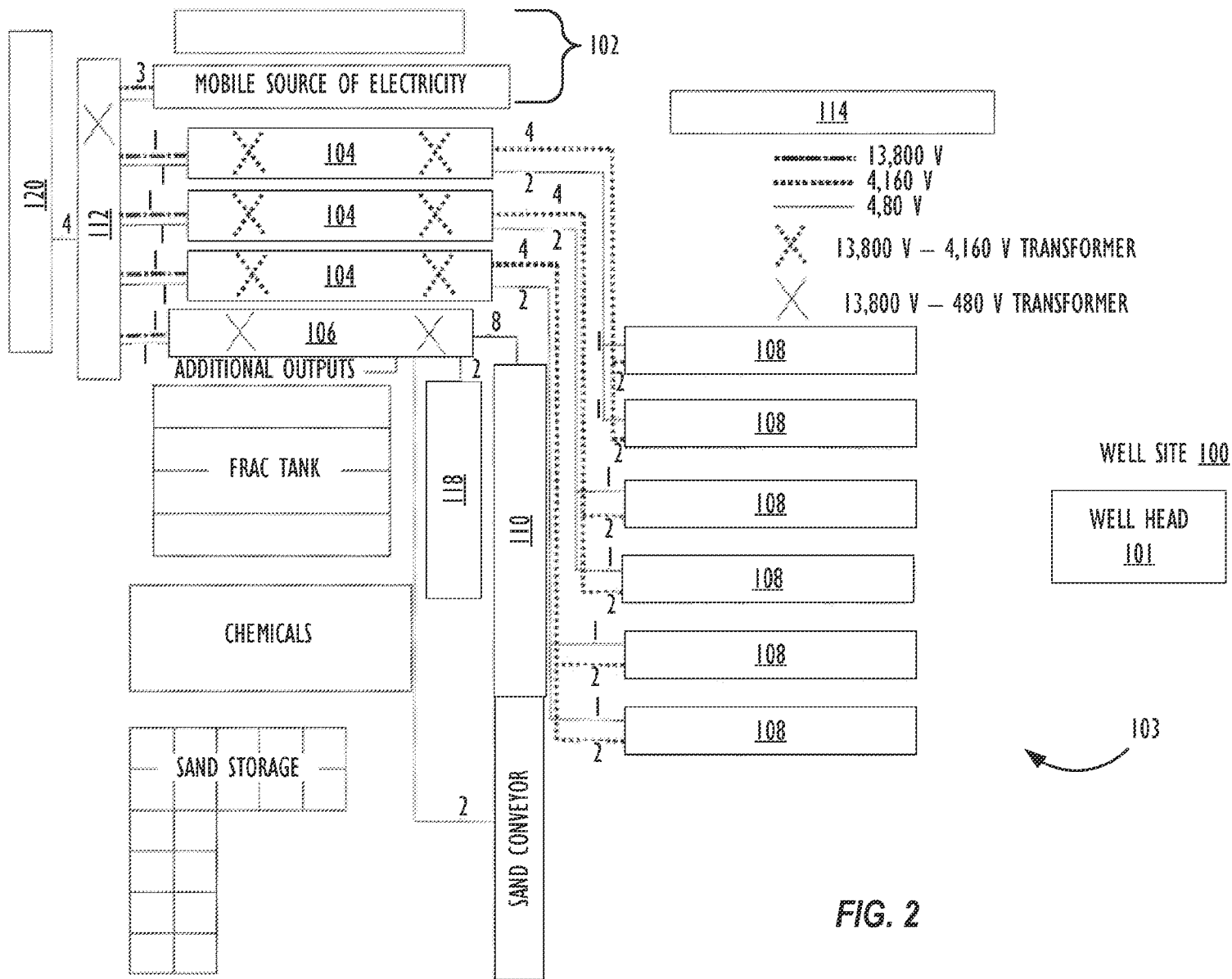


FIG. 2

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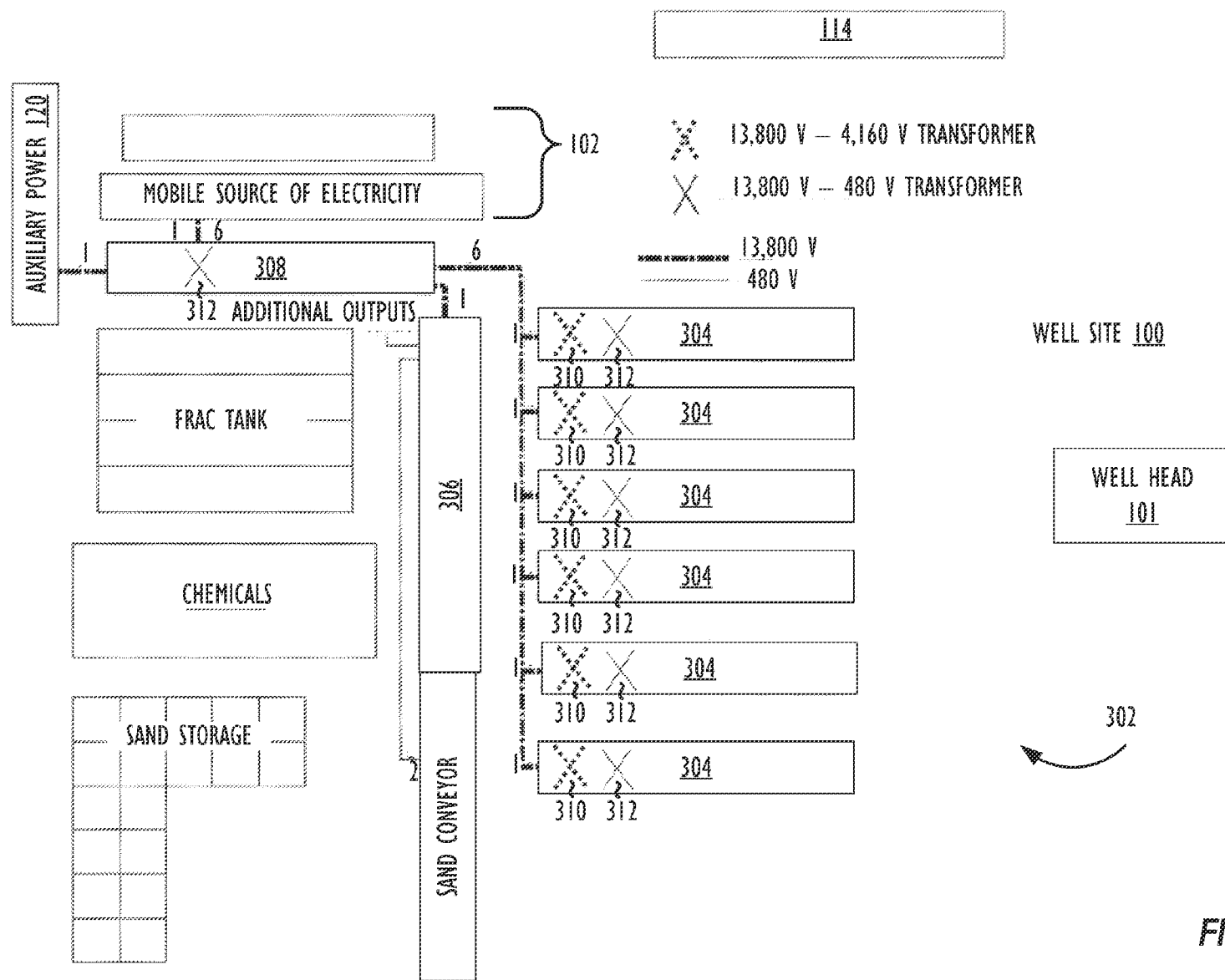
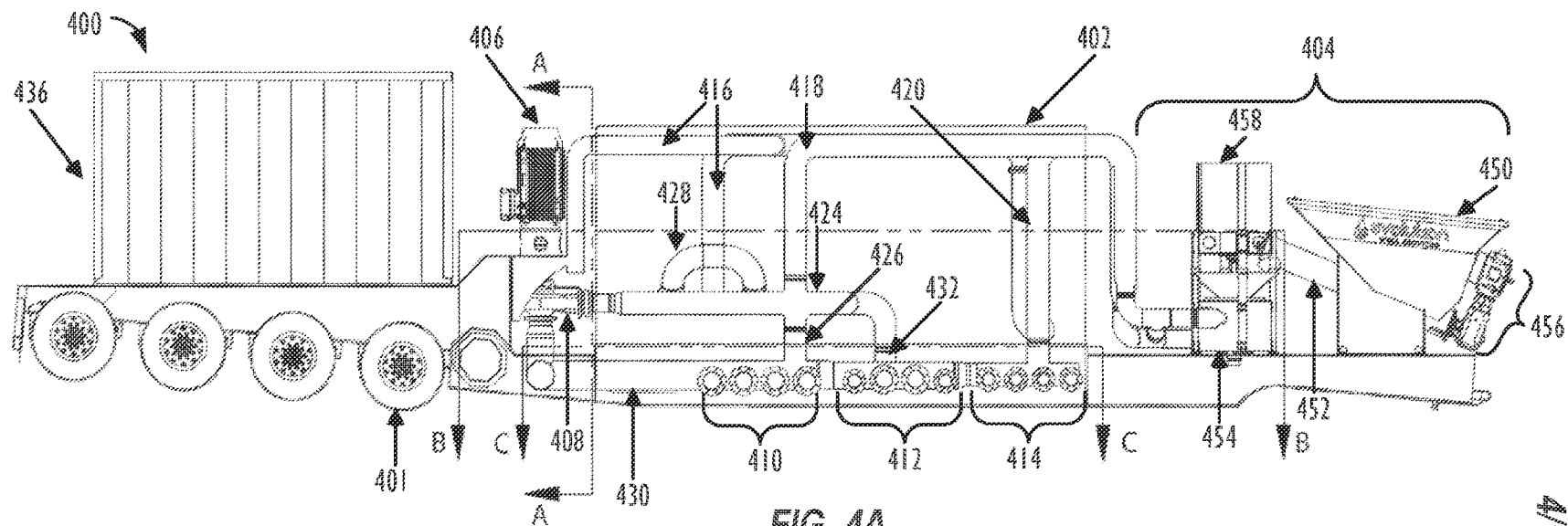
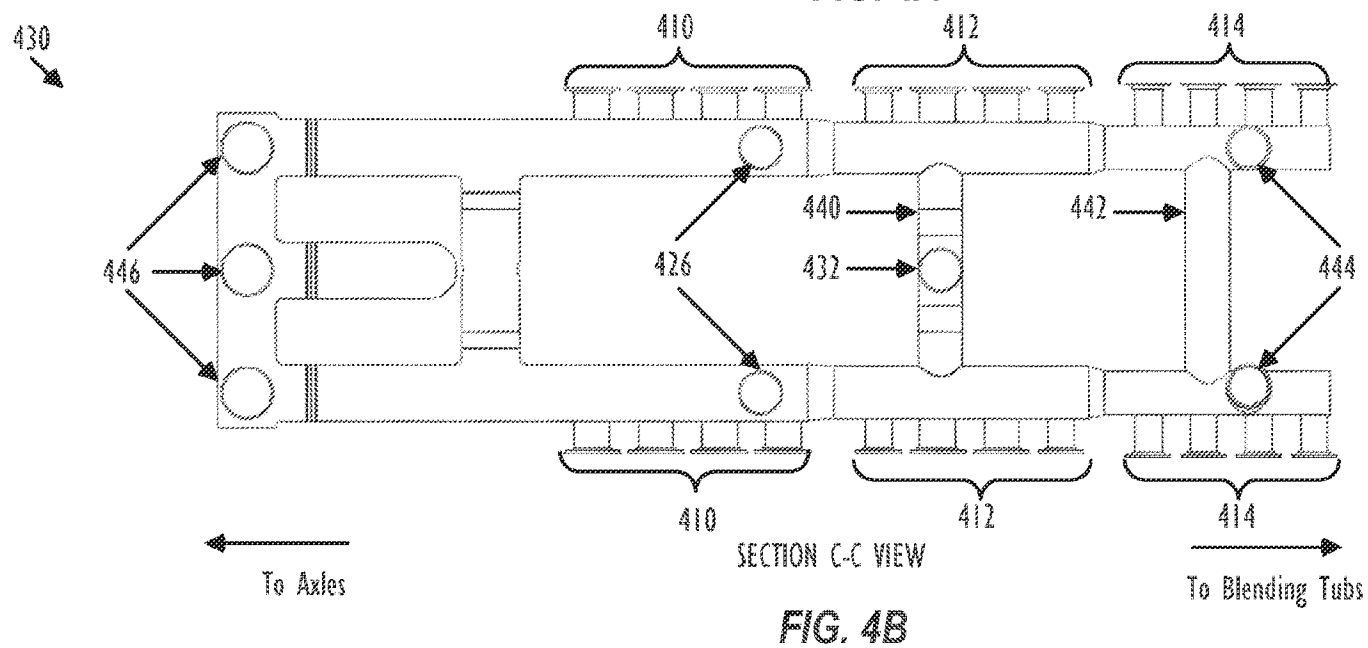
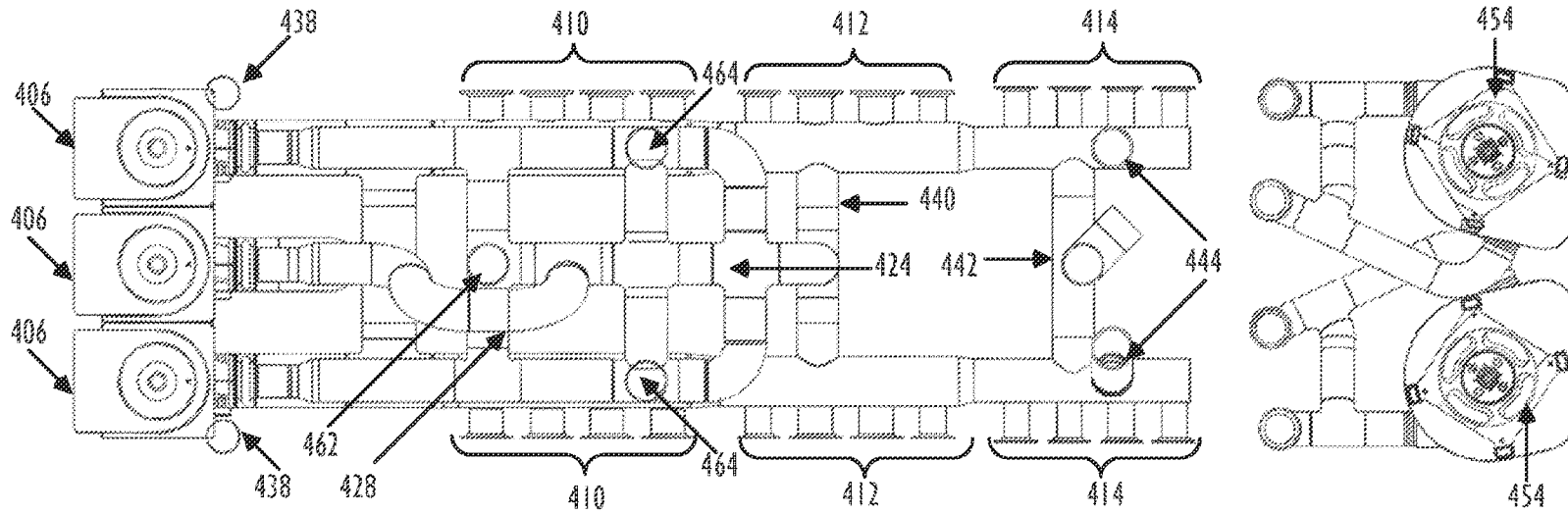


FIG. 3



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SECTION B-B VIEW

FIG. 4C

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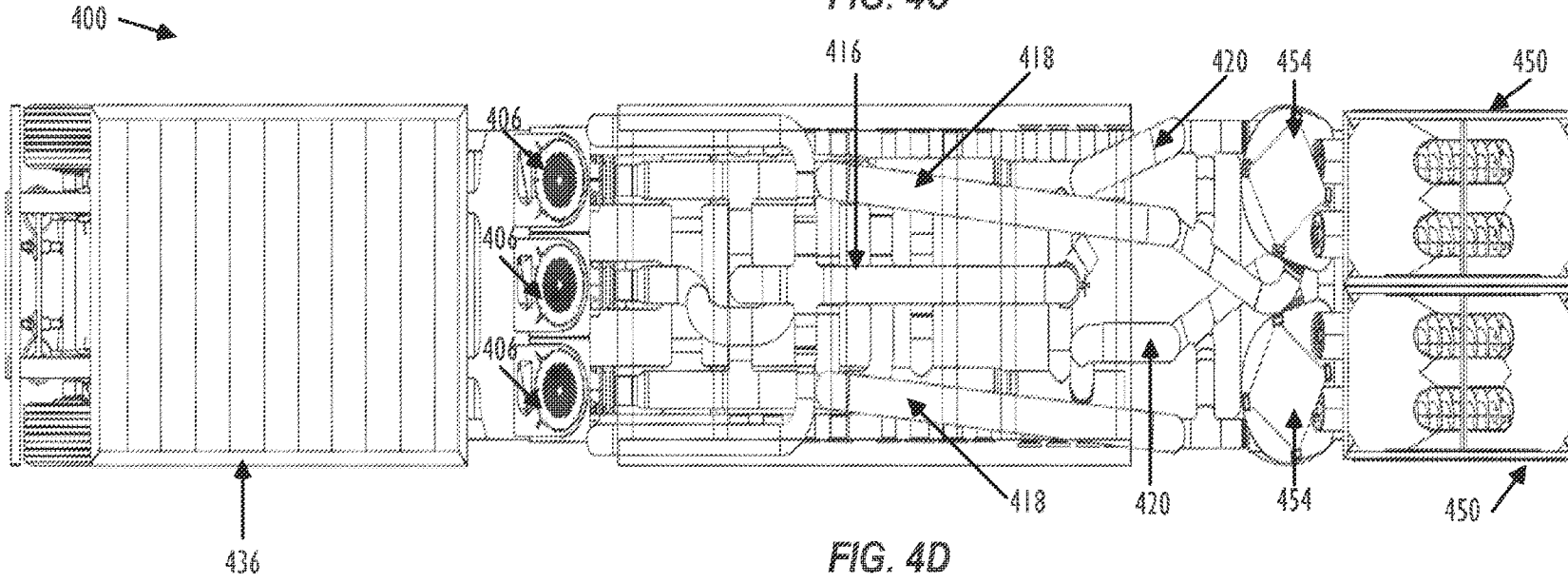
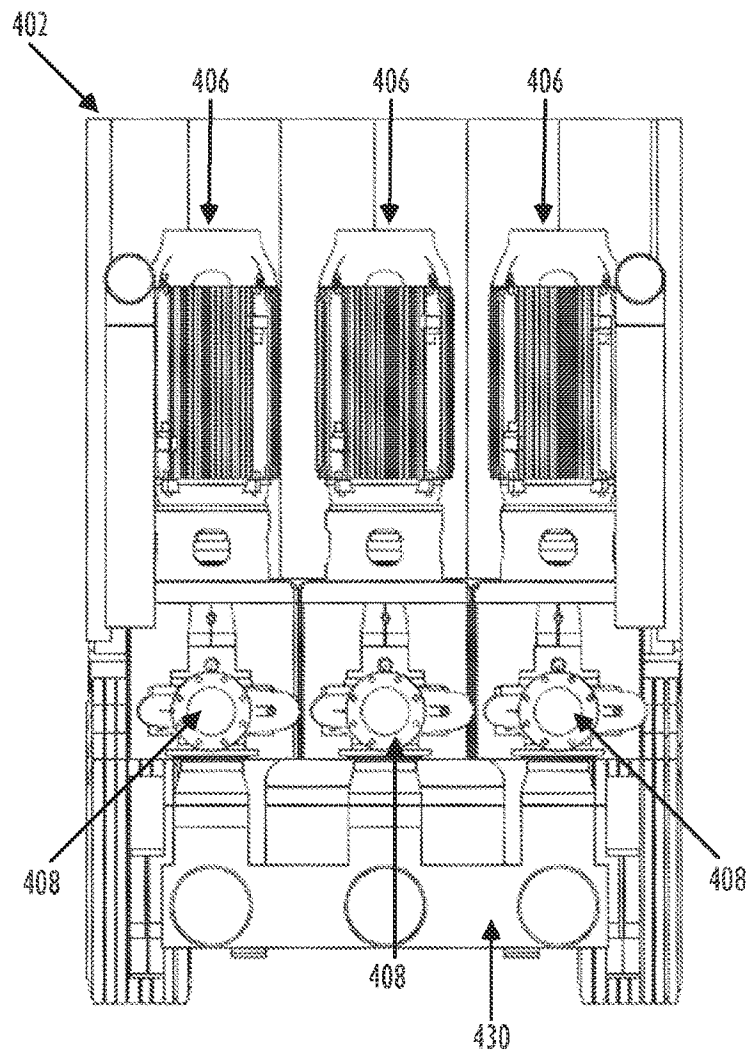


FIG. 4D

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SECTION A-A VIEW

FIG. 4E

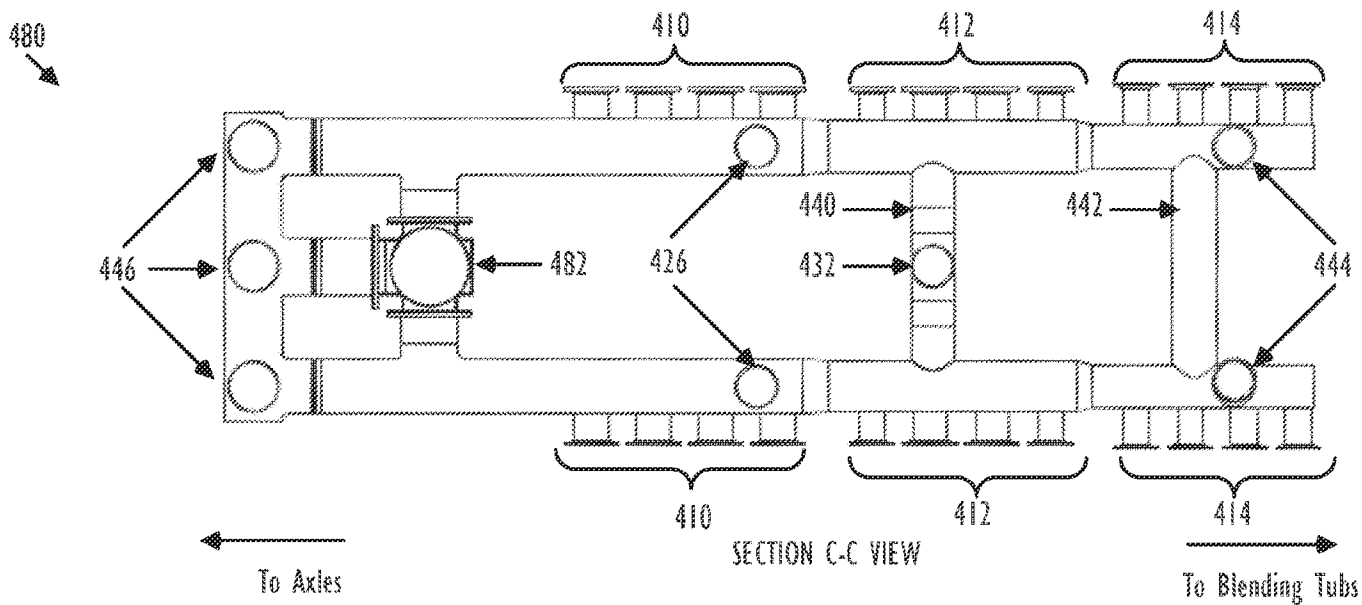


FIG. 4F

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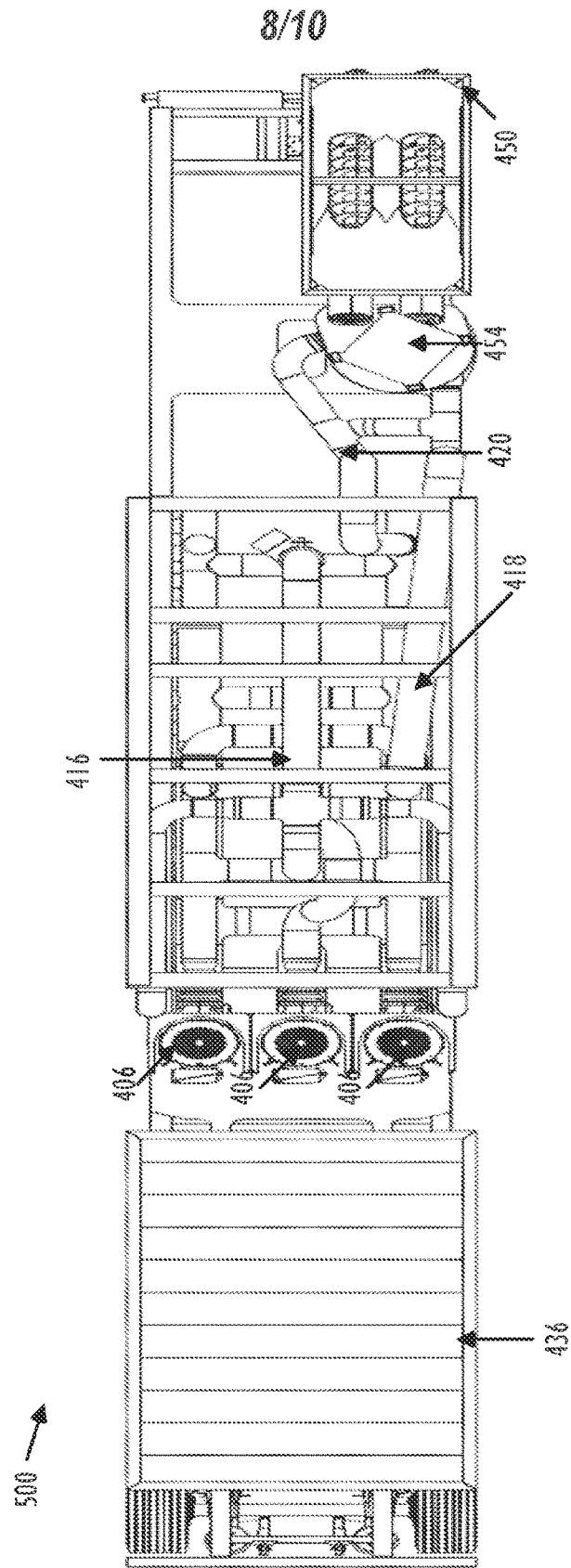


FIG. 5

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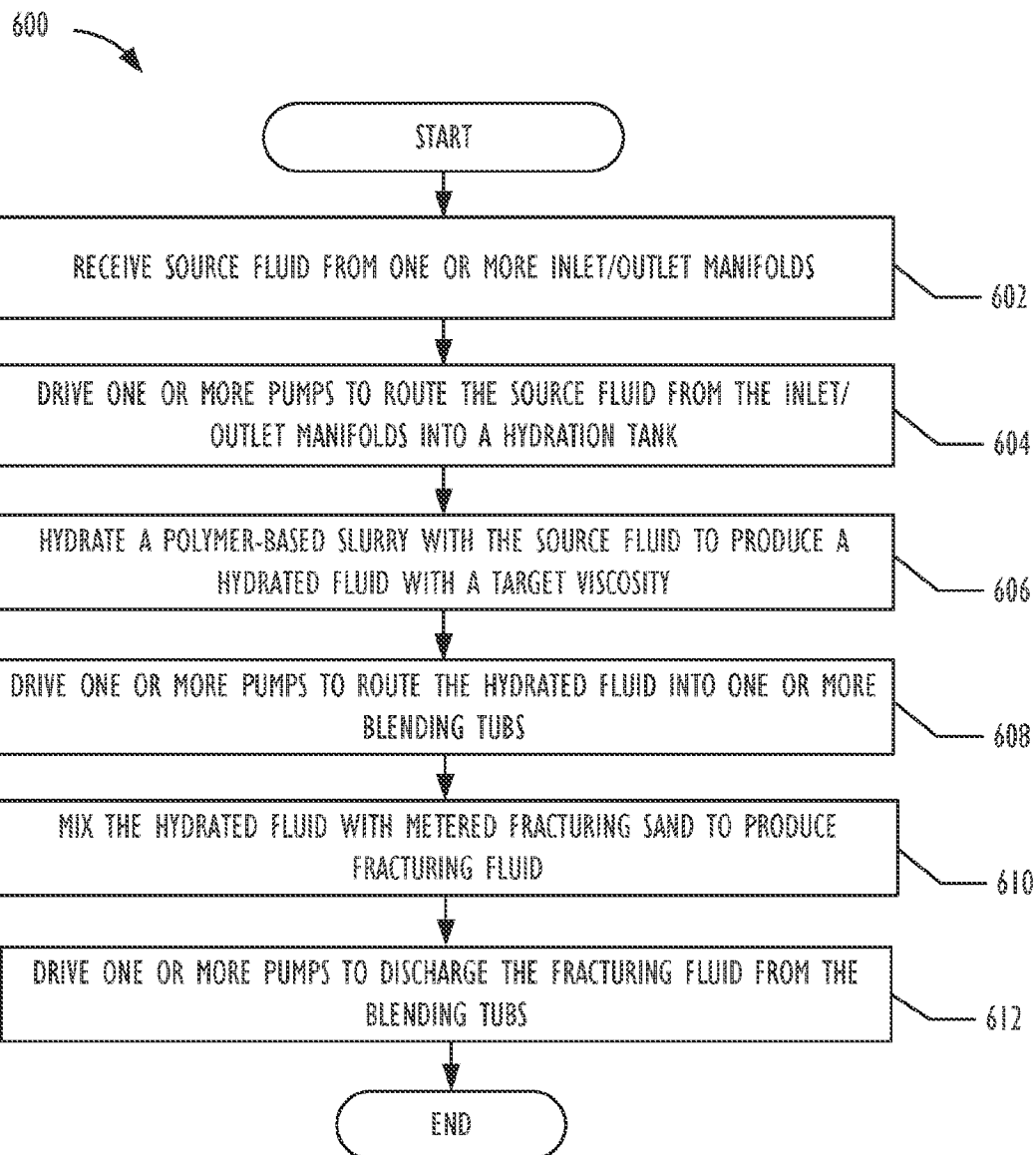


FIG. 6

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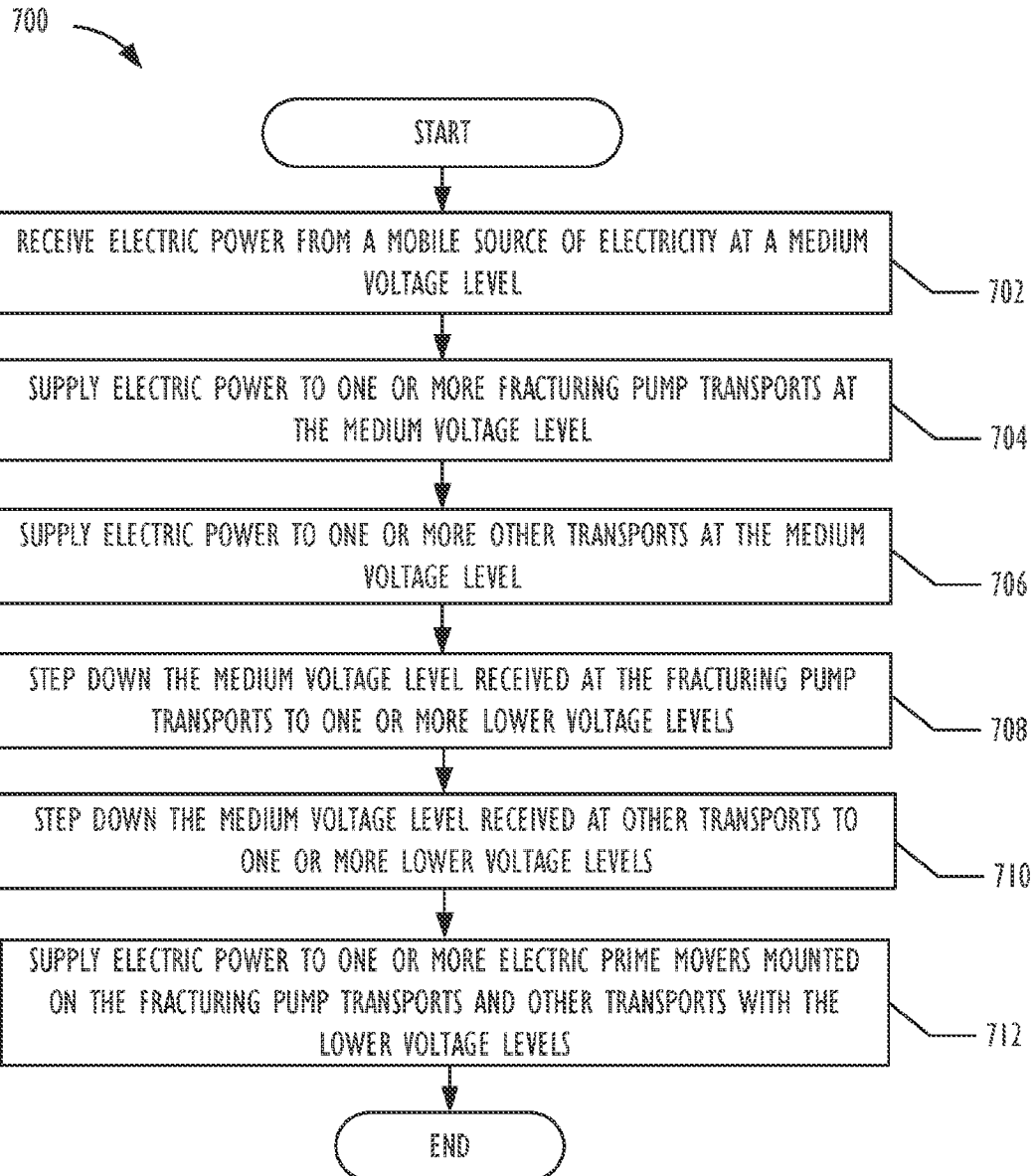


FIG. 7

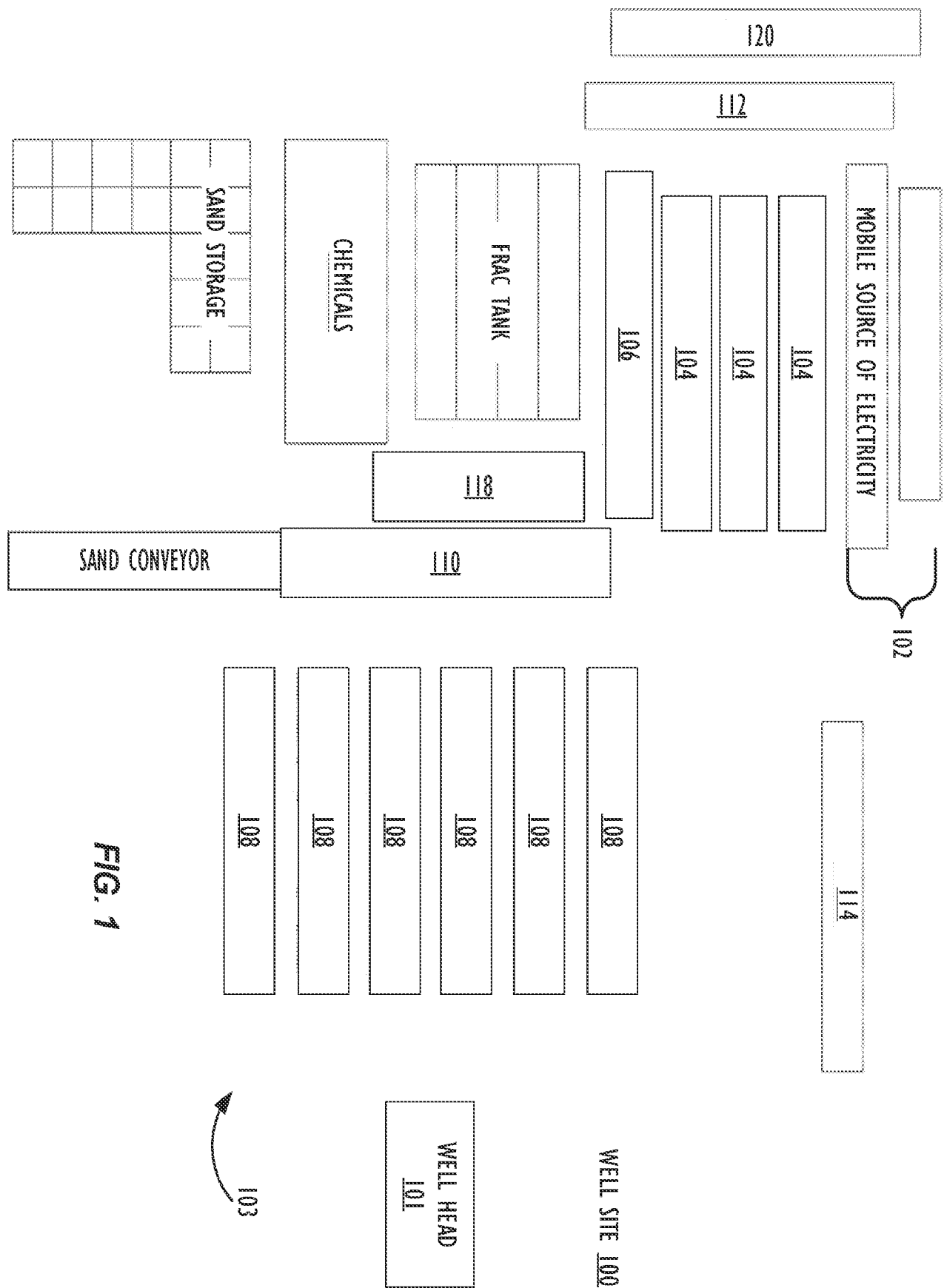


FIG. 1



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(71)申请人 凯龙高科技股份有限公司

地址 214153 江苏省无锡市惠山经济开发区钱桥配套区庙塘桥

(72)发明人 臧志成 李云峰 单以海 尹海峰
唐惠玲

(74)专利代理机构 北京品源专利代理有限公司
11332

代理人 胡彬

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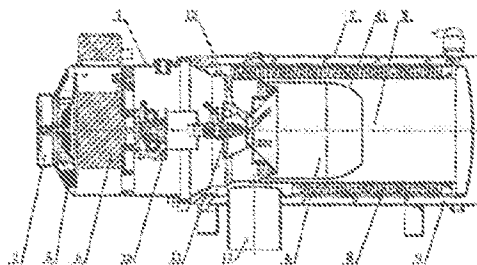
权利要求书1页 说明书2页 附图3页

(54)发明名称

一种甲醇加热器

(57)摘要

本发明公开一种甲醇加热器,包括机体,机体的一端开有进风口,其另一端设置有预燃烧室,预燃烧室设置于热交换器内,并与热交换器中的主燃烧室相连接,热交换器上开有排气口,热交换器的换热介质出口与汽车内散热器的加热介质进口相连,且热交换器的换热介质进口与循环泵的一端相连,循环泵的另一端与汽车内散热器的加热介质出口相连,机体内位于进风口与预燃烧室之间设置有用于提供甲醇的燃料泵,燃料泵的出液端连接有喷嘴,机体内邻近喷嘴处设置有点火电极。本发明不会影响车辆续航里程,且其结构简单、紧凑,并具有燃烧充分、环保性好的特点,经测试,其排放污染物的含量仅为燃油加热器的1/3~1/2,启动、停止时不会产生烟雾。



1. 一种甲醇加热器, 其特征在于, 包括机体, 所述机体的一端开有进风口, 其另一端设置有预燃烧室, 所述预燃烧室设置于热交换器内, 并与热交换器中的主燃烧室相连通, 所述热交换器上开有排气口, 所述热交换器的换热介质出口与汽车内散热器的加热介质进口相连, 且热交换器的换热介质进口与循环泵的一端相连, 所述循环泵的另一端与汽车内散热器的加热介质出口相连, 所述机体内位于进风口与预燃烧室之间设置有用于提供甲醇的燃料泵, 所述燃料泵的出液端连接有喷嘴, 所述机体内邻近喷嘴处设置有点火电极。

2. 根据权利要求1所述的一种甲醇加热器, 其特征在于: 所述机体内邻近进风口处设置有由电机驱动的助燃风扇。

3. 根据权利要求2所述的一种甲醇加热器, 其特征在于: 所述电机为变频电机。

4. 根据权利要求1所述的一种甲醇加热器, 其特征在于: 所述燃料泵为脉冲柱塞泵。

5. 根据权利要求1所述的一种甲醇加热器, 其特征在于: 所述热交换器包括换热壳体, 所述换热壳体的内壁上设置有换热片, 且换热壳体为中空结构, 换热壳体的中空部分形成换热介质通道。

6. 根据权利要求5所述的一种甲醇加热器, 其特征在于: 所述换热介质通道为螺旋形。

7. 根据权利要求1所述的一种甲醇加热器, 其特征在于: 所述预燃烧室远离点火电极的一端设置有缩口部, 所述缩口部的口径由邻近点火电极的一端至远离点火电极的一端依次减小。

一种甲醇加热器

技术领域

[0001] 本发明涉及汽车领域,尤其涉及一种甲醇加热器。

背景技术

[0002] 汽车是指以车载电源为动力,用电机驱动车轮行驶,符合道路交通、安全法规各项要求的车辆。由于对环境影响相对传统汽车较小,其前景被广泛看好。

[0003] 目前,大型的汽车如电动公交车、电动客车,其车厢取暖的热源主要采用燃油加热器或电加热器,然而,燃油加热器存在污染物排放偏高的问题,尤其是启动或停止时,其污染物排放较大,肉眼可明显看到烟雾变化,特别不方便的是,在气温变化时,需要更换不同牌号的柴油;电加热器虽然解决了燃油加热器存在的污染物排放偏高的问题,但其增加了用电负荷,一定程度上会影响续航里程;此外,现有甲醇燃料汽车是以甲醇作为燃料的汽车,现阶段甲醇燃料汽车存在冬季冷启动困难的问题,如何在冬季给甲醇发动机预热,提高甲醇燃料汽车的适应性,急需解决。

发明内容

[0004] 本发明的目的在于针对上述问题,提供一种甲醇加热器,其能在不影响车辆续航里程的条件下,给车厢采暖、除霜或预热发动机,并极大的降低污染物排放。

[0005] 本发明的目的是通过以下技术方案来实现:

[0006] 一种甲醇加热器,包括机体,所述机体的一端开有进风口,其另一端设置有预燃烧室,所述预燃烧室设置于热交换器内,并与热交换器中的主燃烧室相连通,所述热交换器上开有排气口,所述热交换器的换热介质出口与汽车内散热器的加热介质进口相连,且热交换器的换热介质进口与循环泵的一端相连,所述循环泵的另一端与汽车内散热器的加热介质出口相连,所述机体内位于进风口与预燃烧室之间设置有用于提供甲醇的燃料泵,所述燃料泵的出液端连接有喷嘴,所述机体内邻近喷嘴处设置有点火电极。

[0007] 作为本发明的一种优选方案,所述机体内邻近进风口处设置有由电机驱动的助燃风扇。

[0008] 作为本发明的一种优选方案,所述电机为变频电机。

[0009] 作为本发明的一种优选方案,所述燃料泵为脉冲柱塞泵。

[0010] 作为本发明的一种优选方案,所述热交换器包括换热壳体,所述换热壳体的内壁设置有换热片,且换热壳体为中空结构,换热壳体的中空部分形成换热介质通道。

[0011] 作为本发明的一种优选方案,所述换热介质通道为螺旋形。

[0012] 作为本发明的一种优选方案,所述预燃烧室远离点火电极的一端设置有缩口部,所述缩口部的口径由邻近点火电极的一端至远离点火电极的一端依次减小;通过采用上述结构,使得甲醇燃料能够燃烧充分。

[0013] 本发明的有益效果为,所述一种甲醇加热器不会影响车辆续航里程,且其结构简单、紧凑,并具有燃烧充分、环保性好的特点,经测试,其排放污染物的含量仅为燃油加热器

的 $1/3 \sim 1/2$,启动、停止时不会产生烟雾。

附图说明

[0014] 图1为本发明一种甲醇加热器的主视图;

[0015] 图2为本发明一种甲醇加热器的侧视图;

[0016] 图3为本发明一种甲醇加热器的俯视图。

具体实施方式

[0017] 下面结合附图并通过具体实施方式来进一步说明本发明的技术方案,可以理解的是,此处所描述的实施例仅仅用于解释本发明,而非对本发明的限定。

[0018] 请参照图1至图3所示,于本实施例中,一种甲醇加热器,包括机体1,所述机体1的左端开有进风口2,其右端设置有预燃烧室4,所述机体1内邻近进风口2处设置有由电机6驱动的助燃风扇5,所述电机6为变频电机,所述预燃烧室4设置于热交换器内,并与热交换器中的主燃烧室3相连通,所述预燃烧室4的右端设置有缩口部41,所述缩口部41的口径由左端至右端依次减小,所述热交换器上开有排气口13,所述热交换器包括换热壳体7,所述换热壳体7的内壁上设置有换热片8,且换热壳体7为中空结构,换热壳体7的中空部分形成换热介质通道9,所述换热介质通道9为螺旋形,所述换热介质通道9的换热介质出口15与汽车内散热器的加热介质进口相连,且换热介质通道9的换热介质进口与循环泵14的一端相连,所述循环泵14的另一端与汽车内散热器的加热介质出口相连,所述机体1内位于进风口2与预燃烧室4之间设置有用于提供甲醇的燃料泵10,所述燃料泵10为脉冲柱塞泵,且燃料泵10的出液端连接有喷嘴11,所述机体1内邻近喷嘴11处设置有点火电极12。

[0019] 所述换热片8的截面为门字形结构,且其开口的宽度由靠近火焰的一端至排气口13的一端依次递增,即由图1中的右端至左端依次递增,进而可改善气体流动性,提高换热效率。

[0020] 工作时,助燃风扇5由电机6带动吹出高速旋转的助燃风,甲醇燃料由燃料泵10加压后经喷嘴11喷出,喷出的雾化甲醇燃料迅速与助燃空气混合后,被点火电极12高压放电点燃后在预燃烧室4内部分燃烧,并将混合气体加热到一定温度,经过预燃烧室4右端缩口部41缩口后,混合气体再次膨胀,并于主燃烧室3内充分燃烧,其燃烧热量通过换热片8传给换热介质通道9内的换热介质,换热介质在循环泵14的作用下被送至汽车内的散热器,供汽车内取暖、除霜或给发动机预热。

[0021] 一种甲醇加热器不会影响车辆续航里程,且具有环保性好的特点,经测试,其尾气排放污染物的含量仅为燃油加热器的 $1/3 \sim 1/2$,启动、停止时不会产生烟雾。

[0022] 以上实施例只是阐述了本发明的基本原理和特性,本发明不受上述实施例限制,在不脱离本发明精神和范围的前提下,本发明还有各种变化和改变,这些变化和改变都落入要求保护的本发明范围内。本发明要求保护范围由所附的权利要求书界定。

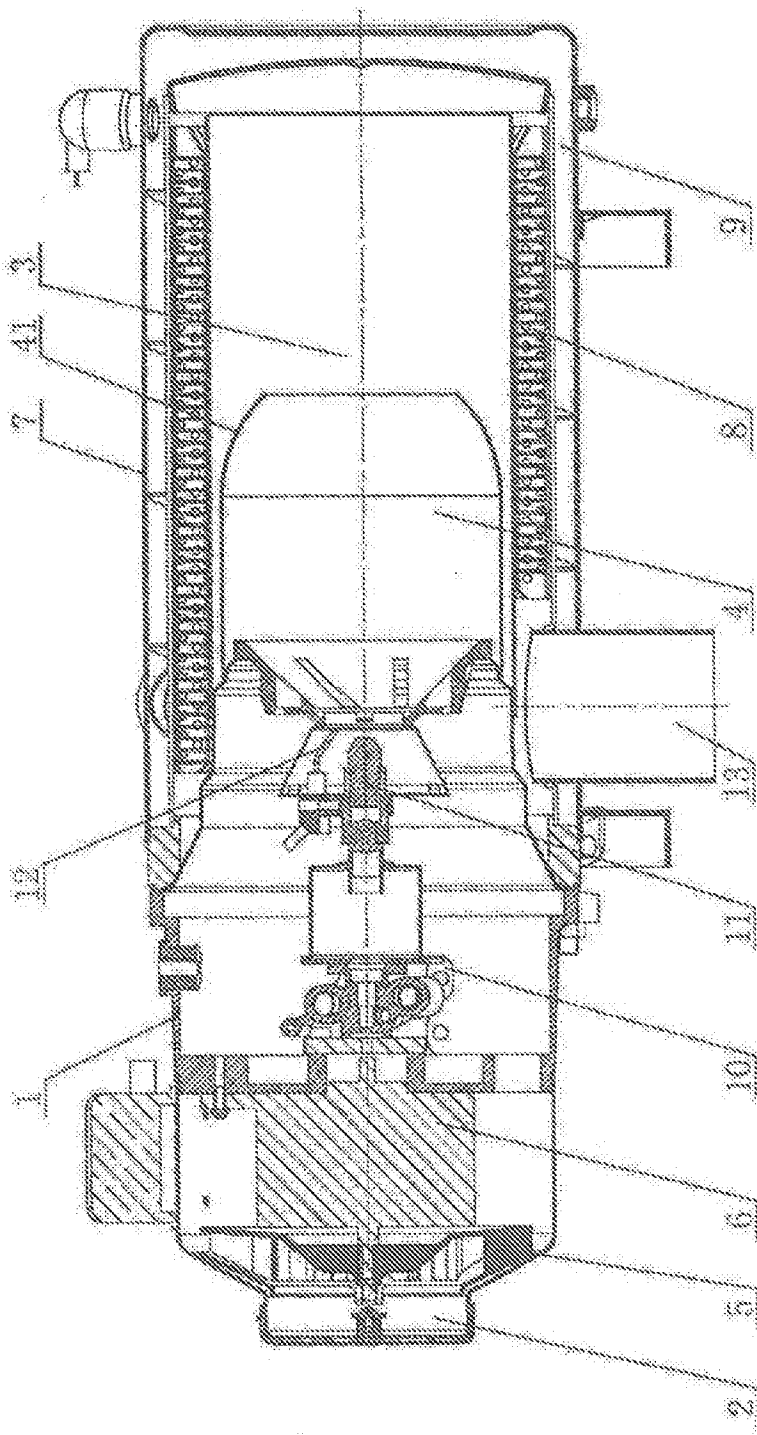


图1

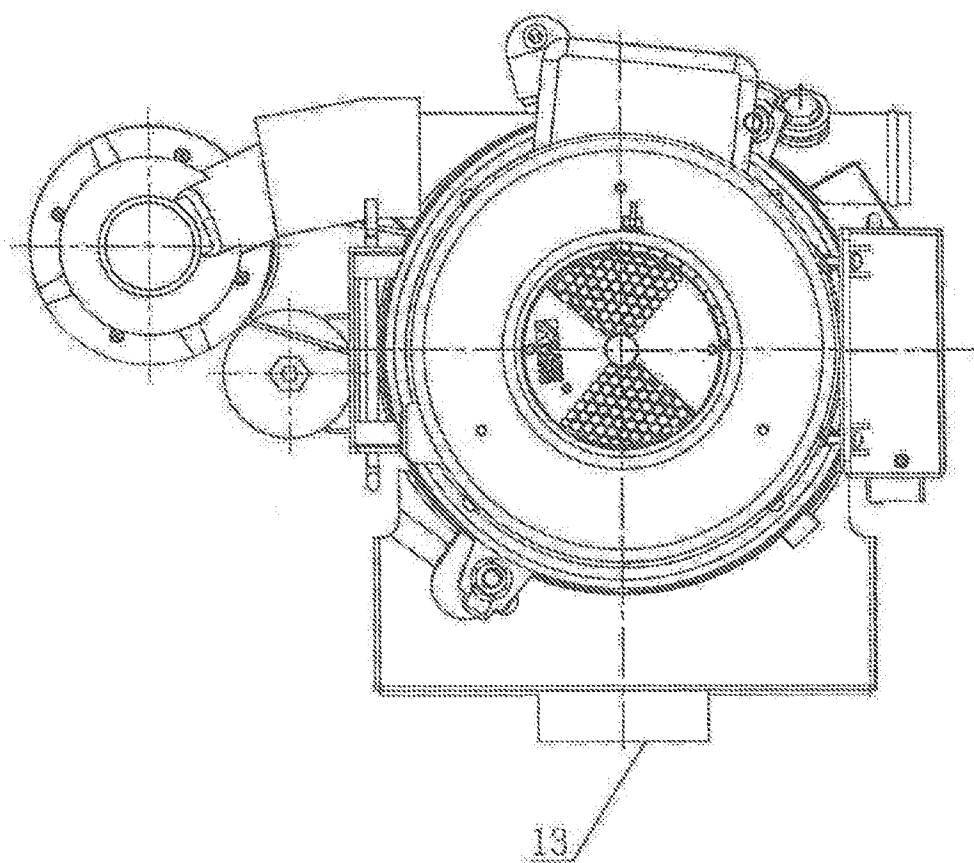


图2

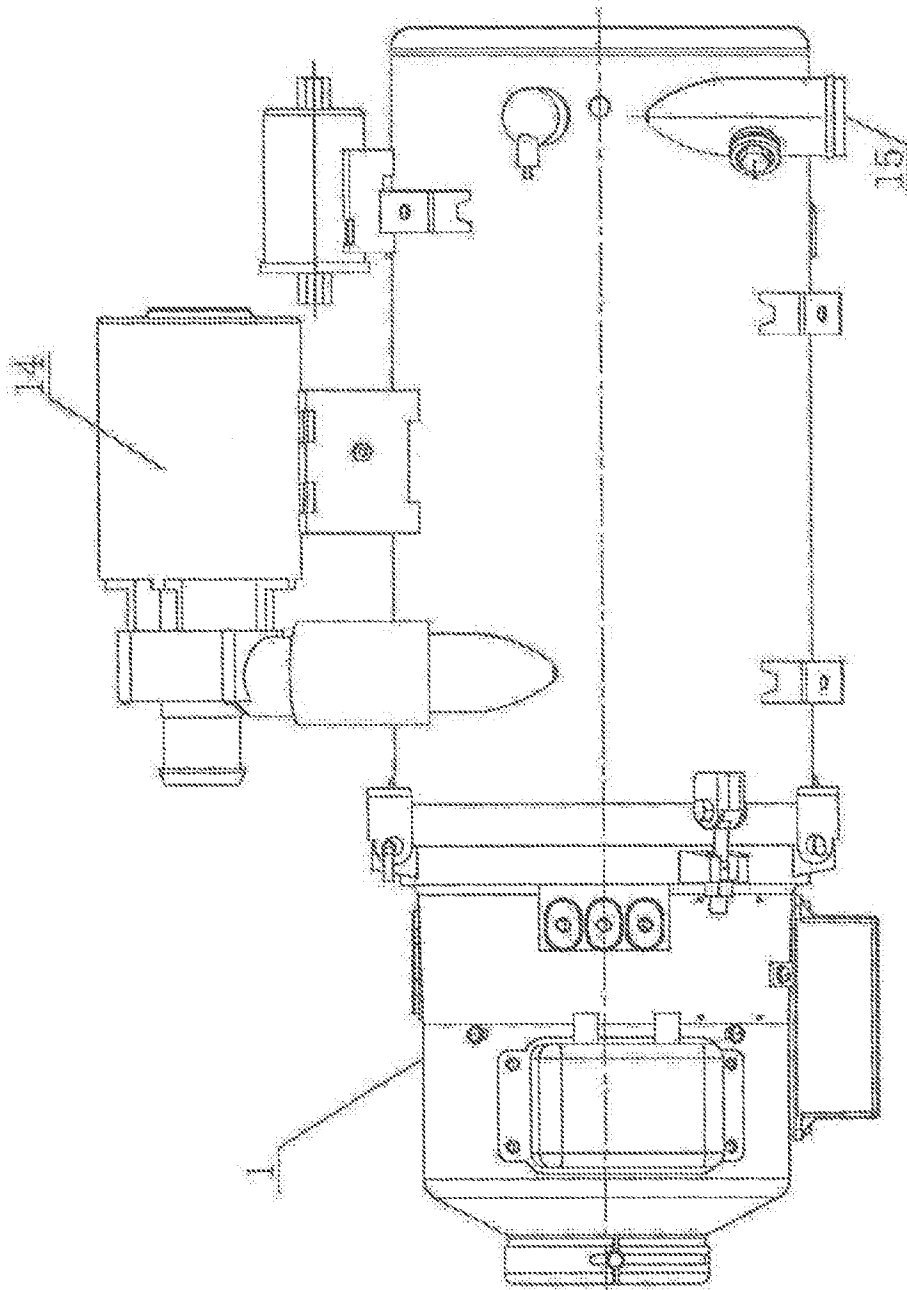


图3

CN108049999A Methanol alcohol heater

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The wording below is an initial machine translation of the original publication. To apply more advanced translation technology, use Patent Translate.

[0001] Technical field

[0002] The invention relates to the field of automobiles, in particular to a methanol heater.

[0003] Background technique

[0004] Automobile is a vehicle that is driven by a vehicle-mounted power supply and driven by a motor-driven wheel to meet the requirements of road traffic and safety regulations. As the impact on the environment is relatively small compared to traditional cars, its prospects are widely optimistic.

[0005] At present, large-sized automobiles, such as electric buses and electric buses, mainly use fuel heaters or electric heaters for heat sources in their compartments. However, fuel heaters have a problem of high pollutant emissions, especially when starting or stopping. The emission of pollutants is relatively large, and the change of smoke can be clearly seen with the naked eye. Particularly inconvenient is that when the temperature changes, different grades of diesel oil need to be replaced; the electric heater solves the problem of high emission of pollutants in the fuel heater. However, it has increased the power load, which will affect the cruising range to a certain extent. In addition, the existing methanol fuel vehicle is a car with methanol as the fuel. At this stage, the methanol fuel vehicle has the problem of cold start in winter. How to give methanol in the winter? Rethinking the engine and improving the adaptability of the methanol fuel vehicle are urgently needed.

[0006] Summary of the invention

[0007] An object of the present invention is to provide a methanol heater that can provide heating, defrosting, or warm-up of the vehicle without affecting the cruising range of the vehicle, and greatly reduces the emission of pollutants.

[0008] The purpose of the present invention is to achieve through the following technical solutions:

[0009] A methanol heater includes a body having an air inlet at one end and a pre-combustion chamber at the other end. The pre-combustion chamber is disposed in a heat exchanger and is connected to a main combustion chamber in a heat exchanger. In communication, an exhaust port is opened in the heat exchanger, a heat exchange medium outlet of the heat exchanger is connected to a heating medium inlet of a radiator in the automobile, and a heat exchange medium inlet and a circulation pump are connected with the heating medium outlet of the radiator in the automobile, and a fuel pump for supplying methanol is arranged in the body between the air inlet and the pre-combustion chamber, and the liquid outlet of the fuel pump is provided in the body. A nozzle is connected and an ignition electrode is provided in the body adjacent to the nozzle.

[0010] As a preferred solution of the present invention, a booster fan driven by a motor is disposed in the body near the air inlet.

[0011] As a preferred solution of the present invention, the motor is a variable frequency motor.

[0012] As a preferred solution of the present invention, the fuel pump is a pulse plunger pump.

[0013] As a preferred solution of the present invention, the heat exchanger includes a heat exchange shell, a heat exchange sheet is arranged on the inner wall of the heat exchange shell, and the heat exchange shell is a hollow structure, and the heat exchange sheet is hollow. Part of the formation of heat exchange media channels.

[0014] As a preferred solution of the present invention, the heat exchange medium passage is spiral.

[0012] As a preferred solution of the present invention, the end of the pre-combustion chamber remote from the ignition electrode is provided with a necking portion, and the mouth diameter of the necking portion is reduced from one end adjacent to the ignition electrode to the end remote from the ignition electrode. The above structure enables sufficient combustion of the methanol fuel.

[0013] The beneficial effect of the present invention is that the methanol heater does not affect the cruising range of the vehicle, and its structure is simple and compact, and has the characteristics of full combustion and good environmental protection. After testing, the content of discharged pollutants is only 1/3 to 1/2 of the fuel heater does not generate smoke when starting or stopping.

[0017] Description of the drawings

[0018] Figure 1 is a front view of a methanol heater according to the present invention;

[0019] Figure 2 is a side view of a methanol heater of the present invention;

[0020] FIG. 3 is a top view of a methanol heater of the present invention.

[0021] detailed description

[0022] The technical solutions of the present invention will be further described below with reference to the accompanying drawings and specific implementation manners. It can be understood that the embodiments described herein are only used to explain the present invention and do not limit the present invention.

[0023] Referring to FIGS. 1 to 3, in the present embodiment, a methanol heater includes a body 1, an air inlet 2 is opened at a left end of the body 1, and a pre-combustion chamber 4 is disposed at a right end of the body 1. A combustion-supporting fan 5 driven by a motor 6 is disposed adjacent to the air inlet 2 in the interior 1. The combustion chamber 4 is provided with a necking portion 4.1. The mouth diameter of the necking portion 4.1 is frequently reduced from the left end to the right end, and an exhaust port 1.3 is opened on the inner wall of the heat exchanger. The heat exchanger comprises a heat exchanger shell 7, a heat exchanger sheet 8 is arranged on the inner wall of the heat exchanger shell 7, and the heat exchanger sheet 7 is a hollow structure, and the hollow part of the heat exchanger shell 7 forms a heat exchange medium channel 9. The heat exchange medium channel 9 is in a spiral shape. The heat exchange medium outlet 1.5 of the heat exchange medium channel 9 is connected to the heating medium inlet of the radiator in the automobile, and the heat exchange medium inlet and the circulating pump of the medium channel 9 of the changer are connected. One end of the 1.4 is connected, and the other end of the circulation pump 1.6 is connected to the heating medium outlet of the radiator in the automobile. A fuel pump 1.10 for supplying methanol is disposed between the air inlet 2 and the pre-combustion chamber 4 in the body 1 and the fuel pump 1.10 is a pulse plunger pump, and the nozzle 1.1 is connected to the liquid outlet of the fuel pump 1.10. The ignition electrode 1.2 is provided in the body 1 adjacent to the nozzle 1.1.

[0024] The cross-section of the heat exchanger sheet 8 is a gas-shaped structure, and the width of the opening thereof is gradually increased from the end near the flame to the end of the exhaust port 1.3, that is, from the right end to the left end in FIG. 1, thereby improving the gas flow. Sex, improve heat transfer efficiency.

[0025] During operation, the combustion-supporting fan 5 is driven by the motor 6 to blow out high-speed rotating combustion air. The methanol fuel is pressurized by the fuel pump 1.10 and then is ejected through the nozzle 1.1. The sprayed atomized methanol fuel quickly mixes with the combustion air, and the ignited electrode 1.2 is mixed. After the ignition of the high pressure discharge, partial combustion occurs in the pre-combustion chamber 4 and the mixed gas is heated to a certain temperature. After passing through the necking portion 4.1 at the right end of the pre-combustion chamber 4, the mixed gas expands again and is fully burned in the main combustion chamber 3. The combustion heat is transferred to the heat exchange medium in the heat exchange medium passage 9 through the heat exchange sheet 8, and the heat exchange medium is sent to the radiator in the automobile under the action of the circulation pump 1.4 to provide heating, defrosting, or heating in the automobile. Engine warm up.

[0026] A methanol heater does not affect the cruising range of the vehicle, and it is environmentally friendly. After testing, the amount of pollutants emitted by the exhaust gas is only 1/3 to 1/2 of the fuel heater, and it will not start or stop. Produce smoke.

[0027] The above embodiments merely illustrate the basic principle and characteristics of the present invention, and the present invention is not limited by the above embodiments. Without departing from the spirit and scope of the present invention, the present invention has various changes and changes, and these changes and changes are it falls within the scope of the claimed invention. The scope of the invention is defined by the appended claims.

Electronic Acknowledgement Receipt

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Application Number:	16597014
International Application Number:	
Confirmation Number:	4687
Title of Invention:	MODULAR SWITCHGEAR SYSTEM AND POWER DISTRIBUTION FOR ELECTRIC OILFIELD EQUIPMENT
First Named Inventor/Applicant Name:	Jared Oehring
Customer Number:	132858
Filer:	Taylor P. Evans/Tina Fluharty
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
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Espacenet

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Portable direct current emergency power source car

Inventor(s): HAN WEI; ZHU XIANGLIAN; QIAN XIAOSEN; XU RONGJUN; ZHU XIAOYONG ± (韩伟, ; 朱祥连, ; 钱小森, ; 许荣军, ; 朱晓勇)

Applicant(s): ZHENJIANG DAQO SECHERON TRACTION POWER CO LTD ± (镇江大全赛雪龙牵引电气有限公司)

Classification: - **international:** *B62D63/06; H02J9/00*
- **cooperative:**

Application number: CN201620888198U 20160816

Priority number (s): CN201620888198U 20160816

Abstract of CN205986303 (U)

The utility model relates to a portable direct current emergency power source car, including highly integrated's medium voltage switchgear or constitutions such as low -voltage switchgear, rectifier transformer, rectifier, direct current switch cabinet, control panel, cable transfer case, cable wire reel and portable flat -bed trailer, all equipment highly integrated all install on the flat -bed trailer that has the automatic rising location, and the flat -bed trailer is furnished with a trailing link that pulls of buying car in installments, has characteristics such as traction movement input fast, also can shift up down independent installation from the flat -bed trailer according to the user demand, the distribution part adopts prepackage type box -type substation scheme, and compact structure is non -maintaining, long service life.



(12)实用新型专利

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(73)专利权人 镇江人全赛雪龙牵引电气有限公司

地址 212211 江苏省镇江市扬中市新坝镇
新中南路66号

(72)发明人 韩伟 朱祥连 钱小森 许荣军
朱晓勇

(74)专利代理机构 南京经纬专利商标代理有限公司 32200

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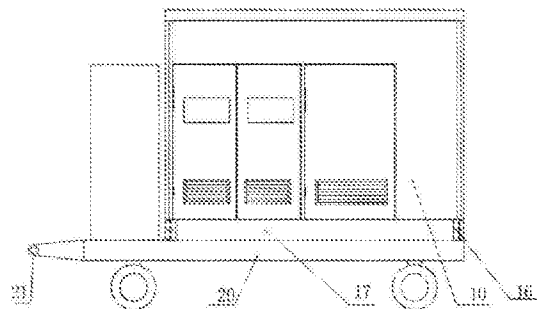
权利要求书1页 说明书2页 附图1页

(54)实用新型名称

一种移动式直流应急电源车

(57)摘要

本实用新型涉及一种移动式直流应急电源车,包括高度集成化的中压开关柜或/和低压开关柜、整流变压器、整流器、直流开关柜、控制屏、电缆转接箱、电缆绕线盘以及移动式平板挂车等组成,所有设备高度集成化,全部安装到具有自动升降定位的平板挂车上;且平板挂车配有供车辆牵引的牵引挂环,具有可快速牵引移动投放等特点,也可根据使用需求从平板挂车上移下,独立安装;配电部分采用预装式箱式变电站方案,结构紧凑,免维护,使用寿命长。



1.一种移动式直流应急电源车,其特征在于,所述移动式直流应急电源车包括移动式平板挂车,所述移动式平板挂车安装有预装式箱式变电站,所述预装式箱式变电站上设有固定支件将所述预装式箱式变电站固定在移动式平板挂车上;所述预装式箱式变电站内设有相互连通的中压开关柜或/和低压开关柜、整流变压器、整流器和直流开关柜;所述预装式箱式变电站底部设有电缆走线通道;所述移动式平板挂车设有供车辆牵引的牵引挂环。

2.根据权利要求1所述的一种移动式直流应急电源车,其特征在于,所述预装式箱式变电站内还设有控制屏;所述移动式直流应急电源车上还设有电缆转接箱和电缆绕线盘。

3.根据权利要求1所述的一种移动式直流应急电源车,其特征在于,所述预装式箱式变电站上设有固定支件并通过活动连接方式将所述预装式箱式变电站固定在移动式平板挂车上。

4.根据权利要求3所述的一种移动式直流应急电源车,其特征在于,所述预装式箱式变电站上设有固定支件并通过螺栓固定方式将所述预装式箱式变电站固定在移动式平板挂车上。

5.根据权利要求1所述的一种移动式直流应急电源车,其特征在于,所述移动式平板挂车为自动升降定位的移动式平板挂车。

6.根据权利要求5所述的一种移动式直流应急电源车,其特征在于,所述自动升降定位的移动式平板挂车通过液压支腿升降装置实现自动升降。

一种移动式直流应急电源车

技术领域

[0001] 本实用新型涉及城市轨道交通系统中的供电设备,具体涉及一种移动式直流应急电源车。

背景技术

[0002] 在城市轨道交通项目建设初期临时车辆用电、变电站故障退出运行而临时供电、灾害应急供电、变电所供电设备大修无法及时恢复供电等情况下,没有临时电源供使用使其恢复正常工作,因此需要提供移动式直流应急电源。

实用新型内容

[0003] 本实用新型的目的在于为了克服现有技术中的不足而提供一种移动式直流应急电源车,满足城市轨道交通项目建设初期临时车辆用电、变电站故障退出运行而临时供电、灾害应急供电、变电所供电设备大修无法及时恢复供电等供电需求而专门设计。

[0004] 为实现上述技术目的采用的技术方案为:

[0005] 一种移动式直流应急电源车,包括移动式平板挂车,所述移动式平板挂车安装有预装式箱式变电站,所述预装式箱式变电站上设有固定件将所述预装式箱式变电站固定在移动式平板挂车上;所述预装式箱式变电站内设有相互连通的中压开关柜或/和低压开关柜、整流变压器、整流器和直流开关柜;所述预装式箱式变电站底部设有电缆走线通道;所述移动式平板挂车设有供车辆牵引的牵引挂环。

[0006] 本实用新型提出的一种移动式直流应急电源车的进一步优选方案为:

[0007] 其中,所述预装式箱式变电站内还设有控制屏;所述移动式直流应急电源车上还设有电缆转接箱和电缆绕线盘。

[0008] 其中,预装式箱式变电站通过活动连接方式将预装式箱式变电站固定在移动式平板挂车上;优选为螺栓固定方式预装式箱式变电站固定在移动式平板挂车上。

[0009] 其中,移动式平板挂车为可自动升降定位的移动式平板挂车;其中可自动升降定位的移动式平板挂车通过液压支腿升降装置实现自动升降。

[0010] 本实用新型提出的一种移动式直流应急电源车,与现有技术相比,有益效果为:本实用新型的移动式直流应急电源车由高度集成化的中压开关柜或/和低压开关柜、整流变压器、整流器、直流开关柜、控制屏、电缆转接箱、电缆绕线盘以及移动式平板挂车等组成,所有设备高度集成化,全部安装到具有自动升降定位的平板挂车上;且平板挂车配有供车辆牵引的牵引挂环,具有可快速牵引移动投放等特点,也可根据使用需求从平板挂车上移下,独立安装;配电部分采用预装式箱式变电站方案,结构紧凑,免维护,使用寿命长。

附图说明

[0011] 图1:移动式直流应急电源车的结构示意图。

[0012] 图2:移动式直流应急电源车的俯视图。

[0013] 说明书附图中的附图标记说明如下：

[0014] 10预装式箱式变电站,11中压开关柜或/和低压开关柜,12整流变压器,13整流器,14直流开关柜,15控制屏,16固定安装支件,17电缆走线通道,20平板挂车,21牵引挂环,31电缆转接箱,32电缆绕线盘。

具体实施方式

[0015] 下面结合具体实施方式和附图对本实用新型作进一步说明。

[0016] 图1-2所示为本实用新型提出的一种移动式直流应急电源车的一个实施例的结构示意图。图中显示,所述移动式直流应急电源车包括移动式平板挂车20,移动式平板挂车上安装有预装式箱式变电站10,预装式箱式变电站上设有固定支件16将预装式箱式变电站固定在移动式平板挂车上;其中,预装式箱式变电站通过螺栓固定的方式固定在移动式平板挂车上,使得预装式箱式变电站可根据需要从移动式平板挂车上移下,独立安装。预装式箱式变电站内设有相互连通的中压开关柜或/和低压开关柜11、整流变压器12、整流器13和直流开关柜14;预装式箱式变电站底部设有电缆走线通道17,使得预装式箱式变电站内部的电缆可很容易从电缆走线通道连接至外部配套的设备上,方便电缆接线。移动式平板挂车设有供车辆牵引的牵引挂环21。其中,预装式箱式变电站内还设有控制屏15;其中,移动式直流应急电源车上还设有电缆转接箱31和电缆绕线盘32,用于快速收放电缆。

[0017] 本申请中所述的“和/或”的含义指的是各自单独存在或两者同时存在的情况均包括在内。

[0018] 本申请中所述的“连接”的含义可以是部件之间的直接连接也可以是部件间通过其它部件的间接连接。

[0019] 本实用新型的具体实施方式中凡未涉及到的说明属于本领域的公知技术,可参考公知技术加以实施。

[0020] 上述具体实施方式是对本实用新型提出的一种移动式直流应急电源车技术思想的具体支持,不能以此限定本实用新型的保护范围,凡是按照本实用新型提出的技术思想,在本技术方案的基础上所做的任何等同变化或等效改动,均属于本实用新型技术方案保护范围。

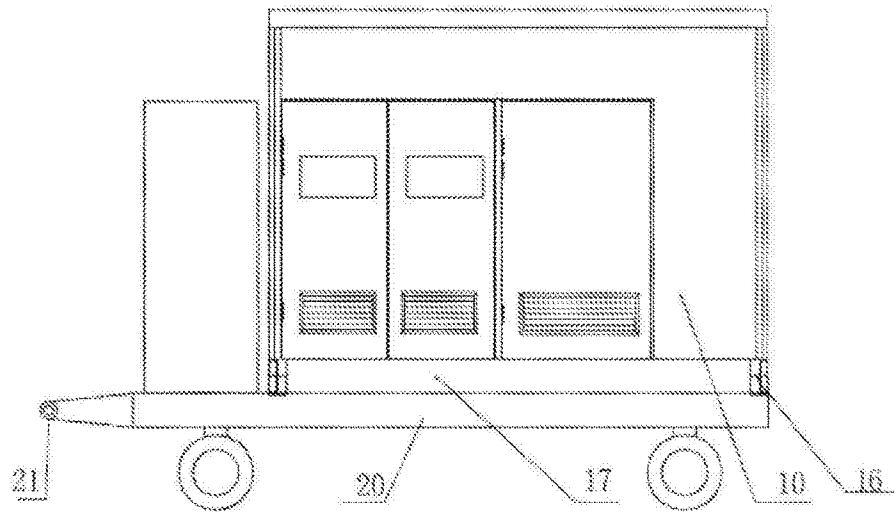


图1

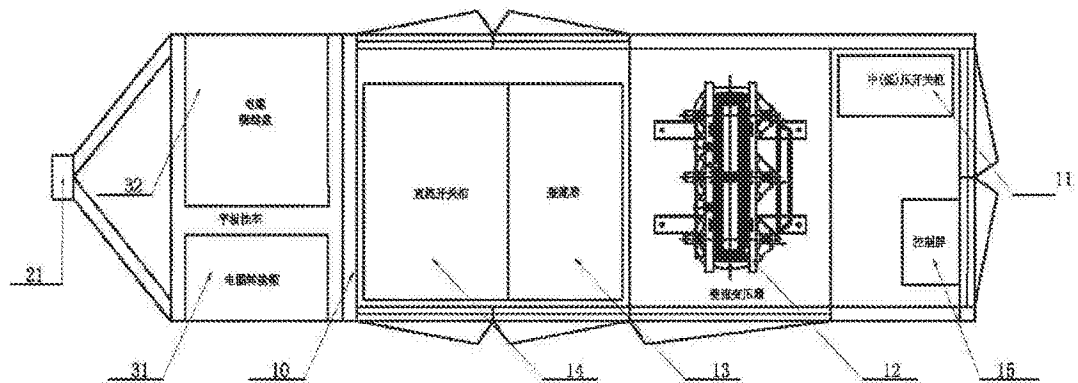


图2

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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

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

AMENDMENT

Dear Sir/Madam:

In response to the Non-Final Office Action mailed January 10, 2020, Applicant hereby requests reconsideration of the above-referenced Application for patent, and reconsideration of the rejections in view of the amendments and the following arguments. Applicant hereby authorizes the Commissioner to charge any fees necessary for continued prosecution of this Application to **Hogan Lovells US LLP's Deposit Account Number 501349**.

AMENDMENTS TO THE CLAIMS

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

Listing of claims:

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

a support structure having a first area, a second area, a third area, and a fourth area arranged adjacent one another;

an electric powered, multi-plunger pump with up to 15 plungers, arranged in the first area, the electric powered pump coupled to a well associated with the subterranean formation and powered by at least one electric motor, also arranged in the first area, the electric powered pump configured to pump fluid into a wellbore associated with the well ~~at a high pressure so that the fluid passes from the wellbore into the subterranean formation and fractures the subterranean formation;~~

a variable frequency drive (VFD), arranged in the second area proximate the first area, connected to the at least one electric motor to control [[the]] a speed of the at least one electric motor;

a transformer, arranged in the third area proximate the second area, the transformer positioned within an enclosure, the transformer distributing power to the electric pump, the power being received from at least one generator at a voltage higher than an operating voltage of the electric pump; and

a cooling system, arranged in the fourth area proximate the third area, the cooling system providing a cooling fluid to the VFD via one or more headers.

2. (Original) The system of claim 1, further comprising:

a control system arranged in the fourth area, the control system including one or more operating parameters of the electric pump, VFD, transformer, or cooling system.

3. (Original) The system of claim 1, further comprising:
a switchgear subassembly, the switchgear subassembly having integrated core units configured to operate in a connected position, an open position, or a grounded position.

4. (Previously Presented) The system of claim 3, wherein the switchgear subassembly comprises:

a busbar shielded, at least partially, by solid insulation;
an isolating ground switch, enclosed within a tank arranged proximate the busbar; and
cable connections for coupling to the switchgear.

5. (Original) The system of claim 1, wherein the fourth section is arranged at a higher elevation than the first section, the fourth section associated with a gooseneck portion of a trailer.

6. (Original) The system of claim 1, wherein the support structure is at least one of a trailer, a skid, a pad, a truck bed, or a combination thereof.

7. (Previously Presented) The system of claim 1, further comprising:
cable trays positioned below a walking surface of the fourth section, the cable trays being covered by a hinged cover that pivots to provide access to the cable trays.

8. (Original) The system of claim 1, wherein the cooling system comprises a radiator that utilizes a water/glycol mixture.

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

at least one generator;
at least one switchgear receiving electrical power from the generator;
an electric powered pump, arranged on a support structure, the electric powered pump coupled to a well associated with the subterranean formation and powered by at least one electric motor, the electric powered pump configured to pump fluid into a wellbore associated with the

~~well at a high pressure so that the fluid passes from the wellbore into the subterranean formation and fractures the subterranean formation;~~

a variable frequency drive (VFD), arranged on the support structure proximate the electric powered pump, connected to the at least one electric motor to control ~~[[the]]~~ a speed of the at least one electric motor;

a transformer, arranged on the support structure proximate the VFD, the transformer distributing power to the electric powered pump, the power being received from the least one generator at a voltage higher than an operating voltage of the electric powered pump; and

a cooling system, arranged on the support structure proximate the transformer, the cooling system providing a cooling fluid to the VFD.

10. (Original) The system of claim 9, wherein the at least one switchgear comprises integrated core units configured to operate in a connected position, an open position, or a grounded position.

11. (Previously Presented) The system of claim 10, wherein the switchgear subassembly comprises:

a busbar shielded, at least partially, by solid insulation;

an isolating ground switch, enclosed within a tank arranged proximate the busbar; and
cable connections for coupling to the switchgear.

12. (Original) The system of claim 9, further comprising:

a transformer service platform that provides access to the transformer, the transformer service platform positioned at a higher elevation than at least a portion of a base of the electric powered pump.

13. (Original) The system of claim 9, wherein the support structure is at least one of a trailer, a skid, a pad, a truck bed, or a combination thereof.

14. (Previously Presented) The system of claim 9, further comprising:

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

15. (Cancelled)

16. (Original) The system of claim 9, further comprising:
a human machine interface, positioned proximate the VFD; and
a platform cover at least partially covering the humane machine interface and VFD.

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

[[a]] ~~an plurality of~~ electric powered pump pumps coupled to a well associated with the subterranean formation and powered by at least one electric motor, the electric powered pump configured to pump fluid into a wellbore associated with the well at a high pressure so that the fluid passes from the wellbore into the subterranean formation and fractures the subterranean formation;

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

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

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

18. (Previously Presented) The system of claim 17, wherein the common load sharing bus is configured to synchronize three-phase power of a similar voltage and frequency from different sources, the switchgear evenly distributing an electrical load between the plurality of electric pumps and the at least one generator.

19. (Currently Amended) The system of claim 17, wherein the common load sharing bus is configured to isolate the electric powered pump ~~one or more of the plurality of electric powered pumps~~, the at least one generator, and the switchgear.

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

21. (New) The system of claim 17, wherein the electric powered pump, the VFD, the switchgear, and the transformer are mounted on a common support structure and a single cable couples the switchgear to the transformer.

REMARKS

This amendment is in response to the Non-Final Office Action mailed July 23, 2020. Claims 1-20 were pending with claims 1, 9, and 17 being independent. Claims 1-20 stand rejected. Specifically, claims 1, 2, 5, 6, 9, 12, 13, and 16 are rejected under 35 U.S.C. § 103 as allegedly unpatentable over Morris et al. (U.S. Patent Publication No. 2019/0203572; hereinafter “Morris”) and Broussard et al. (U.S. Patent Publication No. 2016/0032703; hereinafter “Broussard”). Claims 3, 4, 10 and 11 stand rejected under 35 U.S.C. § 103 as allegedly unpatentable over Morris and Mori et al. (U.S. Patent No. 7,835,140; hereinafter “Mori”). Claims 8 and 15 stand rejected under 35 U.S.C. § 103 as allegedly unpatentable over Morris and Symchuk (U.S. Patent No. 9,932,799; hereinafter “Symchuk”). Claims 7 and 14 stand rejected under 35 U.S.C. § 103 as allegedly unpatentable over Morris and Oehring et al. (U.S. Patent Publication No. 2016/0105022; hereinafter “Oehring”). Claims 17, 18, and 20 stand rejected under 35 U.S.C. § 103 as allegedly unpatentable over Morris, Broussard, and Benussi et al. (U.S. Patent Publication No. 2020/0194976; hereinafter “Benussi”). Claim 19 stands rejected under 35 U.S.C. § 103 as allegedly unpatentable over Morris, Broussard, Benussi, and Mori. Applicant respectfully disagrees and traverses these rejections.

By the present response, claims 1, 9, 17, 19, and 20 are amended, without prejudice, claim 15 is cancelled, and claim 21 is new. No new matter is added and support may be found in the specification, for example in at least paragraphs 88 and 104 and FIGS. 13 and 15. Upon entry of the amendments, Claims 1-14 and 16-21 will remain pending. Applicant respectfully requests reconsideration and allowance of the pending claims.

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

The Office Action rejects claims 1, 2, 5, 6, 9, 12, 13, and 16 under 35 U.S.C. § 103 as allegedly unpatentable over Morris and Broussard. Applicant respectfully disagrees and traverses this rejection.

As an initial matter, for claimed subject matter to be obvious, either the prior art references must expressly teach each claim limitation or else the record must disclose a reason for a person of ordinary skill in the art to modify the prior art teachings to obtain the claimed invention. *Beckson Marine, Inc. v. NFM, Inc.*, 292 F.3d 718, 727 (Fed. Cir. 2002). The rejection must make “a searching comparison of the claimed invention—including all its limitations—

with the teaching of the prior art.” *In re Wada and Murphy*, Appeal 2007-3733, citing *In re Ochiai*, 71 F.3d 1565, 1572 (Fed. Cir. 1995) and *CMFT v. Yieldup Intern. Corp.*, 349 F.3d 1333, 1342 (Fed. Cir. 2003) (emphasis added). Indeed, the references used to make the rejection must, at the very least, suggest all of the claim elements. Further, the Office must provide evidence which, as a whole, shows that the legal determination sought to be proved (i.e., the reference teachings establish a prima facie case of obviousness) is more probable than not. M.P.E.P. § 2142. Accordingly, “the key to supporting any rejection under ... 103 is the clear articulation of the reason(s) why the claimed invention would have been obvious.” *Id.* See also *KSR Int’l Co. v. Teleflex, Inc.*, 550 U.S. 398, 82 U.S.P.Q.2d 1385, 1395-97 (2007).

Additionally, Section 2142 of the M.P.E.P. states that, in an obviousness analysis, “impermissible hindsight must be avoided and the legal conclusion must be reached on the basis of the facts *gleaned from the prior art*” (emphasis added). See also M.P.E.P. § 2145(X)(A) (stating “[a]ny judgment on obviousness is in a sense necessarily a reconstruction based on hindsight reasoning, but so long as it takes into account only knowledge which was within the level of ordinary skill in the art at the time the claimed invention was made and *does not include knowledge gleaned only from applicant’s disclosure*, such a reconstruction is proper” (quoting *In re McLaughlin*, 443 F.2d 1392, 1395 (C.C.P.A. 1971)) (emphasis added)). The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills*, 916 F.2d 680, 683 (Fed. Cir 1990); M.P.E.P. § 2143.01. Moreover, the Federal Circuit has instructed that “[o]ne cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention.” *In re Fine*, 837 F.2d 1071, 1075 (Fed. Cir. 1988). Finally, it is improper to combine references where the references teach away from their combination. *In re Grasselli*, 713 F.2d 731, 743 (Fed. Cir. 1983).

Furthermore, obviousness rejections are improper when a proposed modification would render the prior art inoperable or where the prior art has failed to recognize an unsolved problem or solution. See *In re Fritch*, 972 F. 2d 1260, 1265 (Fed. Cir. 1992) and *Cardiac Pacemakers, Inc. v. St. Jude Medical, Inc.*, 381 F.3d 1371 (Fed. Cir. 2004). Additionally, proposed combinations require a reasonable expectation of success. See *In re Dow Chem. Co.*, 837 F.2d 469 (Fed. Cir. 1988).

A. Independent Claim 1

Applicant's independent claim 1 recites:

A hydraulic fracturing system for fracturing a subterranean formation, comprising:

a support structure having a first area, a second area, a third area, and a fourth area arranged adjacent one another;

an electric powered, multi-plunger pump with up to 15 plungers, arranged in the first area, the electric powered pump coupled to a well associated with the subterranean formation and powered by at least one electric motor, also arranged in the first area, the electric powered pump configured to pump fluid into a wellbore associated with the well;

a variable frequency drive (VFD), arranged in the second area proximate the first area, connected to the at least one electric motor to control a speed of the at least one electric motor;

a transformer, arranged in the third area proximate the second area, the transformer positioned within an enclosure, the transformer distributing power to the electric pump, the power being received from at least one generator at a voltage higher than an operating voltage of the electric pump; and

a cooling system, arranged in the fourth area proximate the third area, the cooling system providing a cooling fluid to the VFD via one or more headers.

Applicant respectfully asserts that the Office Action has failed to recognize an unsolved problem or solution and furthermore that the proposed combination would change the principle of operation of Morris. For at least this reason, among others, Applicant respectfully requests withdrawal of the rejection of claim 1.

1. *The proposed combination fails to recognize an unsolved problem or solution.*

The proposed combination of Morris and Broussard fails to recognize or solve the problem identified in claim 1 with respect to arrangement components at a well site. As recognized by Applicant, "space at the well site is at a premium, having numerous skids, trailers, and the like may present logistical challenges." Specification, ¶ [0007]. Accordingly, Applicant has provided a system that arranged components together on a common structure in order to reduce clutter at the well site. Indeed, the benefits of Applicant's system are also noted in the specification, "[a]ccordingly, the system makes it possible to meet electric powered hydraulic fracturing need while also providing flexibility and simplicity in the design of functional units, a small footprint for space savings, environmentally robust components, along

with easy extensions and upgrades.” *Id.* at [0097]. The combination proposed in the Office Action, however, fails to recognize and identify the problem and solution.

The Office Action’s proposed combination fails to address a combined system that includes each of a pump, motor, VFD, cooling system, and transformer on a common support structure. Indeed, Morris explicitly teaches segregation of various features claimed on a common structure. By way of example, FIG. 2 illustrates separation and removal VFDs from the pumping units 108. *See* Morris at FIG. 2. Contrary to the assertion in the Office Action, paragraphs 77 and 79 do not teach VFDs on the common support structure. For example, cited paragraph 77 is silent as to the location of the VFD, but rather indicates that fewer motors may lead to fewer VFDs. *See* Morris, ¶ [0077]. Similarly, paragraph 79 is also silent regarding the location of the VFD. *See id.* at ¶ [0079]. It is more than a trivial substitution to modify Morris to include VFDs onto the pumping units 108, as contended in the Office Action. Without recognizing the problems or the source of the problems, the proposed combination does not disclose, teach, or suggest the solution provided by the instant application. The Supreme Court in *Eible Process* and its progeny long have held that recognizing the source of the problem is inventive. Accordingly, Applicant respectfully requests withdrawal of the rejection of claim 1.

2. *The proposed combination would change the principle of operation of Morris.*

As noted above, Morris is directed toward a grouping of components at a well site such that the electrical components are arranged close to one another and the pumping components are also positioned close to one another. *See* Morris at FIGS. 1 and 2. For example, Morris describes an advantageous position of the power transports 104 (including the VFDs) relative to other power equipment. *See, e.g., id.* at ¶ [0052]. The proposed combination, however, would modify Morris such that it would wholly change the configuration at the well site in a manner neither planned nor identified in Morris. By way of example, the proposed modification would allegedly remove at least 3 trailers 104 (FIG. 2) and somehow combine these components with the 6 trailers 108 (FIG. 2). This is more than merely a matter of design choice and it is not as simple as merely combining components into one. Morris acknowledges this limitation, noting that height, length, and weight restrictions are present for various components. *See id.* at ¶ [0062]. Accordingly, Applicant respectfully asserts that the Examiner’s proposed combination is more than a design choice and would change the principal of operation

of Morris at least because the modification would modify the design feature directed toward maintaining size requirements for trailers to enable transportation along roadways. For at least this reason, among others, Applicant respectfully requests withdrawal of the rejection of claim 1.

B. Independent Claim 9

Applicant's independent claim 9 recites:

A hydraulic fracturing system for fracturing a subterranean formation, comprising:

- at least one generator;
- at least one switchgear receiving electrical power from the generator;
- an electric powered pump, arranged on a support structure, the electric powered pump coupled to a well associated with the subterranean formation and powered by at least one electric motor, the electric powered pump configured to pump fluid into a wellbore associated with the well;
- a variable frequency drive (VFD), arranged on the support structure proximate the electric powered pump, connected to the at least one electric motor to control a speed of the at least one electric motor;
- a transformer, arranged on the support structure proximate the VFD, the transformer distributing power to the electric powered pump, the power being received from the least one generator at a voltage higher than an operating voltage of the electric powered pump; and
- a cooling system, arranged on the support structure proximate the transformer, the cooling system providing a cooling fluid to the VFD.

Independent claim 9 recites certain features that are similar to claim 1, and for at least the reasons described above with respect to claim 1, Applicant respectfully requests withdrawal of the rejection of claim 9.

C. Dependent Claims 2, 5, 6, 12, 13, and 16

Claims 2, 5, 6, 12, 13, and 16 depend from at least one of independent claims 1 and 9. Accordingly, Applicant respectfully asserts these claims are allowable at least due to their dependence from an allowable base claim. Accordingly, Applicant respectfully requests withdrawal of the rejection of claims 2, 5, 6, 12, 13, and 16.

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

The Office Action rejects claims 3, 4, 10, and 11 as allegedly unpatentable over Morris and Mori. Applicant respectfully disagrees and traverses this rejection.

Claims 3, 4, 10, and 11 depend from at least one of independent claims 1 and 9. Accordingly, Applicant respectfully asserts the claims are allowable at least due to their dependence from an allowable base claim. Accordingly, Applicant respectfully requests withdrawal of the rejection of claims 3, 4, 10, and 11.

III. Claims 8 and 15 are Patentable over Morris and Symchuk

The Office Action rejects claims 8 and 15 as allegedly unpatentable over Morris and Symchuk. Applicant respectfully disagrees and traverses this rejection.

Claims 8 and 15 depend from at least one of independent claims 1 and 9. Accordingly, Applicant respectfully asserts the claims are allowable at least due to their dependence from an allowable base claim. Accordingly, Applicant respectfully requests withdrawal of the rejection of claims 8 and 15.

IV. Claims 7 and 14 are Patentable over Morris and Oehring

The Office Action rejects claims 7 and 14 as allegedly unpatentable over Morris and Oehring. Applicant respectfully disagrees and traverses this rejection.

Claims 7 and 14 depend from at least one of independent claims 1 and 9. Accordingly, Applicant respectfully asserts the claims are allowable at least due to their dependence from an allowable base claim. Accordingly, Applicant respectfully requests withdrawal of the rejection of claims 7 and 14.

V. Claims 17, 18, and 20 are Patentable over Morris, Broussard, and Benussi

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

A. Independent Claim 17

Applicant's independent claim 17 recites:

A hydraulic fracturing system for fracturing a subterranean formation, comprising:

an electric powered pump coupled to a well associated with the subterranean formation and powered by at least one electric motor, the electric powered pump configured to pump fluid into a wellbore associated with the well at a high pressure so that the fluid passes from the wellbore into the subterranean formation and fractures the subterranean formation;

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

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

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

Applicant respectfully asserts that the Office Action at least fails to identify each feature of claim 17 in the prior art. For example, the cited reference at least fails to teach or suggest “a switchgear, receiving power from at least one generator, configured to distribute power to a plurality of pieces of wellsite equipment, the switchgear having a common load sharing bus and front aligned, shielded cable connections, the switchgear being positioned within an enclosure.” Accordingly, Applicant respectfully requests withdrawal of the rejection.

The Office Action is silent with respect to the “front aligned” cable connections as recited in amended claim 17. Furthermore, cited reference Benussi, which allegedly discloses the common load sharing bus, merely illustrates schematic layouts and does not describe the alignment or configuration of any connections. *See Benussi, FIGS. 1-3.* For at least this reason, among others, Applicant respectfully requests withdrawal of the rejection of claim 17.

B. Dependent Claims 18 and 20

Claims 18 and 20 depend from independent claim 17. Accordingly, Applicant respectfully asserts these claims are allowable at least due to their dependence from an allowable base claim. Accordingly, Applicant respectfully requests withdrawal of the rejection of claims 18 and 20.

Furthermore, Applicant respectfully asserts the cited references, taken alone or in hypothetical combination, fail to teach or suggest a single cable connection. The Office Action acknowledges that Morris “does not teach a particular number of cables.” Office Action, 10. However, the number of cables is not “a design choice” but in this instance, is a significant improvement over cluttered well sites that often have multiple cables running between various components at the well site. For example, Applicant’s disclosure notes that “[i]n various embodiments, a single high voltage cable, for example a 13.8 kV cable, is run from the switchgear to the pumping unit because the transformer is mounted on the same platform as the

VFD, MCC, and frac pump.” Specification at ¶ [0017]. Additionally, a “single cable” is further described in at least paragraph 46 with reference to the advantages that the disclosed arrangement provides to enable the single cable attachment. Accordingly, Applicant respectfully disagrees that such an arrangement is merely a design choice at least because the configuration disclosed by Applicant is what enables the configuration at all. For at least this reason, among others, Applicant respectfully requests withdrawal of the rejection of claim 20.

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

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

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

VII. Conclusion

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

Respectfully submitted,

Date: October 22, 2020

/Joe Grdinovac/
Joe Grdinovac
Registration No. 72,224
HOGAN LOVELLS US LLP
609 Main Street, Suite 4200
Houston, Texas 77002
Telephone: (713) 632-1413
Facsimile: (713) 632-1401
Email: joe.grdinovac@hoganlovells.com

Electronic Acknowledgement Receipt

EFS ID:	40922264
Application Number:	16597014
International Application Number:	
Confirmation Number:	4687
Title of Invention:	MODULAR SWITCHGEAR SYSTEM AND POWER DISTRIBUTION FOR ELECTRIC OILFIELD EQUIPMENT
First Named Inventor/Applicant Name:	Jared Oehring
Customer Number:	132858
Filer:	Joe Grdinovac/Stephanie McDonough
Filer Authorized By:	Joe Grdinovac
Attorney Docket Number:	047158.100048
Receipt Date:	22-OCT-2020
Filing Date:	09-OCT-2019
Time Stamp:	17:21:07
Application Type:	Utility under 35 USC 111(a)

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			b001ac8af40ec2a521715279d44b2c24f6ff8284		

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Applicant Arguments/Remarks Made in an Amendment	7	14	

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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.

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

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	1	9324049		2016-04-26	Thomeer	
	2	10415332		2019-09-17	Morris	
	3	10669804		2020-06-02	Kotrla	
	4	3055682		1962-09-25	Bacher	
	5	9513055		2016-12-06	Seal	
	6	9061223		2015-06-23	Winborn	
	7	8091928		2012-01-10	Carrier	
	8	6719900		2004-04-13	Hawkins	

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

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

9	5433243		1995-07-18	Griswold	
10	5230366		1993-07-27	Marandi	
11	2610741		1952-09-16	Schmid	
12	10337308		2019-07-02	Broussard	
13	5004400		1991-04-02	Handke	
14	9260253		2016-02-16	Naizer	
15	9340353		2016-05-17	Oren	
16	9499335		2016-11-22	Mclver	
17	9909398		2018-03-06	Pham	
18	8997904		2015-04-07	Cryer	
19	8774972		2014-07-08	Rusnak	

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

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

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

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	3	20130299167		2013-11-14	Fordyce	
	4	20110052423		2011-03-03	Gambier	
	5	20030079875		2003-05-01	Weng	
	6	20170226838		2017-08-10	Ciezobka	

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

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

7	20170096885		2017-04-06	Oehring	
8	20170175516		2017-06-22	Eslinger	
9	20190010793		2019-01-10	Hinderliter	
10	20130317750		2013-11-28	Hunter	
11	20190112910		2019-04-18	Oehring	
12	20160326854		2016-11-10	Broussard	
13	20170130743		2017-05-11	Anderson	
14	20140138079		2014-05-22	Broussard	
15	20180045331		2018-02-15	Lopez	
16	20180266412		2018-09-20	Stokkevag	
17	20180343125		2018-11-29	Clish	

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

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

18	20180291713	2018-10-11	Jeanson
19	20200232454	2020-07-23	Chretien
20	20190119096	2019-04-25	Haile
21	20180238147	2018-08-23	Shahri
22	20140238683	2014-08-28	Korach
23	20130284278	2013-10-31	Winborn
24	20060065319	2006-03-30	Csitari
25	20130306322	2013-11-21	Sanborn

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

FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Number ³	Country Code ² i	Kind Code ⁴	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear	T ⁵
	1							

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

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

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

NON-PATENT LITERATURE DOCUMENTS			Remove
Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T ⁵
	1	International Search Report and Written Opinion mailed June 2, 2020 in corresponding PCT Application No. PCT/US20/23809	✗
	2	International Search Report and Written Opinion mailed June 23, 2020 in corresponding PCT Application No. PCT/US20/23912	☒
	3	International Search Report and Written Opinion mailed July 22, 2020 in corresponding PCT Application No. PCT/US20/00017	☒
	4	Office Action mailed August 4, 2020 in related U.S. Patent Application No. 16/385,070	☒
	5	Office Action mailed June 29, 2020 in related U.S. Patent Application No. 16/404,283	☒
	6	Office Action mailed June 29, 2020 in related U.S. Patent Application No. 16/728,359	☒
	7	Office Action mailed June 22, 2020 in related U.S. Patent Application No. 16/377,861	☒
	8	Canadian Office Action mailed August 18, 2020 in related CA Patent Application No. 2,933,444	☒
	9	Canadian Office Action mailed August 17, 2020 in related CA Patent Application No. 2,944,968	☒

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

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

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

EXAMINER SIGNATURE

Examiner Signature		Date Considered	
--------------------	--	-----------------	--

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

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

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

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

CERTIFICATION STATEMENT

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

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

OR

- ☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

- ☒ See attached certification statement.

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

A certification statement is not submitted herewith.

SIGNATURE

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

Signature	/Taylor P. Evans/	Date (YYYY-MM-DD)	2020-09-02
Name/Print	Taylor P. Evans	Registration Number	60506

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

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 records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

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)

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

Date of mailing
(day/month/year) **23 JUN 2020**

Applicant's or agent's file reference
047156.500052

FOR FURTHER ACTION See paragraphs 1 and 4 below

International application No.
PCT/US2020/023912

International filing date
(day/month/year) **20 March 2020**

Applicant **U.S. WELL SERVICES, LLC**

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

Filing of amendments and statement under Article 19:

The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

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

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

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

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

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

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

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

4. Reminders

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

Shortly after the expiration of 18 months from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90bis.1 and 90bis.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 45bis.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 047156.500052		FOR FURTHER ACTION see Form PCT/ISA/220 as well as, where applicable, item 5 below.	
International application No. PCT/US2020/023912	International filing date (day/month/year) 20 March 2020	(Earliest) Priority Date (day/month/year) 20 March 2019	
Applicant U.S. WELL SERVICES, LLC			

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

This international search report consists of a total of 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 43.6bis(a)).

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

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

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

4. With regard to the title,

☒ the text is approved as submitted by the applicant.

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

5. With regard to the abstract,

☒ the text is approved as submitted by the applicant.

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

6. With regard to the drawings,

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

☒ as suggested by the applicant.

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

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

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

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2020/023912

A. CLASSIFICATION OF SUBJECT MATTER

IPC(B) - E21B 43/26; E21B 41/00; E21B 43/16; E21B 43/267; E21B 47/00; F04B 49/20 (2020.01)
 CPC - E21B 43/26; E21B 21/062; E21B 41/00; E21B 43/128; E21B 43/267; E21B 47/00; F04B 51/00
 (2020.05)

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

see Search History document

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

see Search History document

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

see Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2017/0096885 A1 (US WELL SERVICES LLC) 06 April 2017 (06.04.2017) entire document	1-6, 9-13, 15
Y	US 2017/0175516 A1 (SCHLUMBERGER TECHNOLOGY CORPORATION) 22 June 2017 (22.06.2017) entire document	1-6, 9-13, 15
A	US 2019/0010793 A1 (US WELL SERVICES LLC) 10 January 2019 (10.01.2019) entire document	1-15
A	US 2013/0317750 A1 (S.P.M. FLOW CONTROL, INC.) 28 November 2013 (28.11.2013) entire document	1-15
A	US 2016/0258267 A1 (STEWART & STEVENSON, LLC) 08 September 2016 (08.09.2016) entire document	1-15

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"D" document cited by the applicant in the international application

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

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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

"&" document member of the same patent family

Date of the actual completion of the international search

19 May 2020

Date of mailing of the international search report

23 JUN 2020

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents
P.O. Box 1450, Alexandria, VA 22313-1450

Facsimile No. 571-273-8300

Authorized officer

Blaine R. Copenhaver

Telephone No. PCT Helpdesk: 571-272-4300

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

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

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

Date of mailing
(day/month/year)

23 JUN 2020

Applicant's or agent's file reference
047156.500052

FOR FURTHER ACTION

See paragraph 2 below

International application No.

PCT/US2020/023912

International filing date (day/month/year)

20 March 2020

Priority date (day/month/year)

20 March 2019

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

IPC(8) - E21B 43/26; E21B 41/00; E21B 43/16; E21B 43/267; E21B 47/00; F04B 49/20 (2020.01)

CPC - E21B 43/26; E21B 21/062; E21B 41/00; E21B 43/128; E21B 43/267; E21B 47/00; F04B 51/00 (2020.05)

Applicant **U.S. WELL SERVICES, LLC**

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

- ☒ 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 43bis.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 66.1bis(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
Mail Stop PCT, Attn: ISA/US
Commissioner for Patents
P.O. Box 1450, Alexandria, VA 22313-1450
Facsimile No. 571-273-8300

Date of completion of this opinion

19 May 2020

Authorized officer

Blaine R. Copenheaver

PCT Helpdesk: 571-272-4300

Telephone No. 571-272-4300

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

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US2020/023912

Box No. I Basis of this opinion

1. With regard to the language, this opinion has been established on the basis of:
 - ☒ the international application in the language in which it was filed.
 - ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).
2. ☐ This opinion has been established taking into account the rectification of an obvious mistake authorized by or notified to this Authority under Rule 91 (Rule 43bis.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 13ter.1(s) 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 13ter.1(a)).
 - ☐ on paper or in the form of an image file (Rule 13ter.1(b) and Administrative Instructions, Section 713).
4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
5. Additional comments:

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.
PCT/US2020/023912

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

1. Statement

Novelty (N)	Claims	1-15	YES
	Claims	None	NO
Inventive step (IS)	Claims	7, 8, 14	YES
	Claims	1-6, 9-13, 15	NO
Industrial applicability (IA)	Claims	1-15	YES
	Claims	None	NO

2. Citations and explanations:

Claims 1-6, 9-13, and 15 lack an inventive step under PCT Article 33(3) as being obvious over US 2017/0096885 A1 to US Well Services LLC (hereinafter US Well '885) in view of Schlumberger Technology Corporation (hereinafter Schlumberger).

Regarding Claim 1, US Well '885 discloses a hydraulic fracturing system ("A hydraulic fracturing system", abstract), comprising: a pump system (pump system 36, fig. 1) fluidly coupled to a wellhead at a well site (fig. 1 shows pump system 36 fluidly coupled to a wellhead 41 at a well site next to well bore 12) to pump a fracturing fluid into the wellhead ("After being discharged from pump system 36, slurry is pumped into a wellhead assembly 41", para. [0030]); a blender (blender unit 28, fig. 1) configured to mix together proppant and a fluid mixture to form the fracturing fluid ("A proppant source 32 contains proppant, which is delivered to the blender unit 28 as represented by line 34, where line 34 can be a conveyor. Inside the blender unit 28, the proppant and fluid/additive mixture are combined to form a fracturing slurry", para. [0028]); a proppant storage and delivery system configured to provide the proppant for the blender ("A proppant source 32 contains proppant, which is delivered to the blender unit 28 as represented by line 34", para. [0028]); a hydration unit (hydration unit 18, fig. 1) configured to mix an additive into a fluid to form the fluid mixture ("The fluid, which in one example is water, is mixed inside of the hydration unit 18 with the additives. In an embodiment, the fluid and additives are mixed over a period of time, to allow for uniform distribution of the additives within the fluid", para. [0028]) and provide the fluid mixture to the blender ("In the example of FIG. 1, the fluid and additive mixture is transferred to a blender unit 28 via line 30", para. [0028]); a fluid storage and delivery system configured to provide the fluid for the hydration unit (fig. 1 shows fluid source 20 and line 22 configured to provide fluid for the hydration unit 18); an additive storage and delivery system configured to provide the additive to the hydration unit (fig. 1 shows additive source 24 and line 26 configured to provide the additive to the hydration unit 18).

US Well '885 fails to explicitly disclose damage accumulation monitoring, a damage accumulation monitoring system comprising a plurality of sensing devices and integrated into one or more components of the pump system, the blender system, the proppant storage and delivery system, the fluid storage and delivery system, and the additive storage and delivery system, the damage accumulation sensor system configured to monitor a plurality of parameters of the hydraulic fracturing system via the plurality of sensing devices to determine respective accumulated damage measurements of the one or more components.

Schlumberger, in the field of state estimation and run life prediction for pumping system (title, abstract), teaches a damage accumulation monitoring system ("Additionally, virtual torque shaft data may be used to predict torsional fatigue life damage and remaining fatigue life of various shafts in submersible pumping system 22", para. [0039]), a damage accumulation monitoring system comprising a plurality of sensing devices ("Another illustrated component is a sensor unit 52 utilized in sensing a variety of wellbore parameters. It should be noted, however, that sensor unit 52 may comprise a variety of sensors", para. [0019]) and integrated into one or more components of the pump system, the blender system, the proppant storage and delivery system, the fluid storage and delivery system, and the additive storage and delivery system ("sensor systems deployed along electric submersible pumping system 22, along casing 36, or along other regions of the wellbore 24 to obtain data for determining one or more desired parameters, as described more fully below", para. [0019]), the damage accumulation sensor system configured to monitor a plurality of parameters of the pumping system via the plurality of sensing devices ("a variety of sensor systems 52 may comprise sensors located at surface 30 to obtain desired data helpful in the process of determining measured parameters related to prediction of failures/run life of electric submersible pumping system 22 or specific components of pumping system 22", para. [0019]) to determine respective accumulated damage measurements of the one or more components ("sensor systems 52 may comprise sensors located at surface 30 to obtain desired data helpful in the process of determining measured parameters related to prediction of failures/run life of electric submersible pumping system 22 or specific components of pumping system 22", para. [0019]; "the processing system 54 also may be used to control operation of the pumping system, ..., a control system for adjusting operation of the electric submersible pumping system 22 in response to predictions of run life or component failure", para. [0023]). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify US Well '885 with the teaching of Schlumberger for the purpose of monitoring the pumping system and its components and thereby predicting the run life of a pumping system (abstract of Schlumberger).

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Supplemental Box

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

Regarding Claim 2, modified US Well '885 discloses the hydraulic fracturing system of claim 1.

US Well '885 fails to explicitly disclose wherein the accumulated damage measurement of a component is indicative of an amount of actual usage incurred by the component during a period of time.

Schlumberger, in the field of state estimation and run life prediction for pumping system (title, abstract), teaches wherein the accumulated damage measurement of a component is indicative of an amount of actual usage incurred by the component during a period of time ("sensor systems deployed along electric submersible pumping system 22, along casing 36, or along other regions of the wellbore 24 to obtain data for determining one or more desired parameters, as described more fully below, ... sensor systems 52 may comprise sensors located at surface 30 to obtain desired data helpful in the process of determining measured parameters related to prediction of failures/run life of electric submersible pumping system 22 or specific components of pumping system 22", para. [0019]; "The measured data 80 is obtained from sensors, such as sensors 74, which monitor at least one component of electric submersible pumping system 22 during operation. This data is provided to the component/system degradation model 70 so that the data may be appropriately processed via processing system 54 to predict a remaining useful life of the component (or overall pumping system 22) during operation of the electric submersible pumping system 22", para. [0028]).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify US Well '885 with the teaching of Schlumberger for the purpose of monitoring the pumping system and its components and thereby predicting the run life of a pumping system (abstract of Schlumberger).

Regarding Claim 3, US Well '885 discloses a hydraulic fracturing system ("A hydraulic fracturing system", abstract), comprising: a plurality of hydraulic fracturing equipment positioned at a well site ("The system further includes hydraulic fracturing system components for making the fracturing fluid slurry", abstract), comprising: one or more pumps configured to pressurize a fracturing fluid (fig. 1 shows pump system 36 fluidly coupled to a wellhead 41 at a well site next to well bore 12; "After being discharged from pump system 36, slurry is pumped into a wellhead assembly 41", para. [0030]); and a distribution system fluidly coupled to receive and consolidate fracturing fluid from the plurality of pumps for injection into a wellhead (blender unit 28, fig. 1; "A proppant source 32 contains proppant, which is delivered to the blender unit 28 as represented by line 34, where line 34 can be a conveyor. Inside the blender unit 28, the proppant and fluid/additive mixture are combined to form a fracturing slurry", para. [0028]; "A proppant source 32 contains proppant, which is delivered to the blender unit 28 as represented by line 34", para. [0028]; "The fluid, which in one example is water, is mixed inside of the hydration unit 18 with the additives. In an embodiment, the fluid and additives are mixed over a period of time, to allow for uniform distribution of the additives within the fluid", para. [0028]; "After being discharged from pump system 36, slurry is pumped into a wellhead assembly 41. Discharge piping 42 connects discharge of pump system 36 with wellhead assembly 41 and provides a conduit for the slurry between the pump system 36 and the wellhead assembly 41", para. [0030]).

US Well '885 fails to explicitly disclose damage accumulation monitoring, a damage accumulation monitoring system, comprising: a plurality of sensing devices integrated into respective components of the plurality of hydraulic fracturing equipment, the plurality of sensing devices configured to measure a plurality of usage parameters of the respective components; and a processing device configured to receive the plurality of usage parameters and determine respective damage accumulation measurements of the respective components based at least in part on the usage parameters.

Schlumberger, in the field of state estimation and run life prediction for pumping system (title, abstract), teaches a damage accumulation monitoring system ("Additionally, virtual torque shaft data may be used to predict torsional fatigue life damage and remaining fatigue life of various shafts in submersible pumping system 22", para. [0039]), a damage accumulation monitoring system, comprising: a plurality of sensing devices ("Another illustrated component is a sensor unit 52 utilized in sensing a variety of wellbore parameters. It should be noted, however, that sensor unit 52 may comprise a variety of sensors", para. [0019]) integrated into respective components of the plurality of hydraulic fracturing equipment ("sensor systems deployed along electric submersible pumping system 22, along casing 36, or along other regions of the wellbore 24 to obtain data for determining one or more desired parameters, as described more fully below", para. [0019]), the plurality of sensing devices configured to measure a plurality of usage parameters of the respective components ("a variety of sensor systems 52 may comprise sensors located at surface 30 to obtain desired data helpful in the process of determining measured parameters related to prediction of failures/run life of electric submersible pumping system 22 or specific components of pumping system 22", para. [0019]); and a processing device configured to receive the plurality of usage parameters (fig. 2 shows processor control system 54 configured to receive parameters from the sensor unit 52 and sensors 74) and determine respective damage accumulation measurements of the respective components based at least in part on the usage parameters ("sensor systems 52 may comprise sensors located at surface 30 to obtain desired data helpful in the process of determining measured parameters related to prediction of failures/run life of electric submersible pumping system 22 or specific components of pumping system 22", para. [0019]; "the processing system 54 also may be used to control operation of the pumping system, ... a control system for adjusting operation of the electric submersible pumping system 22 in response to predictions of run life or component failure", para. [0023]; "The measured data 80 is obtained from sensors, such as sensors 74, which monitor at least one component of electric submersible pumping system 22 during operation. This data is provided to the component/system degradation model 70 so that the data may be appropriately processed via processing system 54 to predict a remaining useful life of the component (or overall pumping system 22) during operation of the electric submersible pumping system 22", para. [0028]).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify US Well '885 with the teaching of Schlumberger for the purpose of monitoring the pumping system and its components and thereby predicting the run life of a pumping system (abstract of Schlumberger).

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Supplemental Box

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

Regarding Claim 4, modified US Well '885 discloses the hydraulic fracturing system of claim 3.

US Well '885 fails to explicitly disclose wherein the accumulated damage measurement of a component is indicative of an amount of actual usage incurred by the component during a period of time.

Schlumberger, in the field of state estimation and run life prediction for pumping system (title, abstract), teaches wherein the accumulated damage measurement of a component is indicative of an amount of actual usage incurred by the component during a period of time ("the control aspects of processing system 54 may be automated so that automatic adjustments to the operation of pumping system 22 may be implemented in response to run life/component failure predictions resulting from data processed according to algorithm 66", para. [0023]; "Referring generally to FIG. 3, an example of overall algorithm 66 is illustrated as one technique for evaluating data related to electric submersible pumping system 22 in a manner facilitating run life prediction", para. [0024]; this shows the amount of usage for the pumping system 22 components over a period of time).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify US Well '885 with the teaching of Schlumberger for the purpose of avoiding the pumping system from a failure and thereby automatically adjust the operation of pumping system in response to the life/failure time for a component(s) (para. [0023] of Schlumberger).

Regarding Claim 5, modified US Well '885 discloses the hydraulic fracturing system of claim 4.

US Well '885 fails to explicitly disclose wherein the damage accumulation monitoring system further determines an estimated remaining life of the component based on the accumulated damage measurement, wherein the estimated remaining life is expressed as a percentage.

Schlumberger, in the field of state estimation and run life prediction for pumping system (title, abstract), teaches wherein the damage accumulation monitoring system further determines an estimated remaining life of the component based on the accumulated damage measurement ("This data is provided to the component/system degradation model 70 so that the data may be appropriately processed via processing system 54 to predict a remaining useful life of the component (or overall pumping system 22) during operation of the electric submersible pumping system 22", para. [0028]; "the degradation model 70 may be programmed or otherwise configured to predict the remaining useful life of the motor magnet wire based on the motor winding temperatures according to predetermined relationships between useful life and temperatures", para. [0029]).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify US Well '885 with the teaching of Schlumberger for the purpose of monitoring the pumping system and its components and thereby predicting the run life of a pumping system (abstract of Schlumberger).

It would have been obvious to one of ordinary skill in the art at the time of the invention to provide any type of displayed/indicated information on the estimated remaining life is expressed as a percentage since such a modification depends only on the intended use of the apparatus/system and the desired information to be displayed. The motivation for doing so would have been to providing a better scale for the life time of the parts and thereby alarming the operator on the optimum time to replace the pumping parts.

Regarding Claim 6, modified US Well '885 discloses the hydraulic fracturing system of claim 4.

US Well '885 fails to explicitly disclose wherein the damage accumulation monitoring system further determines a damage accumulation rate based on the accumulated damage measurement with respect to the duration of the period of time.

Schlumberger, in the field of state estimation and run life prediction for pumping system (title, abstract), teaches wherein the damage accumulation monitoring system further determines a damage accumulation rate based on the accumulated damage measurement with respect to the duration of the period of time ("the control aspects of processing system 54 may be automated so that automatic adjustments to the operation of pumping system 22 may be implemented in response to run life/component failure predictions resulting from data processed according to algorithm 66", para. [0023]; "Referring generally to FIG. 3, an example of overall algorithm 66 is illustrated as one technique for evaluating data related to electric submersible pumping system 22 in a manner facilitating run life prediction", para. [0024]; this shows the amount of usage for the pumping system 22 components over a period of time).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify US Well '885 with the teaching of Schlumberger for the purpose of avoiding the pumping system from a failure and thereby automatically adjust the operation of pumping system in response to the life/failure time for a component(s) (para. [0023] of Schlumberger).

Regarding Claim 9, modified US Well '885 discloses the hydraulic fracturing system of claim 3.

US Well '885 fails to explicitly disclose wherein the use parameters include one or more of a set of parameters including operation time, observed cycles, amount pumped, fuel consumed, power consumed, number of start/stops, or amount of flow.

Schlumberger, in the field of state estimation and run life prediction for pumping system (title, abstract), teaches wherein the use parameters include one or more of a set of parameters including operation time, observed cycles, amount pumped, fuel consumed, power consumed, number of start/stops, or amount of flow ("an electric submersible pumping system 22 having a submersible pump 40, a pump intake 42, and a submersible electric motor 44 that powers submersible pump 40", para. [0018]; "The processing system 54 may be used to process data from the sensors and/or other data according to a desired overall algorithm which facilitates prediction of system run life. In some applications, the processing system 54 is in the form of a computer based control system which may be used to control, for example, a surface power system 56 which is operated to supply electrical power to pumping system 22 via power cable 46", para. [0020]; "This allows the processing system 54 to be used as a control system for adjusting operation of the electric submersible pumping system 22 in response to predictions of run life or component failure. In some applications, the control aspects of processing system 54 may be automated so that automatic adjustments to the operation of pumping system 22 may be implemented in response to run life/component failure predictions resulting from data processed according to algorithm 66", para. [0023]).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify US Well '885 with the teaching of Schlumberger for the purpose of avoiding the pumping system from a failure and thereby automatically adjust the operation of pumping system in response to the life/failure time for a component(s) (para. [0023] of Schlumberger).

Supplemental Box

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

Regarding Claim 10, US Well '885 discloses a hydraulic fracturing method ("A hydraulic fracturing system", abstract), comprising: a pump system (pump system 36, fig. 1), comprising: providing a fracturing fluid to a plurality of pumps (Arranged in rows and transverse to acid tanker 100 are pump trucks 1021-12, which make up the pump system 36 for pressurizing the slurry so that it can be injected into wellhead 41, para. [0038]); pumping the fracturing fluid into a distribution system (fig. 2 shows the slurry being pumped into pump trucks 1021-12); injecting the fracturing fluid into a wellhead ("After being discharged from pump system 36, slurry is pumped into a wellhead assembly 41", para. [0030]).

US Well '885 fails to explicitly disclose detecting respective usage parameters associated with of a plurality of components of the plurality of pumps, the distribution system, or the wellhead via a plurality of sensing devices instrumented thereon; and determining a damage accumulation parameter associated with of a plurality of components of the plurality of pumps, the distribution system, or the wellhead based at least in part on the respective usage parameters.

Schlumberger, in the field of state estimation and run life prediction for pumping system (title, abstract), teaches detecting respective usage parameters associated with of a plurality of components of the plurality of pumps ("Additionally, virtual torque shaft data may be used to predict torsional fatigue life damage and remaining fatigue life of various shafts in submersible pumping system 22", para. [0039]), the distribution system, or the wellhead via a plurality of sensing devices instrumented thereon ("Another illustrated component is a sensor unit 52 utilized in sensing a variety of wellbore parameters. It should be noted, however, that sensor unit 52 may comprise a variety of sensors", para. [0019]); and determining a damage accumulation parameter associated with of a plurality of components of the plurality of pumps, the distribution system, or the wellhead based at least in part on the respective usage parameters ("sensor systems deployed along electric submersible pumping system 22, along casing 36, or along other regions of the wellbore 24 to obtain data for determining one or more desired parameters, as described more fully below", para. [0019]; "a variety of sensor systems 52 may comprise sensors located at surface 30 to obtain desired data helpful in the process of determining measured parameters related to prediction of failures/run life of electric submersible pumping system 22 or specific components of pumping system 22", para. [0019]; "sensor systems 52 may comprise sensors located at surface 30 to obtain desired data helpful in the process of determining measured parameters related to prediction of failures/run life of electric submersible pumping system 22 or specific components of pumping system 22", para. [0019]; "the processing system 54 also may be used to control operation of the pumping system,...a control system for adjusting operation of the electric submersible pumping system 22 in response to predictions of run life or component failure", para. [0023]). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify US Well '885 with the teaching of Schlumberger for the purpose of monitoring the pumping system and its components and thereby predicting the run life of a pumping system (abstract of Schlumberger).

Regarding Claim 11, modified US Well '885 discloses the hydraulic fracturing method of claim 10.

US Well '885 fails to explicitly disclose wherein the accumulated damage parameter of a component is indicative of an amount of actual usage incurred by the component during a period of time.

Schlumberger, in the field of state estimation and run life prediction for pumping system (title, abstract), teaches wherein the accumulated damage parameter of a component is indicative of an amount of actual usage incurred by the component during a period of time ("the control aspects of processing system 54 may be automated so that automatic adjustments to the operation of pumping system 22 may be implemented in response to run life/component failure predictions resulting from data processed according to algorithm 66", para. [0023]; "Referring generally to FIG. 3, an example of overall algorithm 66 is illustrated as one technique for evaluating data related to electric submersible pumping system 22 in a manner facilitating run life prediction", para. [0024]; this shows the amount of usage for the pumping system 22 components over a period of time).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify US Well '885 with the teaching of Schlumberger for the purpose of avoiding the pumping system from a failure and thereby automatically adjust the operation of pumping system in response to the life/failure time for a components (para. [0023] of Schlumberger).

Regarding Claim 12, modified US Well '885 discloses the hydraulic fracturing method of claim 10.

US Well '885 fails to explicitly disclose determining an estimated remaining life of the component based on the accumulated damage parameter, wherein the estimated remaining life is expressed as a percentage.

Schlumberger, in the field of state estimation and run life prediction for pumping system (title, abstract), teaches wherein the damage accumulation monitoring system further determines an estimated remaining life of the component based on the accumulated damage measurement ("This data is provided to the component/system degradation model 70 so that the data may be appropriately processed via processing system 54 to predict a remaining useful life of the component (or overall pumping system 22) during operation of the electric submersible pumping system 22", para. [0028]; "the degradation model 70 may be programmed or otherwise configured to predict the remaining useful life of the motor magnet wire based on the motor winding temperatures according to predetermined relationships between useful life and temperatures", para. [0029]).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify US Well '885 with the teaching of Schlumberger for the purpose of monitoring the pumping system and its components and thereby predicting the run life of a pumping system (abstract of Schlumberger).

It would have been obvious to one of ordinary skill in the art at the time of the invention to provide any type of displayed/indicated information on the estimated remaining life is expressed as a percentage since such a modification depends only on the intended use of the apparatus/system and the desired information to be displayed. The motivation for doing so would have been to providing a better scale for the life time of the parts and thereby alarming the operator on the optimum time to replace the pumping parts.

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

Continuation of:

Regarding Claim 13, modified US Well '885 discloses the hydraulic fracturing method of claim 11.

US Well '885 fails to explicitly disclose determining a damage accumulation rate based on the accumulated damage parameter with respect to the duration of the period of time.

Schlumberger, in the field of state estimation and run life prediction for pumping system (title, abstract), teaches determining a damage accumulation rate based on the accumulated damage parameter with respect to the duration of the period of time ("the control aspects of processing system 54 may be automated so that automatic adjustments to the operation of pumping system 22 may be implemented in response to run life/component failure predictions resulting from data processed according to algorithm 66", para. [0023]; "Referring generally to FIG. 3, an example of overall algorithm 66 is illustrated as one technique for evaluating data related to electric submersible pumping system 22 in a manner facilitating run life prediction", para. [0024]; this shows the amount of usage for the pumping system 22 components over a period of time).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify US Well '885 with the teaching of Schlumberger for the purpose of avoiding the pumping system from a failure and thereby automatically adjust the operation of pumping system in response to the life/failure time for a components (para. [0023] of Schlumberger).

Regarding Claim 15, modified US Well '885 discloses the hydraulic fracturing method of claim 13.

US Well '885 fails to explicitly disclose further comprising: updating the damage accumulation rate over time.

Schlumberger, in the field of state estimation and run life prediction for pumping system (title, abstract), teaches updating the damage accumulation rate over time ("The measured motor winding temperatures are then used in the corresponding degradation model 70 to predict in real-time the remaining useful life of the pumping string component, e.g. submersible motor 44. In this specific example, the degradation model 70 may be programmed or otherwise configured to predict the remaining useful life of the motor magnet wire based on the motor winding temperatures according to predetermined relationships between useful life and temperatures", para. [0029]).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify US Well '885 with the teaching of Schlumberger for the purpose of avoiding the pumping system from a failure and thereby automatically adjust the operation of pumping system in response to the life/failure time for a components (para. [0023] of Schlumberger).

Claims 7, 8, and 14 meet the criteria set out in PCT Article 33(2)-(3), because the prior art does not teach or fairly suggest:

Regarding claim 7, the prior art of record, individually or in combination, does not teach or fairly suggest the hydraulic fracturing system of claim 6, wherein the damage accumulation monitoring system further determines an estimated maintenance time based on the damage accumulation rate and the accumulated damage measurement.

The following prior art is made of record to support and further define the reasons that claim 7 meets the criteria set out in PCT Article 33 (2)-(3):

Schlumberger discloses the damage accumulation rate and the accumulated damage measurement ("Additionally, virtual torque shaft data may be used to predict torsional fatigue life damage and remaining fatigue life of various shafts in submersible pumping system 22", para. [0039]; "sensor systems 52 may comprise sensors located at surface 30 to obtain desired data helpful in the process of determining measured parameters related to prediction of failures/run life of electric submersible pumping system 22 or specific components of pumping system 22", para. [0019]; "the processing system 54 also may be used to control operation of the pumping system, ..., a control system for adjusting operation of the electric submersible pumping system 22 in response to predictions of run life or component failure", para. [0023]).

However Schlumberger fails to disclose wherein the damage accumulation monitoring system further determines an estimated maintenance time based on the damage accumulation rate and the accumulated damage measurement.

Claim 8 depends from claim 7, and therefore meets the criteria set out in PCT Article 33(2)-(3) for at least the same reasons as claim 7.

Regarding claim 14, the prior art of record, individually or in combination, does not teach or fairly suggest the hydraulic fracturing method of claim 13, further comprising: determining an estimated maintenance time based on the damage accumulation rate and the accumulated damage parameter.

The following prior art is made of record to support and further define the reasons that claim 14 meets the criteria set out in PCT Article 33 (2)-(3):

Schlumberger discloses the damage accumulation rate and the accumulated damage parameter ("Additionally, virtual torque shaft data may be used to predict torsional fatigue life damage and remaining fatigue life of various shafts in submersible pumping system 22", para. [0039]; "sensor systems 52 may comprise sensors located at surface 30 to obtain desired data helpful in the process of determining measured parameters related to prediction of failures/run life of electric submersible pumping system 22 or specific components of pumping system 22", para. [0019]; "the processing system 54 also may be used to control operation of the pumping system, ..., a control system for adjusting operation of the electric submersible pumping system 22 in response to predictions of run life or component failure", para. [0023]).

However Schlumberger fails to disclose determining an estimated maintenance time based on the damage accumulation rate and the accumulated damage parameter.

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

Search History:

Limited Classification Search

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

CPC Class/Subclass(es): E21B 43/26; E21B 21/062; E21B 41/00; E21B 43/128; E21B 43/267; E21B 47/00; F04B 51/00 (2020.05)

IPC (8) Class/Subclass(es): E21B 43/26; E21B 41/00; E21B 43/16; E21B 43/267; E21B 47/00; F04B 49/20; F04B 51/00; G01N 27/90 (2020.01)

U.S. Class/Subclass(es): 73/152.18; 166/75.15; 166/250.01; 166/305.1; 166/308.1; 166/308.2

See Global Search Results.

Global Patent Literature Text Search

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

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

#	Search query	Results
1	(((US D WELL)/PA/OPA OR ("US WELL SERVICES")/NPAN OR ("MATLIN & ACQUISITION")/NPAN OR ("USWS FLEET 10")/NPAN OR ("USWS FLEET II")/NPAN)	47
2	1 AND ((DAMAG+) 3D (ACCUM+))	1
3	(WO2019113147)/PN	1
4	..CITBF NOSOURCE SS 3 1 RANKED	323
5	4 AND ((DAMAG+) 3D (ACCUM+))	0
6	4 AND (FRACTUR+)	109
7	6 AND (BLENDER?)	26
8	6 AND (PROPPANT?)	21
9	7 AND 8	9
10	1 AND (USAG+)	3
11	(US20200073353 OR CA2944980)/PN	2
12	..CITBF NOSOURCE SS 11 SET	5
13	(US9194207)/PN	1
14	..CITBF NOSOURCE SS 13 1 RANKED	162
15	14 AND (FRACTUR+)	36
16	(US20160258267 OR US20130299167 OR US20130180722)/PN	3

17	..CITBF NOSOURCE SS 16 SET	129
18	17 AND ((USAG+) 5D (INCUR+))	0
19	17 AND (USAG+)	1
20	..CITBF NOSOURCE SS 16 2 RANKED	60
21	20 AND (PROPPANT?)	29
22	21 AND (BLENDER?)	5
23	(US10227854 OR US10487261)/PN	2
24	..CITBF NOSOURCE SS 23 1 RANKED	16
25	..CITBF NOSOURCE SS 23 2 RANKED	36
26	(US20130233560)/PN	1
27	..CITBF NOSOURCE SS 26 1 RANKED	19
28	(WO2017213886)/PN	1
29	..CITBF NOSOURCE SS 28 1 RANKED	20
30	(US20140277772 OR US20130233560 OR US20090120635 OR US2004007392 OR US20040007392 OR US4510800 OR WO2010101668)/PN	6
31	..CITBF NOSOURCE SS 30 3 RANKED	19
32	(WO201910158)/PN	1
33	..CITBF NOSOURCE SS 32 1 RANKED	223
34	33 AND (PROPPANT?)	17
35	33 AND (BLENDER?)	21
36	33 AND (USAG+)	11
37	((((HYDRAULIC+) 8D (FRACTUR+)) AND (PUMP+))/TI/AB/CLMS/TX	18851
38	37 AND ((BLENDER?) 8D (PROPPANT?))	50
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40	..CITBF NOSOURCE SS 39 4 RANKED	132
41	40 AND ((BLENDER?) 8D (PROPPANT?))	7
42	37 AND ((USAG+) 5D (INCUR+))	0
43	37 AND (USAG+)	263
44	43 AND (PROPPANT?)	35
45	37 AND ((USAG+) 5D (SENSOR?))	2
46	37 AND (DAMAG+)	2960

47	46 AND (PROPPANT?)	556
48	47 AND (BLENDER?)	33
49	37 AND ((DAMAG+) 5D (ACCUMULAT+))	17
50	(US4839571)/PN	1
51	..CITBF NOSOURCE SS 50 1 RANKED	49
52	51 AND ((DAMAG+) 5D (ACCUMULAT+))	1
53	37 AND ((USAG+) 5D (SENSOR?))	2
54	37 AND ((US+) 5D (SENSOR?))	359
55	54 AND (PROPPANT?)	24
56	37 AND (INCURRED+)	21
57	37 AND (SENSOR?)	1938
58	57 AND ((BLENDER?) 8D (PROPPANT?))	10
59	57 AND (PROPPANT?)	134
60	59 AND (BLENDER?)	15
61	37 AND ((REMAIN+) 5D (LIFE?))	12
62	(WO2017100387)/PN	1
63	..CITBF NOSOURCE SS 62 1 RANKED	5
64	37 AND ((RUN+) 5D (LIFE?))	4
65	37 AND ((FATIG+) 5D (ACCUMULAT+))	2
66	37 AND ((FATIG+) 5D (PUMP+))	18
67	((FRACTUR+) 5D (PUMP+)) AND ((FATIG+) 5D (PUMP+))	38
68	(WO201910158)/PN	1
69	..CITBF NOSOURCE SS 68 1 RANKED	223
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71	69 AND ((LIF+) 5D (PUMP+))	8
72	(166305100)/PCL	1954
73	(166308100)/PCL	1259
74	(166250010)/PCL	1306
75	(166308200)/PCL	443
76	(073152180)/PCL	297
77	(166075150)/PCL	155

78	72 OR 73 OR 74 OR 75 OR 76 OR 77	4919
79	78 AND (((HYDRAULIC+) 8D (FRACTUR+)) AND (PUMP+))	349
80	79 AND ((BLENDER?) 8D (PROPPANT?))	4
81	79 AND (BLENDER?)	18
82	79 AND (PROPPANT?)	138
83	82 AND (SENSOR?)	9
84	78 AND ((FATIG+) 5D (ACCUMULAT+))	0
85	78 AND ((FATIG+) 5D (PUMP+))	2
86	78 AND ((RUN+) 5D (LIFE?))	1
87	78 AND ((FRACTUR+) 5D (PUMP+)) AND ((FATIG+) 5D (PUMP+))	1
88	78 AND ((REMAIN+) 5D (LIFE?))	5
89	78 AND ((USAG+) 5D (INCUR+))	0
90	78 AND ((US+) 5D (INCUR+))	1
91	37 AND ((LIFE+) 5D (PUMP+))	89
92	91 AND (SENSOR?)	7
93	79 AND (HYDRAT+)	27
94	79 AND (ADDITIV+)	58
95	78 AND ((DAMAG+) 5D (ACCUMULAT+))	4
96	79 AND (DAMAG+)	85
97	78 AND ((DAMAG+) 5D (RATE?))	3
98	(E21B-043/26)/IPC	11336
99	(E21B-043/267)/IPC	3985
100	(E21B-043/16)/IPC	7492
101	(E21B-047/00)/IPC	20898
102	(E21B-041/00)/IPC	9203
103	(G01N-027/90)/IPC	9287
104	(F04B-049/20)/IPC	1272
105	(F04B-051/00)/IPC	6145
106	98 OR 99 OR 100 OR 101 OR 102 OR 103 OR 104 OR 105	63853
107	106 AND (((HYDRAULIC+) 8D (FRACTUR+)) AND (PUMP+))	2075
108	107 AND ((BLENDER?) 8D (PROPPANT?))	25

109	107 AND ((USAG+) 5D (INCUR+))	0
110	107 AND ((DAMAG+) 5D (ACCUMULAT+))	2
111	107 AND ((REMAIN+) 5D (LIFE?))	3
112	(US20130317750)/PN	1
113	..CITBF NOSOURCE SS 112 1 RANKED	191
114	113 AND ((REMAIN+) 5D (LIFE?))	20
115	106 AND ((FRACTUR+) 5D (PUMP+)) AND ((FATIG+) 5D (PUMP+))	7
116	106 AND ((REMAIN+) 5D (LIFE?))	80
117	116 AND (FRACTUR+)	6
118	107 AND ((LIFE+) 5D (PUMP+))	20
119	107 AND (BLENDER?)	125
120	107 AND (PROPPANT?)	657
121	119 AND 120	54
122	107 AND ((FATIG+) 5D (PUMP+))	3
123	106 AND ((DAMAG+) 5D (RATE?))	78
124	123 AND (PUMP+)	29
125	106 AND ((RUN+) 5D (LIFE?))	33
126	(US20170175516)/PN	1
127	..CITBF NOSOURCE SS 126 1 RANKED	14
128	(US10113549 OR US20080236821 OR US20130080117 OR US20130151156 OR US20140034390 OR US20180066503)/PN	6
129	..CITBF NOSOURCE SS 128 6 RANKED	56
130	(US8874383)/PN	1
131	..CITBF NOSOURCE SS 130 1 RANKED	35
132	(E21B-043/26)/CPC	6418
133	(E21B-043/267)/CPC	2650
134	(E21B-047/00)/CPC	7033
135	(E21B-043/128)/CPC	1474
136	(E21B-041/00)/CPC	6830
137	(E21B-021/062)/CPC	526
138	(F04B-051/00)/CPC	1879
139	132 OR 133 OR 134 OR 135 OR 136 OR 137 OR 138	23971

140	139 AND (((HYDRAULIC+) 8D (FRACTUR+)) AND (PUMP+))	1382
141	140 AND ((BLENDER?) 8D (PROPPANT?))	23
142	139 AND ((USAG+) 5D (INCUR+))	0
143	140 AND ((REMAIN+) 5D (LIFE?))	3
144	140 AND ((FATIG+) 5D (PUMP+))	1
145	139 AND ((FATIG+) 5D (PUMP+))	12
146	139 AND ((FRACTUR+) 5D (LIFE?))	26
147	139 AND ((SENSOR?) 8D (LIFE?))	47
148	139 AND (((LIFE?) 8D (BLENDER+)) AND (BLENDENR?))	0
149	139 AND (((LIFE?) 8D (PROPPANT+)) AND (BLENDENR?))	0
150	139 AND (((LIFE?) 8D (ADDITIV+)) AND (BLENDENR?))	0
151	139 AND ((DAMAG+) 5D (ACCUMULAT+))	20
152	(WO201762074)/PN	1
153	..CITBF NOSOURCE SS 152 1 RANKED	17
154	140 AND ((BLENDER?) 8D (PROPPANT?))	23
155	139 AND ((USAG+) 5D (INCUR+))	0
156	140 AND ((REMAIN+) 5D (LIFE?))	3
157	139 AND ((FRACTUR+) 5D (PUMP+)) AND ((FATIG+) 5D (PUMP+))	6
158	139 AND ((RUN+) 5D (LIFE?))	22
159	139 AND ((REMAIN+) 5D (LIFE?))	46
160	139 AND ((PROPPANT+) 5D (LIFE?))	2
161	139 AND ((DAMAG+) 5D (SENSOR?))	53
162	(US20180209415)/PN	1
163	..CITBF NOSOURCE SS 162 1 RANKED	6
164	(US20120157356 OR US8905056)/PN	2
165	..CITBF NOSOURCE SS 164 2 RANKED	63
166	139 AND ((DAMAG+) 5D (MAINTENANC+))	9
167	106 AND ((DAMAG+) 5D (MAINTENANC+))	49
168	78 AND ((DAMAG+) 5D (MAINTENANC+))	1
169	37 AND ((DAMAG+) 5D (MAINTENANC+))	4
170	139 AND ((LIF+) 5D (MAINTENANC+))	31

171	78 AND ((LIF+) 5D (MAINTENANC+))	1
172	37 AND ((LIF+) 5D (MAINTENANC+))	18
173	*MEM "home/QPTLD337/ACCUM" /XPN /APID	196

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

#	Search query	Results
1	(hydraulic fracturing system)(pump system)(blender)(proppant)(hydration unit)(additive storage)(monitoring usage incurred)	38
2	(fracturing pump)(incurred usage)(sensor)	1,850
3	(fracturing pump)(hydraulic)(monitoring)(damage)(sensing devices)(usage parameters)	12,400
4	(damage accumulation monitoring)(hydraulic fracturing system)(sensors)(proppant storage)(additive storage)	127
5	(frac pump)(pump system)(blender)(proppant)(hydration unit)(maintenance)(storage)	1,120

Computer Accessed Text Databases Searched

The Patent Analyst searched the following computer accessed text databases:

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

#	Search query	Results
1	(US well services LLC)(hydraulic fracturing system)(pump)(blender)(proppant)	23,200
2	(hydraulic fracturing system)(accumulated damage)(incurred)(pumps)(sensing devices)	258,000
3	(hydraulic fracturing system)(damage accumulation)(remaining lifetime)(pump)(maintenance time)	1,780,000
4	(accumulation)(fracturing pump)(estimated maintenance)(damage parameter)(proppant)(hydration)(fluid storage)	45,400
5	(frac pump)(accumulation damage)(measurement)(sensor)(usage)(incurred)	216,000

Google Scholar: <https://scholar.google.com/>

#	Search query	Results
1	(hydraulic fracturing system)(pump system)(blender)(proppant storage)(hydration unit)(fluid storage)(additive storage)(amount of actual usage incurred)	44
2	(hydraulic fracturing system)(monitoring)(pump)(blender)(proppant)(hydration unit)(measuring proppant usage)(sensors)	306
3	(hydraulic fracturing system)(damage accumulation)(pump system)(life time)(hydration unit)(fluid storage)(proppant)(additive storage)	326
4	(frac pump)(maintenance)(additive storage)(proppant)(damage accumulation)(maintenance)(blender)(sensor)	176

5	(fracturing pump)(hydraulic)(accumulated damage)(measurement)(sensors)(actual usage incurred)(hydration unit)(proppant)	43
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YouTube: <https://youtube.com>

#	Search query	Results
1	(US WELL SERVICES, LLC)(damage accumulation)(monitoring)	N/A
2	(frac pump)(maintenance)(damage accumulation)(proppant)	N/A
3	(frac pump)(proppant storage)(hydration unit)(maintenance)(accumulation measurement)	N/A
4	(frac pump)(accumulated damage measurement)	N/A
5	(frac pump)(accumulated damage parameter)(time period)(duration)	N/A

Date search was completed: 19 May 2020

SR/DD

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

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

PCT

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

(PCT Rule 44.1)

Applicant's or agent's file reference 047158.500056	Date of mailing (day/month/year) 22 JUL 2020
International application No. PCT/US 20/00017	International filing date (day/month/year) 12 May 2020 (12.05.2020)
Applicant U.S. WELL SERVICES, LLC	

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

Filing of amendments and statement under Article 19:

The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

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

How? Directly to the International Bureau preferably through ePCT, or on paper to:

The International Bureau of WIPO, 34, chemin des Colombettes, 1211 Geneva 20, Switzerland

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

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

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

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

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

4. Reminders

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

Shortly after the expiration of 18 months from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90bis.1 and 90bis.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 28 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 45bis.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 <p style="text-align: center;">Lee Young</p> Telephone No. PCT Helpdesk: 571-272-4300
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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 047158.500056		FOR FURTHER ACTION see Form PCT/ISA/220 as well as, where applicable, item 5 below.	
International application No. PCT/US 20/00017	International filing date (day/month/year) 12 May 2020 (12.05.2020)	(Earliest) Priority Date (day/month/year) 13 May 2019 (13.05.2019)	
Applicant U.S. WELL SERVICES, LLC			

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

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

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

1. Basis of the report

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

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

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

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

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

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

4. With regard to the title,

- ☒ the text is approved as submitted by the applicant.
☐ the text has been established by this Authority to read as follows:

5. With regard to the abstract,

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

6. With regard to the drawings,

- a. the figure of the drawings to be published with the abstract is Figure No. 1
☒ as suggested by the applicant.
☐ as selected by this Authority, because the applicant failed to suggest a figure.
☐ as selected by this Authority, because this figure better characterizes the invention.
- b. ☐ none of the figures is to be published with the abstract.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 20/00017

A. CLASSIFICATION OF SUBJECT MATTER

IPC - E21B 43/26, E21B 43/267, E21B 44/00 (2020.01)

CPC - E21B 43/26, E21B 43/267, E21B 44/00

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

See Search History document

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

See Search History document

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

See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2016/0258267 A1 (Stewart & Stevenson, LLC) 8 September 2016 (08.09.2016) Entire document especially para [0014], [0017], [0037]-[0042], [0052]-[0053], [0105] and figs. 1-6	1, 4-5, 8-10, 13-14, 17-18
---		2-3
---		6-7, 11-12, 15-16
A		
Y	US 2019/0112910 A1 (U.S. Well Services, LLC) 18 April 2019 (18.04.2019) Entire document especially para [0018], [0023]-[0024] and [0040] and figs. 1-7	2-3
---		6-7, 11-12, 15-16
A		
A	US 2016/0326854 A1 (US Well Services LLC) 10 November 2016 (10.11.2016) Entire document	1-18
A	US 2017/0130743 A1 (Energy Recovery, Inc.) 11 May 2017 (11.05.2017) Entire document	1-18
A	US 2014/0138079 A1 (US Well Services LLC) 22 May 2014 (22.05.2014) Entire document	1-18
A	US 2018/0045331 A1 (Schlumberger Technology Corporation) 15 February 2018 (15.02.2018) Entire document	1-18
A	US 2018/0286412 A1 (Impact Solutions AS) 20 September 2018 (20.09.2018) Entire document	1-18
A	US 2018/0343125 A1 (Bedrock Automation Platforms Inc.) 29 November 2018 (26.11.2018) Entire document	1-18

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"D" document cited by the applicant in the international application

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

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"I" 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

30 June 2020

Date of mailing of the international search report

22 JUL 2020

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents

P.O. Box 1450, Alexandria, Virginia 22313-1450

Facsimile No. 571-273-8300

Authorized officer

Lee Young

Telephone No. PCT Helpdesk: 571-272-4300

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

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

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

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

Date of mailing (day/month/year) 22 JUL 2020	
Applicant's or agent's file reference 047158.500056	FOR FURTHER ACTION See paragraph 2 below
International application No. PCT/US 20/00017	International filing date (day/month/year) 12 May 2020 (12.05.2020)
Priority date (day/month/year) 13 May 2019 (13.05.2019)	
International Patent Classification (IPC) or both national classification and IPC IPC - E21B 43/26, E21B 43/267, E21B 44/00 (2020.01) CPC - E21B 43/26, E21B 43/267, E21B 44/00	
Applicant U.S. WELL SERVICES, LLC	

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

- ☒ 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 43bis.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 66.1bis(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 Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Date of completion of this opinion 30 June 2020	Authorized officer Lee Young PCT Help Desk Telephone No. 571-272-4300
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Form PCT/ISA/237 (cover sheet) (revised January 2019)

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US 20/00017

Box No. 1 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 43bis.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 13ter.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 13ter.1(a)).
☐ on paper or in the form of an image file (Rule 13ter.1(b) and Administrative Instructions, Section 713).

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

5. Additional comments:

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/US 20/00017

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

1. Statement

Novelty (N)	Claims	1-16	YES
	Claims	None	NO
Inventive step (IS)	Claims	2-3, 6-7, 11-12, 15-16	YES
	Claims	1, 4-5, 8-10, 13-14, 17-18	NO
Industrial applicability (IA)	Claims	1-16	YES
	Claims	None	NO

2. Citations and explanations:

Claims 1, 4-5, 8-10, 13-14 and 17-18 lack an inventive step under PCT Article 33(3) as being obvious over US 2016/0258267 A1 to Stewart & Stevenson, LLC (hereinafter "Stewart")

Regarding Claim 1, Stewart teaches a system (See figs. 1-5; para [0041]-[0042]) for use in fracturing operations (para [0042]), the system characterized by:

an electric motor (411 - "frac motors", fig. 3; para [0047]);

a turbine generator (100a-d - "turbine generators", figs. 2A-B) to generate electric power (See figs. 2A-B; para [0021], [0044]);

a vector control subsystem (410 - "frac motor variable frequency drive", fig. 3; para [0047]) to receive the electric power from the turbine generator (See figs. 2A-B; turbine generators 100a-d supply power for the rest of the system including fracturing unit control system 400 of fig. 3) and to control the electric motor using determined parameters provided to the vector control subsystem (para [0014], [0017], [0037]-[0039], [0105]); and

at least one pump (710 - "fracturing pumps", fig. 6; para [0052]) to receive torque input from the electric motor (para [0052]-[0053]) but does not specifically teach wherein the vector control subsystem is encoderless. However, Stewart does teach that the vector control subsystem is capable of being an encoderless subsystem (para [0041] - an open loop control mode is an encoderless mode). The decision of whether to have the vector control subsystem be encoderless or to comprise an encoder is a binary decision. Accordingly, it would have been obvious to one of ordinary skill in the art using routine experimentation and design principles to have the vector control subsystem be encoderless in order to reduce the complexity of the system as encoderless control subsystems require less components and are easier to construct and include with a system.

Regarding Claim 4, Stewart teaches the system of claim 1, further characterized by: an encoderless variable frequency drive (VFD) (410 - "frac motor variable frequency drive", fig. 3; VFD 410 is encoderless as laid out in treatment of claim 1) functioning as the encoderless vector control subsystem (410 - "frac motor variable frequency drive", fig. 3).

Regarding Claim 5, Stewart teaches the system of claim 1, further characterized by:

a machine interface (para [0038]-[0039] - "human machine interface") to receive the determined parameters for the encoderless vector control subsystem (para [0038]-[0039]); and

at least one processor (para [0039] - "programmable automation controller") to apply the determined parameters to the electric motor prior to engagement of a load with the electric motor (para [0039]).

Regarding Claim 6, Stewart teaches the system of claim 1, wherein the determined parameters for the encoderless vector control subsystem (para [0014], [0017], [0037]-[0039], [0105]) is selected from at least speed values, motor values (para [0038] - "AC motors" speed set points to be entered and transmitted; para [0041]), and proportional-integral-derivative (PID) control values.

Regarding Claim 9, Stewart teaches the system of claim 1, further characterized by: one or more plunger pumps (710a-b - "fracturing pumps", fig. 6; para [0120]-[0121]) adapted to receive the torque input from the electric motor (para [0052]-[0053]) but does not specifically teach wherein the one or more plunger pumps are triplex quintuplex, novemplox, or septuplex plunger pumps. However, Stewart does teach that each of the one or more plunger pumps can comprise a plurality of plungers (para [0120]-[0121] - "n is the number of pump plungers"). Accordingly, it would have been obvious to one of ordinary skill in the art to design the plunger pumps to have enough plungers to at least be a triplex pump (3 plungers) in order to ensure the pumps have the volumetric flow capacity necessary for the fracturing operations.

-*-Continued in Supplemental Box-*-

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US 20/00017

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

Claim 3: The term "the vibration sensor" is confusing and lacks proper antecedent basis. The term is properly introduced in claim 2. As written, claim 3 depends from claim 1. Accordingly, for purposes of this opinion, claim 3 has been interpreted to depend from claim 2.

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US 20/00017

Supplemental Box

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

~*Supplemental Box - Box V.2 - Citations and Explanations~*

Regarding Claim 10, Stewart teaches a method (See figs. 1-6; para [0041]-[0042]) for using electric pumps (710 - "fracturing pumps", fig. 6) in fracturing operations (para [0042]) characterized by:
engaging an electric motor (411 - "frac motors", fig. 3) with a turbine generator (100a-d - "turbine generators", figs. 2A-B);
enabling a vector control subsystem (410 - "frac motor variable frequency drive", fig. 3) to receive electric power from the turbine generator (See figs. 2A-B; para [0044]);
controlling the electric motor using determined parameters input to the vector control subsystem (para [0014], [0017], [0037]-[0039], [0105]); and
engaging at least one pump (710 - "fracturing pumps", fig. 6) with the torque input from the electric motor (para [0052]-[0053]) but does not specifically teach wherein the vector control subsystem is encoderless. However, Stewart does teach that the vector control subsystem is capable of being an encoderless subsystem (para [0041] - an open loop control mode is an encoderless mode). The decision of whether to have the vector control subsystem be encoderless or to comprise an encoder is a binary decision. Accordingly, it would have been obvious to one of ordinary skill in the art using routine experimentation and design principles to have the vector control subsystem be encoderless in order to reduce the complexity of the system as encoderless control subsystems require less components and are easier to construct and include with a system.

Regarding Claim 13, Stewart teaches the method of claim 10, further characterized by: using an encoderless variable frequency drive (VFD) (410 - "frac motor variable frequency drive", fig. 3; VFD 410 is encoderless as laid out in treatment of claim 1) as the encoderless vector control subsystem (410 - "frac motor variable frequency drive", fig. 3).

Regarding Claim 14, Stewart teaches the method of claim 10, further characterized by:
enabling a machine interface (para [0038]-[0039] - "human machine interface") to receive the determined parameters for the encoderless vector control subsystem (para [0038]-[0039]); and
applying, using at least one processor (para [0039] - "programmable automation controller"), the determined parameters to the electric motor prior to engagement of a load with the electric motor (para [0039]).

Regarding Claim 17, Stewart teaches the method of claim 10, wherein the determined parameters for the encoderless vector control subsystem (para [0014], [0017], [0037]-[0039], [0105]) is selected from at least speed values, motor values (para [0038] - "AC motors" speed set points to be entered and transmitted; para [0041]), and proportional-integral-derivative (PID) control values.

Regarding Claim 18, Stewart teaches the method of claim 10, further characterized by: engaging one or more plunger pumps (710a-b - "fracturing pumps", fig. 6; para [0120]-[0121]) with the electric motor to receive the torque out from the electric motor (para [0052]-[0053]) but does not specifically teach wherein the one or more plunger pumps are triplex quintuplex, novemplex, or septuplex plunger pumps. However, Stewart does teach that each of the one or more plunger pumps can comprise a plurality of plungers (para [0120]-[0121] - "n is the number of pump plungers"). Accordingly, it would have been obvious to one of ordinary skill in the art to design the plunger pumps to have enough plungers to at least be a triplex pump (3 plungers) in order to ensure the pumps have the volumetric flow capacity necessary for the fracturing operations.

Claims 2-3 lacks novelty under PCT Article 33(2) as being anticipated by Stewart in view of US 2019/0112910 A1 to U.S. Well Services, LLC (hereinafter "Well")

Regarding Claim 2, Stewart teaches the system of claim 1, but does not specifically teach the system further characterized by: a vibration sensor for monitoring vibration induced in a feature associated with a turbine of the turbine generator and providing input for the determined parameters based in part on the vibration. Further, Well teaches a system for use in fracturing operations (See figs. 1-7; para [0016]) comprising a turbine generator (74 - "turbine", fig. 2) to generate electric power (para [0023]-[0024]), the system further comprising a vibration sensor (178 - "sensor", fig. 7; para [0040]) for monitoring vibration induced in a feature (para [0040]) associated with a turbine (74 - "turbine", fig. 2) of the turbine generator (74 - "turbine", fig. 2; intended use: the vibration sensor is capable of monitoring vibration in a feature associated with the turbine generator) and providing input for the determined parameters based in part on the vibration (para [0040]). Accordingly, it would have been obvious to one of ordinary skill in the art to use the vibration sensor taught by Well on a feature associated with the turbine of the system taught by Stewart in order to allow an operator to determine if the turbine of the system is operating at a too high or too low of a rate.

Regarding Claim 3, the modified Stewart teaches the system of claim 2 (Note: See Box VIII), further characterized by: the vibration sensor (Well: 178 - "sensor", fig. 7; para [0040]) associated with a body of the turbine generator (Stewart: 100a-d - "turbine generators", figs. 2A-B) for monitoring the vibration induced in the body of the turbine of the turbine generator, in part, due to a feedback resonance received to the turbine (intended use: the vibration sensor of well is capable of monitoring vibration in a body of the turbine generator due to a feedback resonance).

~*Continued in next Supplemental Box~*

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US 20/00017

Supplemental Box

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

Continuation of:

~Supplemental Box - Box V.2 - Citations and Explanations~

Claims 6-7, 11-12 and 15-16 meet the criteria of PCT Article 33(2) & 33(3) because, as will be shown, the prior art does not teach, nor does it fairly suggest, the claimed limitations.

The prior art is exemplified by (1) Stewart and (2) Well

(1) Stewart teaches a system (See figs. 1-6; para [0041]-[0042]) for use in fracturing operations (para [0042]), the system characterized by: an electric motor (411 - "frac motors", fig. 3); a turbine generator (100a-d - "turbine generators", figs. 2A-B) to generate electric power (See figs. 2A-B; para [0021], [0044]); a vector control subsystem (410 - "frac motor variable frequency drive", fig. 3) to receive the electric power from the turbine generator (See figs. 2A-B; turbine generators 100a-d supply power for the rest of the system including fracturing unit control system 400 of fig. 3) and to control the electric motor using determined parameters provided to the vector control subsystem (para [0014], [0017], [0037]-[0039], [0105]); and at least one pump (710 - "fracturing pumps", fig. 6) to receive torque input from the electric motor (para [0052]-[0053]).

(2) Well teaches a system for use in fracturing operations (See figs. 1-7; para [0018]) comprising a turbine generator (74 - "turbine", fig. 2) to generate electric power (para [0023]-[0024]), and a vector control subsystem (102 - "VFD", fig. 2), the system further comprising a vibration sensor (178 - "sensor", fig. 7; para [0040]) for monitoring vibration induced in a feature (para [0040]).

Regarding Claim 6, Stewart teaches the system of claim 1, wherein the determined parameters for the encoderless vector control subsystem is determined based in part on oscillation alarm values (para [0055]-[0056]) but does not specifically teach wherein the oscillation alarm values represent vibration in at least a portion of a body associated with the turbine generator, for a period of time, being within a range of about 15 to about 45 upon engagement of the motor with a load. Further, Well teaches a system for use in fracturing operations (See figs. 1-7; para [0018]) comprising a turbine generator (74 - "turbine", fig. 2) to generate electric power (para [0023]-[0024]), and a vector control subsystem (102 - "VFD", fig. 2), the system further comprising a vibration sensor (178 - "sensor", fig. 7; para [0040]) for monitoring vibration induced in a feature (para [0040]). However, any combination of the above references fails to teach wherein the oscillation alarm values represent vibration in at least a portion of a body associated with the turbine generator. Accordingly, the prior art does not specifically teach or fairly suggest individually or in combination the system as claimed.

Regarding Claim 7, Stewart teaches the system of claim 1, wherein the determined parameters for the encoderless vector control subsystem is determined based in part on oscillation alarm values (para [0055]-[0056]) but does not specifically teach wherein the oscillation alarm values represent vibration in at least a portion of a body associated with the turbine generator, for a period of time, being less than about 70 upon engagement of the motor with a load. Further, Well teaches a system for use in fracturing operations (See figs. 1-7; para [0018]) comprising a turbine generator (74 - "turbine", fig. 2) to generate electric power (para [0023]-[0024]), and a vector control subsystem (102 - "VFD", fig. 2), the system further comprising a vibration sensor (178 - "sensor", fig. 7; para [0040]) for monitoring vibration induced in a feature (para [0040]). However, any combination of the above references fails to teach wherein the oscillation alarm values represent vibration in at least a portion of a body associated with the turbine generator. Accordingly, the prior art does not specifically teach or fairly suggest individually or in combination the system as claimed.

Regarding Claim 11, Stewart teaches the method of claim 10, but does not specifically teach wherein the determined parameters are based in part on vibration induced in a feature associated with the turbine generator. Further, Well teaches a system for use in fracturing operations (See figs. 1-7; para [0018]) comprising a turbine generator (74 - "turbine", fig. 2) to generate electric power (para [0023]-[0024]), the system further comprising a vibration sensor (178 - "sensor", fig. 7; para [0040]) for monitoring vibration induced in a feature (para [0040]). However, any combination of the above references fails to teach wherein the determined parameters are based in part on vibration induced in a feature associated with the turbine generator. Accordingly, the prior art does not specifically teach or fairly suggest individually or in combination the method as claimed.

Regarding Claim 12, the prior art does not specifically teach or fairly suggest individually or in combination the method as claimed since it is dependent on claim 11.

Regarding Claim 15, Stewart teaches the method of claim 10, wherein the determined parameters for the encoderless vector control subsystem is determined based in part on oscillation alarm values (para [0055]-[0056]), but does not specifically teach wherein the oscillation alarm values represent vibration in at least a body of a turbine associated with the turbine generator, having values from a range of about 15 to about 45 upon engagement of the motor with a load. Further, Well teaches a system for use in fracturing operations (See figs. 1-7; para [0018]) comprising a turbine generator (74 - "turbine", fig. 2) to generate electric power (para [0023]-[0024]), and a vector control subsystem (102 - "VFD", fig. 2), the system further comprising a vibration sensor (178 - "sensor", fig. 7; para [0040]) for monitoring vibration induced in a feature (para [0040]). However, any combination of the above references fails to teach wherein the oscillation alarm values represent vibration in at least a portion of a body associated with the turbine generator. Accordingly, the prior art does not specifically teach or fairly suggest individually or in combination the method as claimed.

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WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US 20/00017

Supplemental Box

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

Continuation of:

~Supplemental Box - Box V.2 - Citations and Explanations~

Regarding Claim 16, Stewart teaches the method of claim 10, wherein the determined parameters for the encoderless vector control subsystem is determined based in part on oscillation alarm values (para [0055]-[0056]), but does not specifically teach wherein the oscillation alarm values represent vibration in at least a body of a turbine associated with the turbine generator, having decreased values less than a range of about 70 to about 80 upon engagement of the motor with a load. Further, Weil teaches a system for use in fracturing operations (See figs. 1-7; para [0018]) comprising a turbine generator (74 - "turbine", fig. 2) to generate electric power (para [0023]-[0024]), and a vector control subsystem (102 - "VFD", fig. 2), the system further comprising a vibration sensor (178 - "sensor", fig. 7; para [0040]) for monitoring vibration induced in a feature (para [0040]). However, any combination of the above references fails to teach wherein the oscillation alarm values represent vibration in at least a portion of a body associated with the turbine generator. Accordingly, the prior art does not specifically teach or fairly suggest individually or in combination the method as claimed.

Claims 1-18 have industrial applicability as defined by PCT Article 33(4) because the subject matter can be made or used by industry.

SEARCH HISTORY

Application Number	PCT/US 20/00017
Search Conducted By	MFG
Search Approved By	SCL

CPC/IPC Classifications Searched	IPC(8): E21B 43/26, E21B 43/267, E21B 44/00 (2020.01) CPC: E21B 43/26, E21B 43/267, E21B 44/00
Date Conducted	30 June 2020 (30.06.2020)

Documentation Searched	IPC(8): E21B 43/26, E21B 43/267, E21B 44/00 (2020.01) CPC: (keyword limited; see below)
Search Terms Used	U.S. Well Services, Inc jared oehring encoder hydraulic fracturing open loop turbine electric motor sensor vibration alarm value
Date Conducted	30 June 2020 (30.06.2020)

Electronic Database Searched	PatBase
Files Searched	Full-text: AU BE BR CA CH CN DE DK EP ES FI FR GB IN JP KR SE TH TW US WO Bibliographic: (European) AT BA BE BG CH CS CY CZ DD DK EE ES FI GE GR HR HU IE IS IT LT LU LV MC MD MT NL NO PL PT RO RS SE SI SK SM TR UA YU (Asia) EA GC HK ID IL IN KZ MN MY PH RU SG SU TH TJ TW UZ VN (North America) CA CR CU DO GT HN MX NI PA SV TT (South America) AR BR CL CO EC PE UY (Australasia) AU NZ (Africa) AP DZ EG KE MA MW OA ZA ZM ZW
Date Conducted	30 June 2020 (30.06.2020)
Search Logic:	

#

Search query

Results

#	Search query	Results
1	IC=(E21B43/26) OR CPC=(E21B43/26)	11810
2	1 AND FT=(encoderless*)	0
3	FT=(encoderless*)	139
4	3 AND FT=(frac*)	27
5	4 AND FT=(pump* OR turbin*)	7
6	IC=(E21B*) OR CPC=(E21B*)	380349
7	6 AND FT=(encoderless*)	2
8	1 AND FT=(open loop* OR openloop* OR open-loop*)	24
9	8 AND FT=(turbin*)	8
10	6 AND FT=(open loop* OR openloop* OR open-loop*)	466
11	10 AND FT=(turbin*)	110
12	11 AND FT=(pump* AND motor*)	83
13	12 AND FT=(sens* NEAR (turbin* OR vibrat*))	11
14	IC=(E21B43/267) OR CPC=(E21B43/267)	3939
15	(1 OR 14) AND FT=(turbin*)	394
16	15 AND FT=(sens* NEAR vibrat*)	43
17	16 AND FT=(sens* NEAR turbin*)	4
18	pn=(US20160326854 OR US2016258267)	2
19	CTB 18 OR CTF 18	369
20	19 AND TAC=(frac*)	140
21	20 AND FT=(motor*)	87
22	21 AND FT=(turbin*)	47
23	22 NOT (5 OR 7 OR 9 OR 13 OR 17 OR 18)	42
24	IC=(E21B44/00) OR CPC=(E21B44/00)	7341
25	24 AND FT=(turbin*)	618
26	25 AND FT=(frac*)	265
27	26 AND FT=(open loop* OR openloop* OR open-loop* OR (open* NEAR loop*))	36
28	27 NOT (5 OR 7 OR 9 OR 13 OR 17 OR 18)	30
29	15 AND FT=(sens* NEAR turbin*)	8
30	15 AND FT=(vibrat* NEAR turbin*)	3

Electronic Database Searched	Google
Files Searched	Patents
Date Conducted	30 June 2020 (30.06.2020)
<p align="center">Search Logic:</p> <p>assignee:(U.S. Well Services, Inc.) - About 12 results assignee:(jared oehring) - About 25 results (encoder) assignee:(jared oehring) - About 1 results (hydraulic fracturing) (open loop) - About 40,014 results (hydraulic fracturing) (open loop) (turbine) - About 1,803 results (hydraulic fracturing) (open loop) (turbine) (electric motor) - About 929 results (hydraulic fracturing) (open loop) (turbine) (sensor) - About 1,162 results (hydraulic fracturing) (turbine) (vibration sensor) - About 1,604 results (hydraulic fracturing) (turbine sensor) - About 6,714 results (hydraulic fracturing) (turbine sensor) (alarm value) - About 808 results</p>	

Electronic Database Searched	Google
Files Searched	Web
Date Conducted	30 June 2020 (30.06.2020)
<p align="center">Search Logic:</p> <p>(U.S. Well Services, Inc.) - About 3,060,000,000 results (jared oehring) - About 46,900 results (encoder) (jared oehring) - About 581 results (hydraulic fracturing) (open loop) - About 1,270,000 results (hydraulic fracturing) (open loop) (turbine) - About 2,370,000 results (hydraulic fracturing) (open loop) (turbine) (electric motor) - About 144,000 results (hydraulic fracturing) (open loop) (turbine) (sensor) - About 1,720,000 results (hydraulic fracturing) (turbine) (vibration sensor) - About 1,700,000 results (hydraulic fracturing) (turbine sensor) - About 897,000 results (hydraulic fracturing) (turbine sensor) (alarm value) - About 1,520,000 results</p>	

Electronic Acknowledgement Receipt

EFS ID:	40450692
Application Number:	16597014
International Application Number:	
Confirmation Number:	4687
Title of Invention:	MODULAR SWITCHGEAR SYSTEM AND POWER DISTRIBUTION FOR ELECTRIC OILFIELD EQUIPMENT
First Named Inventor/Applicant Name:	Jared Oehring
Customer Number:	132858
Filer:	Taylor P. Evans/Stephanie McDonough
Filer Authorized By:	Taylor P. Evans
Attorney Docket Number:	047158.100048
Receipt Date:	02-SEP-2020
Filing Date:	09-OCT-2019
Time Stamp:	11:11:12
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	047158-100048_IDS.pdf	1036160	no	9
			8a43fc3d4cf507d663c8f3e9b24332e059d053b3b		

Warnings:

Information:					
2	Other Reference-Patent/App/Search documents	047158-100040.pdf	272909	no	8
			6713dd00a0bd08ed1c63ffb36150d1101b2d0c83		
Warnings:					
Information:					
3	Other Reference-Patent/App/Search documents	047158-100050.pdf	264400	no	8
			1e64f5a5ba4882df1663f08d022315f88b9064ea		
Warnings:					
Information:					
4	Other Reference-Patent/App/Search documents	047158-100054.pdf	294356	no	9
			8b4e935944e693768eda4a2c8ce9c54bbcb4b6169		
Warnings:					
Information:					
5	Other Reference-Patent/App/Search documents	047158-100066.pdf	293536	no	8
			b0cdded590ebc7ba806c2634b8cf0dae8ac17d715		
Warnings:					
Information:					
6	Other Reference-Patent/App/Search documents	047158-500051_ISR.pdf	819292	no	17
			ce7cb211944228fd5d3218d796a2cfc9fd2c72		
Warnings:					
The page size in the PDF is too large. The pages should be 8.5 x 11 or A4. If this PDF is submitted, the pages will be resized upon entry into the Image File Wrapper and may affect subsequent processing					
Information:					
7	Other Reference-Patent/App/Search documents	047158-500052_ISR.pdf	896242	no	18
			c2425428ea5877d276d1990bb2fbc90d9fb1c6c2		
Warnings:					
The page size in the PDF is too large. The pages should be 8.5 x 11 or A4. If this PDF is submitted, the pages will be resized upon entry into the Image File Wrapper and may affect subsequent processing					
Information:					

8	Other Reference-Patent/App/Search documents	047158-500056_ISR.pdf	575726	no	13
			80028a0ff8f35f021afe090c0ace9c33b13b1333		

Warnings:

The page size in the PDF is too large. The pages should be 8.5 x 11 or A4. If this PDF is submitted, the pages will be resized upon entry into the Image File Wrapper and may affect subsequent processing

Information:

9	Other Reference-Patent/App/Search documents	CIPO_Office-Action-2020-08-17-P52029CA00.pdf	190566	no	4
			defc90838ca55844161a039faaa41793e96a25d6		

Warnings:

Information:

10	Other Reference-Patent/App/Search documents	CIPO_Office-Action-2020-08-18-P52026CA00.pdf	178892	no	4
			410c4d70ab14fc85319f39b44e6a8b4110a933e7d		

Warnings:

Information:

Total Files Size (in bytes):			4822079
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This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

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

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

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

New International Application Filed with the USPTO as a Receiving Office

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



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www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/597,014	10/09/2019	Jared Oehring	047158.100048	4687
132858	7590	07/23/2020		
Hogan Lovells US LLP 609 Main Street Suite 4200 Houston, TX 77002			EXAMINER BOBISH, CHRISTOPHER S	
			ART UNIT	PAPER NUMBER
			3746	
			NOTIFICATION DATE	DELIVERY MODE
			07/23/2020	ELECTRONIC

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

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

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

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

Office Action Summary**Application No.**

16/597,014

Applicant(s)

Oehring et al.

Examiner

CHRISTOPHER S BOBISH

Art Unit

3746

AIA (FITF) Status

Yes

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

Period for Reply

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

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

Status

1) ☒ Responsive to communication(s) filed on 04/09/2020.

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

2a) ☐ This action is **FINAL**.

2b) ☒ This action is non-final.

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

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

Disposition of Claims*

5) ☒ Claim(s) 1-20 is/are pending in the application.

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

6) ☐ Claim(s) ____ is/are allowed.

7) ☒ Claim(s) 1-20 is/are rejected.

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

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

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

Application Papers

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

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

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

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

Priority under 35 U.S.C. § 119

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

Certified copies:

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

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

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

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

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

Attachment(s)

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

3) ☐ Interview Summary (PTO-413)

Paper No(s)/Mail Date ____.

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

4) ☐ Other: ____.

Paper No(s)/Mail Date ____.

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.

Response to Amendment

The arguments regarding the Morris reference, in the response filed 04/09/2020, have been considered and are persuasive. Therefore the current action is made non-final.

Claim Rejections - 35 USC § 103

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

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

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

Morris teaches:

limitations from claims 1 and 9, a hydraulic fracturing system for fracturing a subterranean formation (FIG. 7. paragraph 77), comprising: a support structure (710) having a first area, a second area, a third area, and a fourth area arranged adjacent one another (see FIG. 7A-7B with various components at different locations on the trailer 710); an electric powered, multi-plunger pump (702) with up to 15 plungers (paragraph 77), arranged in the first area, the electric powered pump coupled to a well associated with the subterranean formation (see paragraph 39 for example) and powered by at least one electric motor (704, paragraph 79), also arranged in the first area (next to the pumps 702), the electric powered pump configured to pump fluid into a wellbore associated with the well at a high pressure so that the fluid passes from the wellbore into the subterranean formation and fractures the subterranean formation (see paragraph 2); a transformer (see paragraph 78), arranged in the third area proximate the second area (near controls 708), the transformer positioned within an enclosure (see FIG. 7), the transformer distributing power to the electric pump, the power being received from at least one generator at a voltage higher than an operating voltage of the electric pump (paragraph 77 teaches the pump transport receives power from a mobile source of electricity; paragraph 51 teaches the generator of the mobile power source; paragraph 78 teaching control of the pumps); and a cooling system, arranged in the fourth area proximate the third area, the cooling system providing a cooling fluid to the VFD via one or more headers (Morris does not explicitly teach a cooling system for the VFD on the pump trailer 710; but teaches cooling VFD's in general (paragraph 46) using water cooling for example; it would have been obvious to one of ordinary skill in the art to utilize a similar cooling system on the pump VFD's to maintain the temperature of the components at a safe level during use);

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

connected to the at least one electric motor to control the speed of the at least one electric motor (paragraph 77, 79);

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

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

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

Morris further teaches:

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

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

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

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

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

Claims 3-4, 10-11 is/are rejected under 35 U.S.C. 103 as being unpatentable over Morris et al (US PGPub No. 2019/0203572) as applied to claims 1 above, and in further view of Mori et al (US Patent No. 7,835,140).

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

Mori teaches:

limitations from claims 3-4 and 10-11, an electric supply system including a switchgear assembly (for example FIG. 1); wherein

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

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

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

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

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

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

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

Morris does not teach cable trays;

Oehring teaches a fracturing system including pumps (110), motors (114), (VFD (115), and cable trays on a walkable portion (112) for running cables between the components (paragraph 41);

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

Claims 17-18 and 20 is/are rejected under 35 U.S.C. 103 as being unpatentable over Morris et al (US PGPub No. 2019/0203572) in view of Broussard et al (US PGPub No. 2016/0032703) in view of Benussi et al (US PGPub No. 2020/0194976).

Morris teaches:

limitations from claim 17, a hydraulic fracturing system for fracturing a subterranean formation (FIG. 7. paragraph 77), comprising: a support structure (710) having a first area, a second area, a third area, and a fourth area arranged adjacent one another (see FIG. 7A-7B with various components at different locations on the trailer 710); an electric powered, multi-plunger pump (702) with up to 15 plungers (paragraph 77), arranged in the first area, the electric powered pump coupled to a well associated with the subterranean formation (see paragraph 39 for example) and powered by at least one electric motor (704, paragraph 79), also arranged in the first area (next to the pumps 702), the electric powered pump configured to pump fluid into a wellbore associated with the well at a high pressure so that the fluid passes from the wellbore into the subterranean formation and fractures the subterranean formation (see paragraph 2); a transformer (see paragraph 78), arranged in the third area proximate the second area (near controls 708), the transformer positioned within an enclosure (see FIG. 7), the transformer distributing power to the electric pump, the power being received from at least one generator at a voltage higher than an operating voltage of the electric pump (paragraph 77 teaches the pump transport receives power from a mobile source of electricity; paragraph 51 teaches the generator of the mobile power source; paragraph 78 teaching control of the pumps); and a cooling system, arranged in the fourth area proximate the third area, the cooling system providing a cooling fluid to the VFD via one or more headers (Morris does not explicitly teach a cooling system for the VFD on the pump trailer 710; but teaches cooling VFD's in general (paragraph 46) using water cooling for example; it would have been obvious to one of ordinary skill in the art to utilize a

similar cooling system on the pump VFD's to maintain the temperature of the components at a safe level during use);

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

Morris does not explicitly teach a common bus bar;

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

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

Morris further teaches:

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

The system of claim 20, wherein the plurality of electric pumps, VFD, and transformer are mounted on a common support structure (710, paragraph 78) and a single cable couples the switchgear to the common support structure

(paragraph 44, 78 teaching the use of cables connecting the power to the pumping components; Morris does not teach a particular number of cables, however the examiner maintains that the number of cables is a matter of design choice based upon the number of pumps to be power and the amount of electricity required);

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

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

Mori teaches:

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

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

components of the assembly including a power source, switch gear, and load (via isolators DS1-2; C. 6 Line 61 through C. 7 Line 18);

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

Response to Arguments

Applicant's arguments, see papers, filed 04/09/2020, with respect to the rejection(s) of claim(s) 1-20 under Morris have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of Morris and Broussard.

Conclusion

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

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

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Devon Kramer can be reached on 571-272-7118. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <https://ppair-my.uspto.gov/pair/PrivatePair>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/CHRISTOPHER S BOBISH/
Examiner, Art Unit 3746

<i>Notice of References Cited</i>	Application/Control No. 16/597,014		Applicant(s)/Patent Under Reexamination Oehring et al.	
	Examiner CHRISTOPHER S BOBISH		Art Unit 3746	Page 1 of 1

U.S. PATENT DOCUMENTS

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	D					
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FOREIGN PATENT DOCUMENTS

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	N					
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*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.

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

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

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

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

Search Notes		
Search Notes	Date	Examiner
Inventor Name Search	12/10/2019	CSB
EAST Search	12/10/2019	CSB
Updated Search	07/08/2020	CSB

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

/CHRISTOPHER S BOBISH/ Examiner, Art Unit 3746	
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Doc code: IDS

PTO/SB/08a (02-18)

Doc description: Information Disclosure Statement (IDS) Filed

Approved for use through 11/30/2020. OMB 0651-0031

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

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

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Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	10302079	B2	2019-05-28	Kendrick	
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Examiner Initial*	Cite No	Publication Number	Kind Code ¹	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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**INFORMATION DISCLOSURE
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Art Unit	3746
Examiner Name	Christopher S. BOBISH
Attorney Docket Number	3746

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FOREIGN PATENT DOCUMENTS

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T ⁵
	1	Non-Final Office Action issued in US Patent Application No. 14/881,535 mailed May 20, 2020	
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First Named Inventor	Jared OEHRING
Art Unit	3746
Examiner Name	Christopher S. BOBISH
Attorney Docket Number	3746

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EXAMINER SIGNATURE

Examiner Signature	/CHRISTOPHER S BOBISH/	Date Considered	07/19/2020
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*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

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

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

CERTIFICATION STATEMENT

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

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

OR

☒ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

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

A certification statement is not submitted herewith.

SIGNATURE

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

Signature	/Taylor P. Evans/	Date (YYYY-MM-DD)	2020-06-19
Name/Print	Taylor P. Evans	Registration Number	60506

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

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

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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.
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.

Doc code: IDS

PTO/SB/08a (03-15)

Doc description: Information Disclosure Statement (IDS) Filed

Approved for use through 07/31/2016. OMB 0651-0031

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

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

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Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
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Attorney Docket Number	047158.100048

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

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30	5655361		1997-08-12	Kishi	

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31	6254462		2001-07-03	Kelton	
32	3061039		1962-10-30	Peters	
33	3773140		1973-11-20	Mahajan	
34	5548093		1996-08-20	Sato	
35	6202702		2001-03-20	Ohira	
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37	8534235		2013-09-17	Chandler	
38	8727068		2014-05-20	Bruin	
39	9103193		2015-08-11	Coli	
40	6164910		2000-12-26	Mayleben	
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43	8905056	2004-12-09	Kendrick
44	4151575	1979-04-24	Hogue
45	5130628	1992-07-14	Owen
46	6315523	2001-11-13	Mills
47	7336514	2008-02-26	Amarillas
48	7525264	1999-04-28	Dodge
49	8096891	2012-01-17	Lochtefeld
50	9160168	2015-10-13	Chapel
51	8146665	2012-04-03	Neal
52	8474521	2013-07-02	Kajaria

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53	9067182	2015-06-30	Nichols
54	8807960	2014-08-19	Stephenson
55	5025861	1991-06-25	Huber et al.
56	7170262	2007-01-30	Pettigrew
57	8997904	2015-04-07	Cryer
58	9051822	2015-06-09	Ayan
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62	5865247	1999-02-02	Paterson
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65	8774972	2014-07-08	Rusnak et al.
66	8905138	2014-12-09	Lundstedt et al.
67	9410410	2016-08-09	Broussard et al.
68	3881551	1975-05-06	Terry
69	4512387	1985-04-23	Rodriguez
70	4845981	1989-07-11	Pearson
71	6776227	2004-08-17	Beida
72	8037936	2011-10-18	Neuroth
73	8760657	2014-06-24	Pope
74	8857506	2014-10-14	Stone, Jr.

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76	5894888		1999-04-20	Wiemers	
77	6491098		2002-12-10	Dallas	
78	7173399		2007-02-06	Sihler	
79	7445041		2008-11-04	O'Brien	
80	7807048		2010-10-05	Collette	
81	8272439		2012-09-25	Strickland	
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87	5590976	1997-01-07	Kilheffer et al.
88	6808303	2004-10-26	Fisher, Gene
89	9587649	2017-03-07	Oehring, Jared
90	4793386	1988-12-27	Sloan, Albert H.
91	2220622	1940-11-05	Homer, P.A.
92	5736838	1998-04-07	Dove et al.
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97	8261528	2012-09-11	Chillar
98	3849662	1974-11-19	Blaskowski
99	4442665	1984-04-17	Fick et al.
100	4676063	1987-06-30	Goebel et al.
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111	9840901	2017-12-12	Oehring et al.
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113	2183364	1939-12-12	Bailey
114	7675189	2010-03-09	Grenier
115	2753940	1956-07-10	Bonner
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119	9475020		2016-10-25	Coli et al.	
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121	9738461		2017-08-22	DeGaray	
122	8139383		2012-03-20	Efrainsson	
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126	7494263		2009-02-24	Dykstra et al.	
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131	10036238		2018-07-31	Oehring	
132	10119381		2018-11-06	Oehring	
133	10107086		2018-10-23	Oehring	
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135	4432064		1984-02-14	Barker	
136	5006044		1991-04-09	Walker, Sr.	
137	4100822		1978-07-18	Rosman	
138	8851860		2014-10-07	Mail	
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11	20070187163	2007-08-16	Cone
12	20080112802	2008-05-15	Orlando
13	20090065299	2009-03-12	Vito
14	20090188181	2009-07-30	Forbis
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17	20140096974	2014-04-10	Coli
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19	20150114652	2015-04-30	Lestz
20	20150225113	2015-08-13	Lungu

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22	20130233542		2013-09-12	Shampine	
23	20150211524		2015-07-30	Broussard	
24	20120127635		2012-05-24	Grindeland	
25	20080264649		2008-10-30	Crawford	
26	20120018016		2012-01-26	Gibson	
27	20150252661		2015-09-10	Glass	
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33	20160273328	2016-09-22	Oehring
34	20160319650	2016-11-03	Oehring
35	20160290114	2016-10-06	Oehring
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44	20110005757		2011-01-13	Hebert	
45	20150159911		2015-06-11	Holt	
46	20080217024		2008-09-11	Moore	
47	20110017468		2011-01-27	Birch et al.	
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56	20130025706	2013-01-31	DeGaray et al.
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66	20100293973		2010-11-25	Erickson	
67	20050116541		2005-06-02	Seiver	
68	20080208478		2008-08-28	Ella et al.	
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70	20100051272		2010-03-04	Loree et al.	
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78	20120232728	2012-09-13	Karimi et al.
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81	20130009469	2013-01-10	Gillett
82	20140054965	2014-02-27	Jain
83	20040102109	2004-05-27	Cratty et al.
84	20160230525	2016-08-11	Lestz et al.
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86	20130175039	2013-07-11	Guidry

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99	20150068754	2015-03-12	Coli et al.
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110	20170313499	2017-11-02	Hughes et al.
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121	20140095114	2014-04-03	Thomeer
122	20150217672	2015-08-06	Shampine
123	20170328179	2017-11-16	Dykstra
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143	20050274508	2005-12-15	Folk
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145	20190003329	2019-01-03	Morris
146	20090045782	2009-02-19	Datta
147	20150097504	2015-04-09	Lamascus
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154	20140219824	2014-08-07	Bumette
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156	20190010793	2019-01-10	Hinderliter
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3	2966672	CA	2012-10-07	Evolution Well Services LLC	☒
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6	2833711	CA	2014-05-16	Broussard	☒
7	2955706	CA	2012-10-07	Coli	☒
8	2964593	CA	2017-10-15	Oehring	☒

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T ⁵
	1	UK Power Networks - Transformers to Supply Heat to Tate Modern - from Press Releases May 16, 2013.	☒
	2	Non-Final Office Action issued in corresponding Application No. 15/293,681 dated February 16, 2017.	☒

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

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

3	Non-Final Office Action issued in corresponding Application No. 15/294,349 dated March 14, 2017.	☒
4	Final Office Action issued in corresponding Application No. 15/145,491 dated January 20, 2017.	☒
5	Non-Final Office Action issued in corresponding Application No. 15/145,443 dated February 7, 2017.	☒
6	Notice of Allowance issued in corresponding Application No. 15/217,040 dated March 28, 2017.	☒
7	Notice of Allowance issued in corresponding Application No. 14/622,532 dated March 27, 2017.	☒
8	Non-Final Office Action issued in corresponding Application No. 15/291,842 dated January 6, 2017.	☒
9	Final Office Action issued in corresponding Application No. 14/622,532 dated December 7, 2016.	☒
10	Non-Final Office Action issued in corresponding Application No. 14/622,532 dated May 17, 2016.	☒
11	Final Office Action issued in corresponding Application No. 14/622,532 dated December 21, 2015.	☒
12	Non-Final Office Action issued in corresponding Application No. 14/622,532 dated August 5, 2015.	☒
13	Non-Final Office Action issued in corresponding Application No. 15/145,491 on September 12, 2016.	☒

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14	Non-Final Office Action issued in corresponding Application No. 15/217,040 dated November 29, 2016.	☒
15	Non-Final Office Action issued in corresponding Application No. 15/235,788 dated December 14, 2016.	☒
16	Non-Final Office Action issued in corresponding Application No. 15/145,491 dated May 15, 2017.	☒
17	Non-Final Office Action issued in corresponding Application No. 15/486,970 dated June 22, 2017	☒
18	Non-Final Office Action issued in corresponding Application No. 15/487,656 dated June 23, 2017	☒
19	Non-Final Office Action issued in corresponding Application No. 15/487,694 dated June 26, 2017	☒
20	Final Office Action issued in corresponding Application No. 15/294,349 dated July 6, 2017	☒
21	Non-Final Office Action issued in corresponding Application No. 14/884,363 dated September 5, 2017	☒
22	Final Office Action issued in corresponding Application No. 15/145,491 dated September 6, 2017	☒
23	Non-Final Office Action issued in corresponding Application No. 14/881,535 dated October 6, 2017	☒
24	Non-Final Office Action issued in corresponding Application No. 15/145,414 dated November 29, 2017	☒

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25	Non-Final Office Action issued in corresponding Application No. 15/644,487 dated November 13, 2017	☒
26	Canadian Office Action dated March 2, 2018 in related Canadian Patent Application No. 2,833,711	☒
27	Office Action dated April 10, 2018 in related U.S. Patent Application No. 15/294,349	☒
28	Office Action dated April 2, 2018 in related U.S. Patent Application No. 15/183,387	☒
29	Office Action dated May 29, 2018 in related U.S. Patent Application No. 15/235,716	☒
30	Canadian Office Action dated April 18, 2018 in related Canadian Patent Application No. 2,928,711	☒
31	Canadian Office Action dated June 22, 2018 in related Canadian Patent Application No. 2,886,697	☒
32	Office Action dated July 25, 2018 in related U.S. Patent Application No. 15/644,487	☒
33	Office Action dated October 4, 2018 in related U.S. Patent Application No. 15/217,081	☒
34	International Search Report and Written Opinion dated September 19, 2018 in related PCT Patent Application No. PCT/US2018/040683	☒
35	Canadian Office Action dated September 28, 2018 in related Canadian Patent Application No. 2,945,281	☒

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Attorney Docket Number	047158.100048

36	Office Action dated December 12, 2018 in related U.S. Patent Application No. 16/160,708	☒
37	International Search Report and Written Opinion dated January 2, 2019 in related PCT Patent Application No. PCT/US18/54542	☒
38	International Search Report and Written Opinion dated January 2, 2019 in related PCT Patent Application No. PCT/US18/54548	☒
39	International Search Report and Written Opinion dated December 31, 2018 in related PCT Patent Application No. PCT/US18/55913	☒
40	International Search Report and Written Opinion dated January 4, 2019 in related PCT Patent Application No. PCT/US18/57539	☒
41	Non-Final Office Action issued February 12, 2019 in related U.S. Patent Application No. 16/170,695	☒
42	International Search Report and Written Opinion dated February 15, 2019 in related PCT Patent Application No. PCT/US18/63977	☒
43	International Search Report and Written Opinion dated March 5, 2019 in related PCT Patent Application No. PCT/US18/63970	☒
44	Non-Final Office Action issued February 25, 2019 in related U.S. Patent Application No. 16/210,749	☒
45	Non-Final Office Action issued March 6, 2019 in related U.S. Patent Application No. 15/183,387	☒
46	Office Action mailed January 30, 2019 in related Canadian Patent Application No. 2,936,997	☒

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47	Office Action mailed March 1, 2019 in related Canadian Patent Application No. 2,943,275	☒
48	International Search Report and Written Opinion mailed April 10, 2019 in corresponding PCT Application No. PCT/US2019/016635	☒
49	Notice of Allowance mailed April 23, 2019 in corresponding U.S. Patent Application No. 15/635,028	☒
50	International Search Report and Written Opinion mailed July 9, 2019 in corresponding PCT Application No. PCT/US2019/027584	☒

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Examiner Name	Christopher S. Bobish
Attorney Docket Number	047158.100048

CERTIFICATION STATEMENT

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

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

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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)	2020-06-17
Name/Print	Taylor P. Evans	Registration Number	60506

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

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

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Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1	9119326		2015-08-25	McDonnell	
	2	5050673		1991-09-24	Baldrige	
	3	7308933		2007-12-18	Mayfield	
	4	6273193		2001-08-14	Hermann	
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	8	1656861		1928-01-17	Leonard	

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9	10227854		2019-03-12	Glass	
10	9932799		2018-04-03	Symchuk	
11	6936947		2005-08-30	Leijon	
12	7835140		2010-11-16	Mori	
13	10393108		2019-08-27	Chong	
14	10378326		2019-08-13	Morris	
15	10371012		2019-08-06	Davis	
16	3302069		1967-01-31	Webster	
17	9728354		2017-08-08	Skolozdra	
18	10436026		2019-10-08	Ounadjela	
19	10246984		2019-04-02	Payne	

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20	10287873	2019-05-14	Filas
21	8800652	2014-08-12	Bartko
22	9915128	2018-03-13	Hunter
23	10196878	2019-02-05	Hunter
24	9963961	2018-05-08	Hardin
25	10260327	2019-04-16	Kajaria
26	7926562	2011-04-19	Poitzsch
27	7082993	2006-08-01	Ayoub
28	8096354	2012-01-17	Poitzsch
29	9976351	2018-05-22	Randall
30	10309205	2019-06-04	Randall

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31	10407990	2019-09-10	Oehring
32	2407796	1946-09-17	Page
33	2416848	1947-03-04	Rothery
34	7894757	2011-07-26	Keast
35	1656861	1928-01-17	Leonard

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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	20150354322		2015-12-10	Vicknair	
	2	20170016433		2017-01-19	Chong	
	3	20050061548		2005-03-24	Hooper	
	4	20150053426		2015-02-26	Smith	

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5	20120247783	2012-10-04	Berner, Jr.
6	20120222865	2012-09-06	Larson
7	20090145611	2009-06-11	Pallini Jr.
8	20080041596	2008-02-21	Blount
9	20170036872	2017-02-09	Wallace
10	20180363437	2018-12-20	Coli
11	20080017369	2008-01-24	Sarada
12	20190203572	2019-07-04	Morris
13	20180245428	2018-08-30	Richards
14	20190316447	2019-10-17	Oehring
15	20190226317	2019-07-25	Payne

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16	20190100989	2019-04-04	Stewart
17	20190178057	2019-06-13	Hunter
18	20180216455	2018-08-02	Andreychuk
19	20190203567	2019-07-04	Ross
20	20170146189	2017-05-25	Herman
21	20190292891	2019-09-26	Kajaria
22	20190292866	2019-09-26	Ross
23	20190128080	2019-05-02	Ross
24	20180363437	2019-12-20	Coli
25	20170030177	2017-02-02	Oehring
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27	20170036872	2017-02-09	Wallace
28	20150300336	2015-10-22	Hernandez
29	20170314979	2017-11-02	Ye
30	20140379300	2014-12-25	Devine
31	20170226842	2017-08-10	Omont

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FOREIGN PATENT DOCUMENTS

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	1	2787814	CA		2014-02-21	Pawlick		×
	2	2978706	CA		2016-09-09	Payne		☒
	3	2945579	CA		2019-10-08	Oehring		☒
	4	2944980	CA		2017-02-12	Oehring		☒

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5	2849825	CA		2018-07-17	Bartko		☒
6	3000322	CA		2013-04-18	Bartko		☒
7	2797081	CA		2019-09-10	Hunter		☒
8	3050131	CA		2011-11-03	Hunter		☒
9	3018485	CA		2017-08-10	Herman		☒
10	2482943	CA		2011-05-24	Ayoub		☒
11	2919649	CA		2019-02-26	Randall		☒
12	2919666	CA		2019-07-16	Randall		☒
13	3006422	CA		2017-06-01	Green		☒
14	2406801	CA		2001-11-01	Demetrius		☒

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	1	International Search Report and Written Opinion mailed January 2, 2020 in related PCT Application No. PCT/US19/55325	×
	2	Notice of Allowance mailed January 9, 2020 in related U.S. Patent Application No. 16/570,331	☒
	3	Non-Final Office Action mailed December 23, 2019 in related U.S. Patent Application No. 16/597,008	☒
	4	Non-Final Office Action mailed March 3, 2020 in related U.S. Patent Application No. 16/152,695	☒
	5	Non-Final Office Action mailed December 6, 2019 in related U.S. Patent Application No. 16/564,186	☒
	6	International Search Report and Written Opinion mailed November 26, 2019 in related PCT Application No. PCT/US19/51018	☒
	7	International Search Report and Written Opinion mailed February 11, 2020 in related PCT Application No. PCT/US2019/055323	☒
	8	Final Office Action mailed March 31, 2020 in related U.S. Patent Application No. 15/356,436	☒

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☒ A certification statement is not submitted herewith.

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Signature	/Taylor P. Evans/	Date (YYYY-MM-DD)	2020-06-17
Name/Print	Taylor P. Evans	Registration Number	60506

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Doc code: IDS

PTO/SB/08a (02-18)

Doc description: Information Disclosure Statement (IDS) Filed

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Application Number	16597014
Filing Date	2019-10-09
First Named Inventor	Jared Oehring
Art Unit	3674
Examiner Name	Christopher S. Bobish
Attorney Docket Number	047158.100048

U.S.PATENTS						Remove
Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	10280724		2019-05-07	Hinderliter	
	2	10254732		2019-04-09	Oehring	
	3	10232332		2019-03-19	Oehring	
	4	5172009		1992-12-15	Mohan	
	5	6484490		2002-11-26	Olsen	
	6	7581379		2009-09-01	Yoshida	
	7	8616005		2013-12-31	Cousino	
	8	10008880		2018-06-26	Vicknair	

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9	5755096	1998-05-26	Holleyman
10	2407796	1946-09-17	Page
11	2416848	1947-03-04	Rothery
12	7984757	2011-07-26	Keast
13	10407990	2019-09-10	Oehring

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	1	20170218727		2017-08-03	Oehring	
	2	20150136043		2015-05-21	Shaaban	
	3	20160105022		2016-04-14	Oehring	
	4	20160265457		2016-09-15	Stephenson	

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5	20140219824	2014-08-07	Bumette
6	20160281484	2016-09-29	Lestz
7	20190010793	2019-01-10	Hinderliter
8	20150211512	2015-07-30	Wiegman
9	20170234250	2017-08-17	Janik
10	20120049625	2012-03-01	Hopwood
11	20190120024	2019-04-25	Oehring
12	20190010793	2019-01-10	Hinderliter
13	20180028992	2018-02-01	Stegemoeller
14	20170218727	2017-08-03	Oehring
15	20150136043	2015-05-21	Shaaban

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16	20190112910		2019-04-18	Oehring	
17	20170096885		2017-04-06	Oehring	
18	20100045109		2010-02-25	Arnold	
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21	20140060658		2014-03-06	Hains	
22	20150027712		2015-01-29	Vicknair	
23	20160290563		2016-10-06	Diggins	
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25	20140255214		2014-09-11	Bumette	
26	20190245348		2019-08-08	Hinderliter	

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27	20190211661	2019-07-11	Reckels
28	20190169971	2019-06-06	Oehring
29	20100038907	2010-02-18	Hunt
30	20190162061	2019-05-30	Stepheson
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32	20190063309	2019-02-28	Davis
33	20040167738	2004-08-26	Miller

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	1	2707269	CA		2010-12-09	Kidd		×

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	1	Non-Final Office Action issued in corresponding Application No. 16/170,695 dated June 7, 2019	×
	2	Non-Final Office Action issued in corresponding Application No. 16/268,030 dated May 10, 2019	☒
	3	Final Office Action issued in corresponding Application No. 16/210,749 dated June 11, 2019	☒
	4	Canadian Office Action mailed May 30, 2019 in corresponding CA Application No. 2,833,711	☒
	5	Canadian Office Action mailed June 20, 2019 in corresponding CA Application No. 2,964,597	☒
	6	International Search Report and Written Opinion mailed July 9, 2019 in related PCT Application No. PCT/US2019/027584	☒
	7	Office Action mailed June 7, 2019 in related U.S. Application No. 16/268,030	☒
	8	International Search Report and Written Opinion mailed September 11, 2019 in related PCT Application No. PCT/US2019/037493	☒
	9	Office Action mailed August 19, 2019 in related U.S. Patent Application No. 15/356,436	☒
	10	Office Action mailed October 2, 2019 in related U.S. Patent Application No. 16/152,732	☒

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11	Office Action mailed September 11, 2019 in related U.S. Patent Application No. 16/268,030	☒
12	Office Action mailed October 11, 2019 in related U.S. Patent Application No. 16/385,070	☒
13	Office Action mailed September 3, 2019 in related U.S. Patent Application No. 15/994,772	☒
14	Office Action mailed September 20, 2019 in related U.S. Patent Application No. 16/443,273	☒
15	Canadian Office Action mailed October 1, 2019 in related Canadian Patent Application No. 2,936,997	☒
16	International Search Report and Written Opinion mailed November 26, 2019 in related PCT Application No. PCT/US19/51018	☒
17	Office Action mailed December 6, 2019 in related U.S. Patent Application No. 16/564,186	☒

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Examiner Signature	/CHRISTOPHER S BOBISH/	Date Considered	07/19/2020
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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)	2020-06-17
Name/Print	Taylor P. Evans	Registration Number	60506

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

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	1	10302079	B2	2019-05-28	Kendrick	
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	1	20170159654	A1	2017-06-08	Kendrick	
	2	20130180722	A1	2013-07-18	Olarte Caro et al.	
	3	20130299167	A1	2013-11-14	Fordyce et al.	
	4	20110052423	A1	2011-03-03	Gambier et al.	
	5	20030079875	A1	2003-01-05	Weng	

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6	20170226838	A1	2017-08-10	Ceizobka et al.
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	1	Non-Final Office Action issued in US Patent Application No. 14/881,535 mailed May 20, 2020	
	2	Non-Final Office Action issued in US Patent Application No. 15/145,443 mailed May 8, 2020	
	3	Non-Final Office Action issued in US Patent Application No. 16/458,696 mailed May 22, 2020	
	4	International Search Report and Written Opinion issued in PCT/US2020/023809 mailed June 2, 2020	
	5	KARIN, "Duel Fuel Diesel Engines," (2015), Taylor & Francis, pp 62-63, Retrieved from https://app.knovel.com/hotlink/doc/id:kpDFDE0001/dual-fueal-diesel-engines/duel-fuel-diesel-engines (Year 2015)	

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6	GOODWIN, "High-voltage auxilliary switchgear for power stations," Power Engineering Journal, 1989, 10 pg. (Year 1989)
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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 inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

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

PCT

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

(PCT Rule 44.1)

Date of mailing
(day/month/year)

02 JUN 2020

Applicant's or agent's file reference
047158.500051

FOR FURTHER ACTION See paragraphs 1 and 4 below

International application No.
PCT/US2020/023809

International filing date
(day/month/year) 20 March 2020

Applicant U.S. WELL SERVICES, LLC

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

Filing of amendments and statement under Article 19:

The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

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

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

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

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

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

4. Reminders

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

Shortly after the expiration of 18 months from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90bis.1 and 90bis.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 45bis.1). The procedure for requesting supplementary international search is described in the *PCT Applicant's Guide*, International Phase, paragraphs 8.006-8.032.

Name and mailing address of the ISA/US
Mail Stop PCT, Attn: ISA/US
Commissioner for Patents
P.O. Box 1450, Alexandria, VA 22313-1450
Facsimile No. 571-273-8300

Authorized officer:

Blaine R. Copenheaver

PCT Helpdesk: 571-272-4300
Telephone No. PCT OSP: 571-272-7714

Form PCT/ISA/220 (July 2017)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 047158.500051	FOR FURTHER ACTION		see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. PCT/US2020/023809	International filing date (day/month/year) 20 March 2020	(Earliest) Priority Date (day/month/year) 20 March 2019	
Applicant U.S. WELL SERVICES, LLC			

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

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

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

1. Basis of the report

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

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

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

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

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

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

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

4. With regard to the title,

☒ the text is approved as submitted by the applicant.

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

5. With regard to the abstract,

☒ the text is approved as submitted by the applicant.

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

6. With regard to the drawings,

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

☒ as suggested by the applicant.

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

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

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

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2020/023809

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - E21B 44/00; E21B 43/18; E21B 43/25; E21B 43/26; E21B 47/00; E21B 49/00 (2020.01)
 CPC - E21B 44/00; E21B 43/16; E21B 43/25; E21B 43/26; E21B 43/267; E21B 47/00; E21B 49/00;
 E21B 49/008 (2020.05)

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

See Search History document

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

USPC - 73/152.18; 166/250.01; 166/250.1; 166/305.1; 166/308.1; 702/11 (keyword delimited)

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

See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2016/0258267 A1 (STEWART & STEVENSON, LLC) 08 September 2016 (08.09.2016) entire document	8, 9, 13
Y		1, 4-7, 10, 12
Y	US 2013/0180722 A1 (SCHLUMBERGER TECHNOLOGY CORPORATION) 18 July 2013 (18.07.2013) entire document	1, 4-7, 10
Y	US 2013/0299167 A1 (GASFRAC ENERGY SERVICES INC.) 14 November 2013 (14.11.2013) entire document	4-6, 12
A	US 2011/0052423 A1 (GAMBIER et al) 03 March 2011 (03.03.2011) entire document	1-15
A	US 2003/0079875 A1 (WENG) 01 May 2003 (01.05.2003) entire document	1-15
A	US 2017/0226838 A1 (GAS TECHNOLOGY INSTITUTE) 10 August 2017 (10.08.2017) entire document	1-15

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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

"&" document member of the same patent family

Date of the actual completion of the international search

11 May 2020

Date of mailing of the international search report

02 JUN 2020

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents

P.O. Box 1450, Alexandria, VA 22313-1450

Facsimile No. 571-273-8300

Authorized officer

Blaine R. Copenheaver

PCT Helpdesk: 571-272-4300

PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (January 2015)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

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

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

Date of mailing
(day/month/year)

02 JUN 2020

Applicant's or agent's file reference
047158.500051

FOR FURTHER ACTION

See paragraph 2 below

International application No.

PCT/US2020/023809

International filing date (day/month/year)

20 March 2020

Priority date (day/month/year)

20 March 2019

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

IPC(8) - E21B 44/00; E21B 43/18; E21B 43/25; E21B 43/26; E21B 47/00; E21B 49/00 (2020.01)

CPC - E21B 44/00; E21B 43/16; E21B 43/25; E21B 43/26; E21B 43/267; E21B 47/00; E21B 49/00;
E21B 49/008 (2020.05)

Applicant **U.S. WELL SERVICES, LLC**

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

- ☒ 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 43bis.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 66.1bis(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
Mail Stop PCT, Attn: ISA/US
Commissioner for Patents
P.O. Box 1450, Alexandria, VA 22313-1450
Facsimile No. 571-273-8300

Date of completion of this opinion

11 May 2020

Authorized officer

Blaine R. Copanheaver

PCT Helpdesk: 571-272-4350
PCT OSP: 571-272-7774

Form PCT/ISA/237 (cover sheet) (January 2015)

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US2020/023809

Box No. I Basis of this opinion

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

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

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

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

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

- ☐ in the form of an Annex C/ST.25 text file.
☐ on paper or in the form of an image file.

b. ☐ furnished together with the international application under PCT Rule 13ter.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 13ter.1(a)).
☐ on paper or in the form of an image file (Rule 13ter.1(b) and Administrative Instructions, Section 713).

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

5. Additional comments:

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/US2020/023809

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

1. Statement

Novelty (N)	Claims	1-7, 10-12, 14, 15	YES
	Claims	8, 9, 13	NO
Inventive step (IS)	Claims	2, 3, 11, 14, 15	YES
	Claims	1, 4-10, 12, 13	NO
Industrial applicability (IA)	Claims	1-15	YES
	Claims	None	NO

2. Citations and explanations:

Claims 8, 9, and 13 lack novelty under PCT Article 33(2) as being anticipated by Stewart & Stevenson, LLC (hereinafter Stewart & Stevenson).

Regarding Claim 8, Stewart & Stevenson discloses a method for regulating one or more pumping rates of an electrically powered hydraulic fracturing pump system (title, "an embodiment includes a method for computational control of the speeds of the AC motors such that hydraulic fracturing design parameters, among these being injection rate and pressures, can be automatically achieved. Using this method, an operator can enter a target injection rate and injection pressure limit, or alternatively,...", para. [0105]), comprising: receiving a desired pumping rate for a first pump ("q Target is the target injection rate", para. [0116]); determining a current pumping rate of an adjacent or opposite second pump ("q is the measured injection rate", para. [0116]); q (current pumping rate) can be determined for any of the pumps in the group of pumps); determining a difference between the desired pumping rate and the current pumping rate ("q Error is the injection rate error defined as q Limit - q when in auto pressure control and defined as q Target - q when in auto rate control", para. [0116]) is within a threshold amount ("As illustrated in FIGS. 15B and 15C, a first step 1040a, 1040b of calculating the error values is implemented followed by a next step 1050a, 1050b of determining whether the measured pressure or measured injection rate exceeds a tolerance value in addition to the target injection rate or a target pressure, depending on whether auto rate or auto pressure is selected, for determining whether injection rate should be decreased following the decrease injection rate module of FIG. 15E. If not, the measured pressure or the measured injection rate is compared to the pressure limit or injection rate limit and the limit minus the tolerance value to determine whether the value falls within a "do not exceed" band in a next step 1060a, 1060b. If yes, the current injection rate is maintained. If not, the measured pressure or the measured injection rate is compared with the pressure limit or the injection rate limit,...to determine whether the injection rate should be increased following the increase injection rate module of FIG. 15D", para. [0117]); applying an adjustment to the desired pumping rate ("Referring to FIGS. 15D and 15E, an increase injection rate module or a decrease injection rate module is illustrated, respectively, for determining which pump to increase the injection rate for and the value of the change in revolutions per minute (RPM) for the selected pump,...in the next operations 1200a, 1200b, the pump for which the injection rate is increased or decreased is selected. In a preferred embodiment, the processing algorithm of the system control unit seeks to maximize the efficiency of the overall system operation,...", para. [0118]).

Regarding Claim 9, Stewart & Stevenson discloses the method of claim 8, and further comprising: determining the difference between the desired pumping rate and the current pumping rate exceeds a threshold amount ("q Error is the injection rate error defined as q Limit - q when in auto pressure control and defined as q Target - q when in auto rate control", para. [0116]); and modifying at least one of the current pumping rate or the desired pumping rate ("As illustrated in FIGS. 15B and 15C, a first step 1040a, 1040b of calculating the error values is implemented followed by a next step 1050a, 1050b of determining whether the measured pressure or measured injection rate exceeds a tolerance value in addition to the target injection rate or a target pressure, depending on whether auto rate or auto pressure is selected, for determining whether injection rate should be decreased following the decrease injection rate module of FIG. 15E. If not, the measured pressure or the measured injection rate is compared to the pressure limit or injection rate limit and the limit minus the tolerance value to determine whether the value falls within a "do not exceed" band in a next step 1060a, 1060b. If yes, the current injection rate is maintained. If not, the measured pressure or the measured injection rate is compared with the pressure limit or the injection rate limit,...to determine whether the injection rate should be increased following the increase injection rate module of FIG. 15D", para. [0117]).

Regarding Claim 13, Stewart & Stevenson discloses the method of claim 8, and further discloses wherein information is transmitted from the one or more pumps from respective sensors ("In this example, a hydraulic fracturing pump 710a may include a pressure transmitter that provides a signal for the pump discharge pressure. The pump discharge pressure is displayed locally and remotely at the system control unit 650", para. [0062]).

Supplemental Box

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

Continuation of:

Claims 1, 7, and 10 lack an inventive step under PCT Article 33(3) as being obvious over Stewart & Stevenson, LLC (hereinafter Stewart & Stevenson) in view of Schlumberger Technology Corporation (hereinafter Schlumberger).

Regarding Claim 1, Stewart & Stevenson discloses a method for regulating a pumping rate of an electrically powered hydraulic fracturing pump (title, "an embodiment includes a method for computational control of the speeds of the AC motors such that hydraulic fracturing design parameters, among these being injection rate and pressures, can be automatically achieved. Using this method, an operator can enter a target injection rate and injection pressure limit, or alternatively,...", para. [0105]), comprising: receiving a rate limit for one or more pumps ("q Limit is the injection rate limit", para. [0116]), determining a desired pumping rate for the one or more pumps ("q Target is the target injection rate", para. [0116]); determining a current rate of the one or more pumps ("q is the measured injection rate", para. [0116]); comparing the desired pumping rate to the current rate ("q Error is the injection rate error defined as q Limit - q when in auto pressure control and defined as q Target - q when in auto rate control", para. [0116]); determining, based at least in part on the comparison, an adjustment to the current rate; determining the adjustment does not exceed the rate limit; and applying the adjustment to the current rate of the one or more pumps ("As illustrated in FIGS. 15B and 15C, a first step 1040a, 1040b of calculating the error values is implemented followed by a next step 1050a, 1050b of determining whether the measured pressure or measured injection rate exceeds a tolerance value in addition to the target injection rate or a target pressure, depending on whether auto rate or auto pressure is selected, for determining whether injection rate should be decreased following the decrease injection rate module of FIG. 15E. If not, the measured pressure or the measured injection rate is compared to the pressure limit or injection rate limit and the limit minus the tolerance value to determine whether the value falls within a "do not exceed" band in a next step 1060a, 1060b. If yes, the current injection rate is maintained. If not, the measured pressure or the measured injection rate is compared with the pressure limit or the injection rate limit,...to determine whether the injection rate should be increased following the increase injection rate module of FIG. 15D", para. [0117]). Stewart & Stevenson fails to explicitly disclose receiving a step rate limit for one or more pumps, the step rate limit corresponding to at least one of a minimum step rate or a maximum step rate.

Schlumberger, in the field of step rate test procedure in the fracturing process (para. [0025]), teaches measuring a step rate limit for one or more pumps, the step rate limit corresponding to at least one of a minimum step rate or a maximum step rate ("Referring generally to FIG. 2, the fracturing process may involve pumping the injection fluid, e.g. water or another suitable fluid, in a "step rate test" procedure followed by the flow back,...The step rate test procedure includes a series of successively higher injection rates for which pressure values are read and recorded at each rate and time step 46, as illustrated in FIG. 2. In FIG. 2, a plot of injection rates and the corresponding stabilized pressure values are graphically represented as a constant slope straight line 46", para. [0025]; fig. 2 shows the maximum pump rate during the step rate test).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Stewart & Stevenson with the teaching of Schlumberger for the purpose of measuring the limits for the pumping rate and thereby finding the formation or breakdown points associated with the injection rates (para. [0025] of Schlumberger).

Regarding Claim 7, modified Stewart & Stevenson discloses the method of claim 1, and further discloses wherein information is transmitted from the one or more pumps from respective sensors ("In this example, a hydraulic fracturing pump 710a may include a pressure transmitter that provides a signal for the pump discharge pressure. The pump discharge pressure is displayed locally and remotely at the system control unit 650", para. [0062]).

Regarding Claim 10, Stewart & Stevenson discloses the method of claim 8.

Stewart & Stevenson fails to explicitly disclose determining a step rate for the first pump.

Schlumberger, in the field of step rate test procedure in the fracturing process (para. [0025]), teaches determining a step rate for the first pump ("Referring generally to FIG. 2, the fracturing process may involve pumping the injection fluid, e.g. water or another suitable fluid, in a "step rate test" procedure followed by the flow back,...The step rate test procedure includes a series of successively higher injection rates for which pressure values are read and recorded at each rate and time step 46, as illustrated in FIG. 2. In FIG. 2, a plot of injection rates and the corresponding stabilized pressure values are graphically represented as a constant slope straight line 48", para. [0025]).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Stewart & Stevenson with the teaching of Schlumberger for the purpose of measuring the limits for the pumping rate and thereby finding the formation or breakdown points associated with the injection rates (para. [0025] of Schlumberger).

Claims 4-6 lack an inventive step under PCT Article 33(3) as being obvious over Stewart & Stevenson, LLC (hereinafter Stewart & Stevenson) in view of Schlumberger Technology Corporation (hereinafter Schlumberger) and Gasfrac Energy Services Inc. (hereinafter Gasfrac Energy).

Regarding Claim 4, modified Stewart & Stevenson discloses the method of claim 1.

Stewart & Stevenson fails to explicitly disclose wherein the desired pumping rate corresponds to at least a fraction of a desired overall pumping rate for a group of pumps.

Gasfrac Energy, in the field of fracturing method (abstract), teaches wherein the desired pumping rate corresponds to at least a fraction of a desired overall pumping rate for a group of pumps ("A first stream of LPG and gelling agent may be pumped with first frac pressure pump 16. A second stream of lubricated proppant may be pumped with second frac pressure pump 18,...The first stream and the second stream are combined within wellhead 32 into a combined stream (FIG. 2). In some cases the ratio by volume of the first stream to the second stream is between 9:1 and 1:9, although other ratios may be used....The method may be controlled using one or more controllers such as command center truck 50 (FIG. 1). Truck 50 may be connected wirelessly or by wired connection to control one or more or all of the operations of the frac components discussed herein", para. [0040]).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Stewart & Stevenson with the teaching of Gasfrac Energy for the purpose of providing multiple supplies to the frac pump and thereby increasing the job size performed by the frac pump (para. [0041] of Gasfrac Energy).

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US2020/023809

Supplemental Box

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

Continuation of:

Regarding Claim 5, modified Stewart & Stevenson discloses the method of claim 4.

Stewart & Stevenson fails to explicitly disclose wherein at least two pumps of the group of pumps operates at a different pumping rate. Gasfrac Energy, in the field fracturing method (abstract), teaches wherein at least two pumps of the group of pumps operates at a different pumping rate ("A first stream of LPG and gelling agent may be pumped with first frac pressure pump 16. A second stream of lubricated proppant may be pumped with second frac pressure pump 18....The first stream and the second stream are combined within wellhead 32 into a combined stream (FIG. 2), in some cases the ratio by volume of the first stream to the second stream is between 9:1 and 1:9, although other ratios may be used.The method may be controlled using one or more controllers such as command center truck 50 (FIG. 1). Truck 50 may be connected wirelessly or by wired connection to control one or more or all of the operations of the frac components discussed herein", para. [0040]).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Stewart & Stevenson with the teaching of Gasfrac Energy for the purpose of providing multiple supplies to the frac pump and thereby increasing the job size performed by the frac pump (para. [0041] of Gasfrac Energy).

Regarding Claim 6, modified Stewart & Stevenson discloses the method of claim 4.

Stewart & Stevenson fails to explicitly disclose wherein at least two pumps of the group of pumps have different adjustments.

Gasfrac Energy, in the field fracturing method (abstract), teaches wherein at least two pumps of the group of pumps have different adjustments ("A first stream of LPG and gelling agent may be pumped with first frac pressure pump 16. A second stream of lubricated proppant may be pumped with second frac pressure pump 18....The first stream and the second stream are combined within wellhead 32 into a combined stream (FIG. 2), in some cases the ratio by volume of the first stream to the second stream is between 9:1 and 1:9, although other ratios may be used.The method may be controlled using one or more controllers such as command center truck 50 (FIG. 1). Truck 50 may be connected wirelessly or by wired connection to control one or more or all of the operations of the frac components discussed herein", para. [0040]; this shows that the adjustment rate for first frac pressure pump 16 and second frac pressure pump 18 are different).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Stewart & Stevenson with the teaching of Gasfrac Energy for the purpose of providing multiple supplies to the frac pump and thereby increasing the job size performed by the frac pump (para. [0041] of Gasfrac Energy).

Claim 12 lacks an inventive step under PCT Article 33(3) as being obvious over Stewart & Stevenson, LLC (hereinafter Stewart & Stevenson) in view of Gasfrac Energy Services Inc. (hereinafter Gasfrac Energy).

Regarding Claim 12, Stewart & Stevenson discloses the method of claim 8.

Stewart & Stevenson fails to explicitly disclose wherein the desired pumping rate corresponds to at least a fraction of a desired overall pumping rate for a group of pumps.

Gasfrac Energy, in the field fracturing method (abstract), teaches wherein the desired pumping rate corresponds to at least a fraction of a desired overall pumping rate for a group of pumps ("A first stream of LPG and gelling agent may be pumped with first frac pressure pump 16. A second stream of lubricated proppant may be pumped with second frac pressure pump 18....The first stream and the second stream are combined within wellhead 32 into a combined stream (FIG. 2), in some cases the ratio by volume of the first stream to the second stream is between 9:1 and 1:9, although other ratios may be used....The method may be controlled using one or more controllers such as command center truck 50 (FIG. 1). Truck 50 may be connected wirelessly or by wired connection to control one or more or all of the operations of the frac components discussed herein", para. [0040]).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Stewart & Stevenson with the teaching of Gasfrac Energy for the purpose of providing multiple supplies to the frac pump and thereby increasing the job size performed by the frac pump (para. [0041] of Gasfrac Energy).

Claims 2, 3, 11, 14, and 15 meet the criteria set out in PCT Article 33(2)-(3), because the prior art does not teach or fairly suggest:

Regarding claim 2, the prior art of record, individually or in combination, does not teach or fairly suggest, further comprising: determining a damage accumulation rate for the one or more pumps; and determining the damage accumulation rate is below a threshold.

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

Gambier et al. (hereinafter Gambier) discloses determining a damage accumulation rate for the one or more pumps ("In a further embodiment, a method, comprises: attaching a sensor to a pump body comprising a piston bore, an inlet bore and an outlet bore, wherein the sensor comprises one or more for temperature, pressure, acceleration, inclination, humidity, light, density, viscosity, flow rate, chemical composition, strain, deformation, positron decay, acoustic emission, Barkhausen noise, accumulated fatigue damage or a combination thereof", para. [0031]).

However Gambier fails to disclose determining the damage accumulation rate is below a threshold.

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US2020/023809

Supplemental Box

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

Continuation of:

Regarding claim 3, the prior art of record, individually or in combination, does not teach or fairly suggest, further comprising: determining a damage accumulation rate for the one or more pumps; determining the damage accumulation rate exceeds a threshold; and transmitting a warning.

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

Gambier discloses determining a damage accumulation rate for the one or more pumps ("in a further embodiment, a method, comprises: attaching a sensor to a pump body comprising a piston bore, an inlet bore and an outlet bore, wherein the sensor comprises one or more for temperature, pressure, acceleration, inclination, humidity, light, density, viscosity, flow rate, chemical composition, strain, deformation, positron decay, acoustic emission, Barkhausen noise, accumulated fatigue damage or a combination thereof", para. [0031]). However Gambier fails to disclose determining the damage accumulation rate exceeds a threshold; and transmitting a warning.

Regarding claim 11, the prior art of record, individually or in combination, does not teach or fairly suggest, wherein the step rate is based, at least in part, on a pump speed, crankshaft rpm, or critical plunger speed.

The following prior art is made of record to support and further define the reasons that claim 11 meets the criteria set out in PCT Article 33(2)-(3):

Schlumberger discloses measuring a step rate limit ("Referring generally to FIG. 2, the fracturing process may involve pumping the injection fluid, e.g. water or another suitable fluid, in a "step rate test" procedure followed by the flow back....The step rate test procedure includes a series of successively higher injection rates for which pressure values are read and recorded at each rate and time step 46, as illustrated in FIG. 2. In FIG. 2, a plot of injection rates and the corresponding stabilized pressure values are graphically represented as a constant slope straight line 48 ", para. [0025]; fig. 2 shows the maximum pump rate during the step rate test). However Schlumberger fails to disclose wherein the step rate is based, at least in part, on a pump speed, crankshaft rpm, or critical plunger speed.

Regarding claim 14, the prior art of record, individually or in combination, does not teach or fairly suggest, further comprising: determining a damage accumulation rate for the first pump; and determining the damage accumulation rate is below a damage threshold.

The following prior art is made of record to support and further define the reasons that claim 14 meets the criteria set out in PCT Article 33(2)-(3):

Gambier discloses determining a damage accumulation rate for the first pump ("in a further embodiment, a method, comprises: attaching a sensor to a pump body comprising a piston bore, an inlet bore and an outlet bore, wherein the sensor comprises one or more for temperature, pressure, acceleration, inclination, humidity, light, density, viscosity, flow rate, chemical composition, strain, deformation, positron decay, acoustic emission, Barkhausen noise, accumulated fatigue damage or a combination thereof", para. [0031]). However Gambier fails to disclose determining the damage accumulation rate is below a damage threshold.

Regarding claim 15, the prior art of record, individually or in combination, does not teach or fairly suggest, further comprising: determining a damage accumulation rate for the first pump; determining the damage accumulation rate exceeds a damage threshold; transmitting a warning.

The following prior art is made of record to support and further define the reasons that claim 15 meets the criteria set out in PCT Article 33(2)-(3):

Gambier discloses further comprising: determining a damage accumulation rate for the first pump ("in a further embodiment, a method, comprises: attaching a sensor to a pump body comprising a piston bore, an inlet bore and an outlet bore, wherein the sensor comprises one or more for temperature, pressure, acceleration, inclination, humidity, light, density, viscosity, flow rate, chemical composition, strain, deformation, positron decay, acoustic emission, Barkhausen noise, accumulated fatigue damage or a combination thereof", para. [0031]).

However Gambier fails to disclose determining the damage accumulation rate exceeds a damage threshold; transmitting a warning.

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

Search History:

Limited Classification Search

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

CPC Class/Subclass(es): E21B 44/00; E21B 43/16; E21B 43/25; E21B 43/26; E21B 43/267; E21B 47/00; E21B 49/00; E21B 49/008 (2020.05)

IPC (8) Class/Subclass(es): E21B 44/00; E21B 43/18; E21B 43/25; E21B 43/26; E21B 47/00; E21B 49/00 (2020.01)

U.S. Class/Subclass(es): 73/152.18; 166/250.01; 166/250.1; 166/305.1; 166/308.1; 702/11

See Global Search Results.

Global Patent Literature Text Search

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

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

#	Search query	Results
1	(("US WELL SERVICES")/NPAN OR ("MATLIN & ACQUISITION")/NPAN OR ("USWS FLEET 10")/NPAN OR ("USWS FLEET II")/NPAN)	46
2	1 AND ((FRACTUR+) 5D (PUMP+))	38
3	2 AND ((PUMP+) 3D (RATE?))	4
4	1 AND ((STEP+) 3D (RATE?))	0
5	1 AND ((PUMP+) 5D (RATE?))	5
6	(US9970278)/PN	1
7	..CITBF NOSOURCE SS 6 1 RANKED	312
8	7 AND ((FRACTUR+) 5D (PUMP+))	64
9	7 AND ((STEP+) 3D (RATE?))	1
10	(US5006044)/PN	1
11	..CITBF NOSOURCE SS 10 1 RANKED	197
12	11 AND ((PUMP+) 3D (RATE?))	18
13	(US20130306322)/PN	1
14	..CITBF NOSOURCE SS 13 1 RANKED	37
15	(US10254732)/PN	1
16	(WO2017201526 OR US5813463)/PN	2

17	..CITBF NOSOURCE SS 16 2 RANKED	2
18	..CITBF NOSOURCE SS 16 1 RANKED	30
19	(US20160290114)/PN	1
20	..CITBF NOSOURCE SS 19 1 RANKED	312
21	20 AND ((STEP) 3D (RATE?))	0
22	20 AND (FRACTUR+)	106
23	22 AND ((PUMP+) 5D (RATE?))	17
24	(EP3265218)/PN	1
25	..CITBF NOSOURCE SS 24 1 RANKED	29
26	(US4192182 OR US20130180722 OR WO200314524)/PN	3
27	..CITBF NOSOURCE SS 26 1 RANKED	39
28	(WO200314524)/PN	1
29	..CITBF NOSOURCE SS 28 1 RANKED	37
30	(US9027641 OR US8863833 OR US8490704 OR US8210257 OR US20120150515)/PN	5
31	..CITBF NOSOURCE SS 30 2 RANKED	39
32	(US3058521 OR US4192182 OR US4372380 OR US5165276 OR US6364015)/PN	5
33	..CITBF NOSOURCE SS 32 4 RANKED	19
34	(US20140151043 OR US7569523)/PN	2
35	..CITBF NOSOURCE SS 34 1 RANKED	14
36	(US10563649)/PN	1
37	(WO2017201526 OR US5050674 OR WO200314524)/PN	3
38	..CITBF NOSOURCE SS 37 3 RANKED	37
39	..CITBF NOSOURCE SS 37 2 RANKED	2
40	(US6364015)/PN	1
41	((((PUMP+) 3D (RATE?)) AND ((FRAC+) 3D (PUMP+)))/TI/AB/CLMS/TX	3875
42	41 AND ((STEP) 3D (RATE?))	42
43	(WO2019217480)/PN	1
44	..CITBF NOSOURCE SS 43 1 RANKED	5
45	41 AND ((DESIR+) AND ((PUMP+) 3D (RATE?)))	271
46	41 AND ((CURRENT) AND ((PUMP+) 3D (RATE?)))	109
47	45 AND 46	50

48	((FRAC+) 5D (PUMP+)) AND ((STEP) 3D (RATE))/TI/AB/CLMS/TX	669
49	48 AND ((PUMP+) 5D (CONTROL+))	111
50	49 AND (+PROCESS+)	69
51	(WO2018125176)/PN	1
52	..CITBF NOSOURCE SS 51 1 RANKED	8
53	(WO201703501)/PN	1
54	..CITBF NOSOURCE SS 53 1 RANKED	29
55	((((STEP) 3D (RATE?)) AND (TEST?)) AND ((FRACTUR+) 3D (PUMP+)))/TI/AB/CLMS/TX	141
56	55 AND ((FLOW+) 3D (RATE?))	43
57	(WO2017201526)/PN	1
58	..CITBF NOSOURCE SS 57 1 RANKED	2
59	((((FRACTUR+) 5D (PUMP+)) AND ((FLOW+) 3D (RATE?)))/TI/AB/CLMS/TX	4836
60	59 AND ((DESIR+) 3D (RATE?))	47
61	59 AND (((ADJUST+) OR (MODIFY+)) 8D ((FLOW+) 3D (RATE?)))	79
62	61 AND ((CONTROL+) OR (+PROCESS+))	72
63	62 AND (THRESHOLD+)	4
64	61 AND (((MAX+) OR (MIN+)) 5D (LIMIT+))	3
65	(US9879514)/PN	1
66	..CITBF NOSOURCE SS 65 1 RANKED	15
67	(WO201735557 OR US3705532)/PN	2
68	..CITBF NOSOURCE SS 67 SET	17
69	((((REGULAT+) 8D ((PUMP+) 3D (RATE?))) AND ((FRACTUR+) 5D (PUMP+)))/TI/AB/CLMS/TX	59
70	((((DIFFERENC+) 5D (RATE?)) AND ((FRACTUR+) 5D (PUMP+)))/TI/AB/CLMS/TX	214
71	70 AND (THRESHOLD+)	5
72	70 AND ((PUMP+) 5D (RATE?))	38
73	(EP3265218)/PN	1
74	..CITBF NOSOURCE SS 73 1 RANKED	29
75	((((FRAC+) 5D (PUMP+)) AND ((PUMP+) 3D (RATE?))) AND (THRESHOLD+))/TI/AB/CLMS/TX	926
76	75 AND ((CONTROL+) OR (+PROCESS+))	732
77	76 AND (((ADJUST+) OR (MODIFY+)) 8D ((FLOW+) 3D (RATE?)))	51

78	75 AND ((TARGET+) 5D (RATE?))	16
79	(WO2018125176)/PN	1
80	..CITBF NOSOURCE SS 79 1 RANKED	8
81	(((((FRAC+) 5D (PUMP+)) AND ((PUMP+) 3D (RATE?))) AND (TARGET+))/TI/AB/CLMS/TX	1726
82	81 AND (((ADJUST+) OR (MODIFY+)) 8D ((FLOW+) 3D (RATE?)))	74
83	(166250010)/PCL	1301
84	(166250100)/PCL	320
85	(166305100)/PCL	1954
86	(166308100)/PCL	1258
87	(702011)/PCL	620
88	(073152180)/PCL	294
89	83 OR 84 OR 85 OR 86 OR 87 OR 88	5237
90	89 AND (((PUMP+) 3D (RATE?)) AND ((FRAC+) 3D (PUMP+)))	26
91	89 AND ((FRAC+) 3D (PUMP+))	248
92	91 AND ((ADJUST+) AND ((FLOW+) 3D (RATE?)))	7
93	91 AND ((ADJUST+) AND ((PUMP+) 3D (RATE?)))	5
94	89 AND ((WELLBORE?) OR ((WELL) 3D (BORE?)))	2578
95	94 AND ((ADJUST+) AND ((FLOW+) 3D (RATE?)))	65
96	89 AND (((ADJUST+) OR (MODIFY+)) 8D ((FLOW+) 3D (RATE?)))	39
97	89 AND ((MEASUR+) 8D ((PUMP+) 3D (RATE?)))	9
98	89 AND ((DESIR+) 8D ((PUMP+) 3D (RATE?)))	10
99	89 AND ((COMPAR+) 8D (((PUMP+) OR (FLOW+)) 3D (RATE?)))	17
100	89 AND ((PUMP+) 3D (RATE?))	110
101	89 AND ((INCREAS+) 5D ((PUMP+) 3D (RATE?)))	12
102	(US8417483 OR US8774972)/PN	2
103	89 AND ((INITIAL+) 5D ((PUMP+) 3D (RATE?)))	2
104	(US20120199356 OR US20140014338 OR US5536115 OR US20140251623 OR US20150192117)/PN	5
105	..CITBF NOSOURCE SS 104 2 RANKED	69
106	(US20140060831 OR US20050230117)/PN	2
107	(E21B-043/25)/IPC	4788
108	(E21B-043/26)/IPC	11280

109	(E21B-049/00)/IPC	13267
110	(E21B-047/00)/IPC	20462
111	(E21B-043/18)/IPC	1240
112	(E21B-049/00)/IPC	13267
113	(E21B-044/00)/IPC	6824
114	107 OR 108 OR 109 OR 110 OR 111 OR 112 OR 113	49621
115	114 AND ((WELLBORE?) OR ((WELL) 3D (BORE?)))	13439
116	115 AND ((FRAC+) 3D (PUMP+))	664
117	116 AND ((PUMP+) 3D (RATE?))	70
118	114 AND ((STEP) 3D (RATE?))	163
119	118 AND (PUMP+)	52
120	114 AND (((PUMP+) 3D (RATE?)) AND ((FRAC+) 3D (PUMP+)))	117
121	120 AND ((ADJUST+) AND ((FLOW+) 3D (RATE?)))	10
122	(US20160258267)/PN	1
123	..CITBF NOSOURCE SS 122 1 RANKED	29
124	115 AND (((ADJUST+) OR (MODIFY+)) 8D ((FLOW+) 3D (RATE?)))	104
125	124 AND ((FRAC+) 3D (PUMP+))	5
126	114 AND ((FRAC+) 3D (PUMP+))	1494
127	126 AND ((TARGET+) 5D (RATE?))	4
128	(US2014027772 OR US20140027772 OR US8774972 OR US20170226842 OR US20150129210)/PN	4
129	..CITBF NOSOURCE SS 128 4 RANKED	163
130	129 AND ((FRAC+) 3D (PUMP+))	10
131	114 AND (((STEP) 3D (RATE?)) OR ((RATE?) 3D (TEST+)))	456
132	131 AND ((FRAC+) 3D (PUMP+))	15
133	(WO2018125176)/PN	1
134	..CITBF NOSOURCE SS 133 1 RANKED	8
135	115 AND ((DAMAG+) 5D ((RATE?) OR (FLOW+) OR (INJECT+)))	113
136	135 AND ((FRAC+) 3D (PUMP+))	9
137	(US4192182 OR US20130180722 OR US5597043)/PN	3
138	..CITBF NOSOURCE SS 137 3 RANKED	19
139	116 AND ((SENSOR?) 5D (TRANSMIT+))	5

140	(US6814142)/PN	1
141	..CITBF NOSOURCE SS 140 1 RANKED	70
142	141 AND ((SENSOR?) 5D (TRANSMIT+))	7
143	118 AND ((LIMIT+) OR (THRESHOLD+))	67
144	(WO2018215763)/PN	1
145	..CITBF NOSOURCE SS 144 1 RANKED	4
146	(US9683432)/PN	1
147	..CITBF NOSOURCE SS 146 1 RANKED	60
148	114 AND ((DATA) 5D (TRANSMI+))	2293
149	148 AND ((PUMP+) 5D (SENSOR?))	84
150	(US20130118739)/PN	1
151	..CITBF NOSOURCE SS 150 1 RANKED	27
152	114 AND ((DAMAG+) 5D (PUMP?))	108
153	152 AND ((THRESHOLD+) OR (LIMIT+))	38
154	(E21B-043/25)/CPC	1217
155	(E21B-043/26)/CPC	6320
156	(E21B-043/267)/CPC	2621
157	(E21B-049/00)/CPC	5917
158	(E21B-049/008)/CPC	583
159	(E21B-047/00)/CPC	7277
160	(E21B-044/00)/CPC	2969
161	(E21B-043/16)/CPC	4723
162	154 OR 155 OR 156 OR 157 OR 158 OR 159 OR 160 OR 161	25780
163	162 AND ((WELLBORE?) OR ((WELL) 3D (BORE?)))	9191
164	163 AND ((DAMAG+) 5D (ACCUMULAT+))	5
165	(WO201762074)/PN	1
166	..CITBF NOSOURCE SS 165 1 RANKED	17
167	162 AND ((DAMAG+) 5D (ACCUMULAT+))	15
168	163 AND ((FRAC+) 3D (PUMP+))	561
169	168 AND ((PUMP+) 3D (RATE?))	72
170	163 AND ((STEP) 3D (RATE?))	56

171	(US8874383)/PN	1
172	..CITBF NOSOURCE SS 171 1 RANKED	35
173	162 AND ((FRAC+) 3D (PUMP+))	1106
174	173 AND ((STEP) 3D (RATE?))	9
175	173 AND ((PUMP+) 5D (SENSOR?))	29
176	173 AND ((DATA) 5D (TRANSMI+))	20
177	163 AND ((DAMAG+) 5D (PUMP?))	40
178	173 AND ((DAMAG+) 5D (PUMP?))	17
179	162 AND ((DAMAG+) 5D ((RATE?) OR (FLOW+) OR (INJECT+)))	188
180	179 AND ((WELLBORE?) OR ((WELL) 3D (BORE?)))	91
181	163 AND (((ADJUST+) OR (MODIFY+)) 8D ((FLOW+) 3D (RATE?)))	69
182	*MEM "home/QPTLD337/FRACP" /XPN /APID	202

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

#	Search query	Results
1	(regulating pumping rate)(fracturing pump)(step rate limit)(pumping rate)(comparing the rates)(adjusting pumping rate)(damage accumulation)(threshold)	2,520
2	(step rate testing)(fracturing pump)(step rate limit)(pumping rate)(desired rate)(adjusting pumping rate)(well bore)(damage accumulation)	2,640
3	(wellbore)(pumps)(fracture)(receiving threshold pumping rate)(determine the desired rate)(measure the current rate)(compare the pumping rates)(adjusting pumping rate)	995
4	(wellbore)(step rate test)(step rate limit)(fracture pump)(damage accumulation rate)	2,620
5	(regulating pumping rate)(electrically powered)(fracturing pump)(desired pump rate)(target pump rate)(step rate limit)	10,900
6	(method)(regulating a pumping rate)(fracturing pump)(desired pump rate)(target pump rate)(damage accumulation rate)	5,317

Computer Accessed Text Databases Searched

The Patent Analyst searched the following computer accessed text databases:

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

#	Search query	Results
1	(US Well Services LLC)(fracturing pump)(pumping rate)(regulating)(step rate limit)(desired pumping rate)	580,000
2	(regulating pumping)(fracturing pump)(step rate)(determine desired pumping rate)(modifying the pumping rate)(adjustment)	3,400,000
3	(wellbore)(fracture pump)(sensor)(transmitting data)(pump rate)	366,000

4	(fracturing pump)(damage rate)(threshold)(pumping rate)(control)(step rate)	3,490,000
5	(pumping rate)(adjustment rate)(damage accumulation rate)(threshold)(fracture pump)(group of pumps)	552,000

Google Scholar: <https://scholar.google.com/>

#	Search query	Results
1	(fracturing pump)(regulating pump)(step rate limit for the pump)(determine pumping rate)(determine the current rate)(comparison)(adjusting the pumping rate)	17,900
2	(determine step rate)(frac pump)(desired pumping rate)(current pumping rate)(comparing the desired rate with the current pumping rate)(threshold)(adjusting pumping rate)(damage accumulation)	8,550
3	(frac pump)(step rate limit)(damage accumulation rate)(wellbore)(threshold)(transmitting a warning)	358
4	(fracture pump)(sensor)(measurement)(transmitting data)(control unit)	24,100
5	(fracture pump)(target pump rate)(damage accumulation rate)(warning)(sensor)(transmitting data)	7,790

YouTube: <https://youtube.com>

#	Search query	Results
1	(fracture pump)(pump rate)(step rate)(limit)(threshold)	N/A
2	(fracture pump)(regulating pump)(adjustment rate)(damage accumulation)	N/A
3	(fracture pump)(damage accumulation)(threshold)(wellbore)	N/A
4	(wellbore)(pumping rate)(fracture)(threshold)(target rate)(current rate)	N/A
5	(fracture pump)(step rate)(limit)(threshold)(multiple pumps)	N/A

Date search was completed: 11 May 2020

SR/DD

Electronic Acknowledgement Receipt

EFS ID:	39776119
Application Number:	16597014
International Application Number:	
Confirmation Number:	4687
Title of Invention:	MODULAR SWITCHGEAR SYSTEM AND POWER DISTRIBUTION FOR ELECTRIC OILFIELD EQUIPMENT
First Named Inventor/Applicant Name:	Jared Oehring
Customer Number:	132858
Filer:	Taylor P. Evans/Tina Fluharty
Filer Authorized By:	Taylor P. Evans
Attorney Docket Number:	047158.100048
Receipt Date:	19-JUN-2020
Filing Date:	09-OCT-2019
Time Stamp:	15:55:24
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	047158-100048-IDS.pdf	1035187	no	5
			20e4d718a477ab308dc052efac0f1734c28fb9d5		

Warnings:

Information:					
2	Non Patent Literature	047158-OA3.pdf	1402077	no	13
			200a2829d9c761f9ec16e70bdb148012c61545e1		
Warnings:					
Information:					
3	Non Patent Literature	047158-OA2.pdf	1517850	no	15
			311251f288e51ea2e54619d0aa9c614a8bb8ff93		
Warnings:					
Information:					
4	Non Patent Literature	047158-OA1.pdf	1272924	no	13
			928a7e85dd2b734bd6e7e6f165fa2b1934ebc61c		
Warnings:					
Information:					
5	Non Patent Literature	047158-ISR.pdf	819292	no	17
			995b9739257b4c0cc50ec90ee2654ea72bfc1fd3		
Warnings:					
The page size in the PDF is too large. The pages should be 8.5 x 11 or A4. If this PDF is submitted, the pages will be resized upon entry into the Image File Wrapper and may affect subsequent processing					
Information:					
6	Non Patent Literature	047158-Karim.pdf	5055149	no	23
			f79d8552702a84ed0e231811674de304ae138298		
Warnings:					
Information:					
7	Non Patent Literature	047158-Goodwin.pdf	2052394	no	10
			445c5d2c928fd40eae7b25406d1755f2bfe8f599		
Warnings:					
Information:					
Total Files Size (in bytes):			13154873		

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.

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

U.S.PATENTS						Remove
Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	9119326		2015-08-25	McDonnell	
	2	5050673		1991-09-24	Baldrige	
	3	7308933		2007-12-18	Mayfield	
	4	6273193		2001-08-14	Hermann	
	5	5366324		1994-11-22	Artt	
	6	8646521		2014-02-11	Bowen	
	7	4759674		1988-07-26	Schroder	
	8	1656861		1928-01-17	Leonard	

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

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Attorney Docket Number		047158.100048

9	10227854		2019-03-12	Glass	
10	9932799		2018-04-03	Symchuk	
11	6936947		2005-08-30	Leijon	
12	7835140		2010-11-16	Mori	
13	10393108		2019-08-27	Chong	
14	10378326		2019-08-13	Morris	
15	10371012		2019-08-06	Davis	
16	3302069		1967-01-31	Webster	
17	9728354		2017-08-08	Skolozdra	
18	10436026		2019-10-08	Ounadjela	
19	10246984		2019-04-02	Payne	

**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
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Attorney Docket Number		047158.100048

20	10287873		2019-05-14	Filas	
21	8800652		2014-08-12	Bartko	
22	9915128		2018-03-13	Hunter	
23	10196878		2019-02-05	Hunter	
24	9963961		2018-05-08	Hardin	
25	10260327		2019-04-16	Kajaria	
26	7926562		2011-04-19	Poitzsch	
27	7082993		2006-08-01	Ayoub	
28	8096354		2012-01-17	Poitzsch	
29	9976351		2018-05-22	Randall	
30	10309205		2019-06-04	Randall	

**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
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Art Unit	3746
Examiner Name	Christopher S. Bobish
Attorney Docket Number	047158.100048

31	10407990	2019-09-10	Oehring
32	2407796	1946-09-17	Page
33	2416848	1947-03-04	Rothery
34	7894757	2011-07-26	Keast
35	1656861	1928-01-17	Leonard

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	20150354322		2015-12-10	Vicknair	
	2	20170016433		2017-01-19	Chong	
	3	20050061548		2005-03-24	Hooper	
	4	20150053426		2015-02-26	Smith	

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

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

5	20120247783		2012-10-04	Berner, Jr.	
6	20120222865		2012-09-06	Larson	
7	20090145611		2009-06-11	Pallini Jr.	
8	20080041596		2008-02-21	Blount	
9	20170036872		2017-02-09	Wallace	
10	20180363437		2018-12-20	Coli	
11	20080017369		2008-01-24	Sarada	
12	20190203572		2019-07-04	Morris	
13	20180245428		2018-08-30	Richards	
14	20190316447		2019-10-17	Oehring	
15	20190226317		2019-07-25	Payne	

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

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

16	20190100989	2019-04-04	Stewart
17	20190178057	2019-06-13	Hunter
18	20180216455	2018-08-02	Andreychuk
19	20190203567	2019-07-04	Ross
20	20170146189	2017-05-25	Herman
21	20190292891	2019-09-26	Kajaria
22	20190292866	2019-09-26	Ross
23	20190128080	2019-05-02	Ross
24	20180363437	2019-12-20	Coli
25	20170030177	2017-02-02	Oehring
26	20080017369	2008-01-24	Sarada

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

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

27	20170036872	2017-02-09	Wallace
28	20150300336	2015-10-22	Hernandez
29	20170314979	2017-11-02	Ye
30	20140379300	2014-12-25	Devine
31	20170226842	2017-08-10	Omont

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

FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Number ³	Country Code ²	Kind Code ⁴	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear	T ⁵
	1	2787814	CA		2014-02-21	Pawlick		×
	2	2978706	CA		2016-09-09	Payne		☒
	3	2945579	CA		2019-10-08	Oehring		☒
	4	2944980	CA		2017-02-12	Oehring		☒

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

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

5	2849825	CA		2018-07-17	Bartko		☒
6	3000322	CA		2013-04-18	Bartko		☒
7	2797081	CA		2019-09-10	Hunter		☒
8	3050131	CA		2011-11-03	Hunter		☒
9	3018485	CA		2017-08-10	Herman		☒
10	2482943	CA		2011-05-24	Ayoub		☒
11	2919649	CA		2019-02-26	Randall		☒
12	2919666	CA		2019-07-16	Randall		☒
13	3006422	CA		2017-06-01	Green		☒
14	2406801	CA		2001-11-01	Demetrius		☒

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

Add

NON-PATENT LITERATURE DOCUMENTS

Remove

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

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

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T ⁵
	1	International Search Report and Written Opinion mailed January 2, 2020 in related PCT Application No. PCT/US19/55325	×
	2	Notice of Allowance mailed January 9, 2020 in related U.S. Patent Application No. 16/570,331	☒
	3	Non-Final Office Action mailed December 23, 2019 in related U.S. Patent Application No. 16/597,008	☒
	4	Non-Final Office Action mailed March 3, 2020 in related U.S. Patent Application No. 16/152,695	☒
	5	Non-Final Office Action mailed December 6, 2019 in related U.S. Patent Application No. 16/564,186	☒
	6	International Search Report and Written Opinion mailed November 26, 2019 in related PCT Application No. PCT/US19/51018	☒
	7	International Search Report and Written Opinion mailed February 11, 2020 in related PCT Application No. PCT/US2019/055323	☒
	8	Final Office Action mailed March 31, 2020 in related U.S. Patent Application No. 15/356,436	☒

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

EXAMINER SIGNATURE

Examiner Signature		Date Considered	
--------------------	--	-----------------	--

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

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

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

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

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

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

CERTIFICATION STATEMENT

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

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

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

- ☒ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.
- ☒ A certification statement is not submitted herewith.

SIGNATURE

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

Signature	/Taylor P. Evans/	Date (YYYY-MM-DD)	2020-06-17
Name/Print	Taylor P. Evans	Registration Number	60506

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

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 records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

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

PCT

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

(PCT Rule 44.1)

Date of mailing
(day/month/year)

19 SEP 2018

Applicant's or agent's file reference

047158.500026

FOR FURTHER ACTION See paragraphs 1 and 4 below

International application No.

PCT/US2018/040683

International filing date
(day/month/year)

03 July 2018

Applicant **U.S. WELL SERVICES, LLC**

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

Filing of amendments and statement under Article 19:

The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

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

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

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

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

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

4. Reminders

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

Shortly after the expiration of 18 months from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90bis.1 and 90bis.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 45bis.1). The procedure for requesting supplementary international search is described in the *PCT Applicant's Guide*, International Phase, paragraphs 8.006-8.032.

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US
Commissioner for Patents
P.O. Box 1450, Alexandria, VA 22313-1450
Facsimile No. 571-273-8300

Authorized officer

Blaine R. Copenheaver

PCT Helpdesk: 571-272-4300

Telephone No. **PCTOSP: 571-272-7774**

Form PCT/ISA/220 (July 2017)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference G47158.500026	FOR FURTHER ACTION		see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. PCT/US2018/040883	International filing date (day/month/year) 03 July 2018	(Earliest) Priority Date (day/month/year) 07 July 2017	
Applicant U.S. WELL SERVICES, LLC			

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

This international search report consists of a total of 3 sheets.

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

1. Basis of the report

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

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

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

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

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

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

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

4. With regard to the title,

☒ the text is approved as submitted by the applicant.

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

5. With regard to the abstract,

☒ the text is approved as submitted by the applicant.

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

6. With regard to the drawings,

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

☐ as suggested by the applicant.

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

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

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

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2018/040683

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.: 5-9, 13, 14
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:

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.:

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.

Form PCT/ISA/210 (continuation of first sheet (2)) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2018/040683

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - E21B 43/26; E21B 41/00; E21B 43/16; F01D 15/10; F02C 7/32 (2018.01)

CPC - E21B 43/26; E21B 41/00; E21B 41/0085; E21B 43/16; F01D 15/10; F02C 7/32; F05D 2220/76 (2018.08)

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

See Search History document

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

USPC - 166/66.4; 166/177.5; 166/308.1 (keyword delimited)

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

See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2016/0348479 A1 (US WELL SERVICES LLC) 01 December 2016 (01.12.2016) entire document	1-4, 10-12, 15
A	US 2017/0104389 A1 (EVOLUTION WELL SERVICES, LLC) 13 April 2017 (13.04.2017) entire document	1-4, 10-12, 15
A	US 2015/0252661 A1 (GLASS) 10 September 2015 (10.09.2015) entire document	1-4, 10-12, 15
A	US 2016/0186531 A1 (HARKLESS et al) 30 June 2016 (30.06.2016) entire document	1-4, 10-12, 15

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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

"&" document member of the same patent family

Date of the actual completion of the international search

22 August 2018

Date of mailing of the international search report

19 SEP 2018

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

Staine R. Copenheaver

PCT Helpdesk: 571-272-4300
PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (January 2015)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

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

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

Date of mailing
(day/month/year)

19 SEP 2018

Applicant's or agent's file reference
047158.500026

FOR FURTHER ACTION

See paragraph 2 below

International application No.

PCT/US2018/040683

International filing date (day/month/year)

03 July 2018

Priority date (day/month/year)

07 July 2017

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

IPC(8) - E21B 43/26; E21B 41/00; E21B 43/16; F01D 15/10; F02C 7/32 (2018.01)

CPC - E21B 43/26; E21B 41/00; E21B 41/0085; E21B 43/16; F01D 15/10; F02C 7/32; F05D 2220/76 (2018.08)

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 43bis.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 56.1bis(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
Mail Stop PCT, Attn: ISA/US
Commissioner for Patents
P.O. Box 1460, Alexandria, VA 22313-1460
Facsimile No. 571-273-8300

Date of completion of this opinion

22 August 2018

Authorized officer

Blaine R. Copenheaver

PCT Helpdesk: 571-272-4300
PCT OSP: 571-272-7774

Form PCT/ISA/237 (cover sheet) (January 2015)

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US2018/040683

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 43bis.1(a)).
3. ☐ With regard to any nucleotide and/or amino acid sequence disclosed in the international application, this opinion has been established on the basis of a sequence listing:
 - a. ☐ forming part of the international application as filed:
 - ☐ in the form of an Annex C/ST.25 text file.
 - ☐ on paper or in the form of an image file.
 - b. ☐ furnished together with the international application under PCT Rule 13ter.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 13ter.1(a)).
 - ☐ on paper or in the form of an image file (Rule 13ter.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/US2018/040683

Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application.

☒ claims Nos. 5-9, 13, 14

because:

☐ the said international application, or the said claims Nos. _____ relate to the following subject matter which does not require an international search (*specify*):

☒ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 5-9, 13, 14 are so unclear that no meaningful opinion could be formed (*specify*):

Claims 5-9, 13, 14 are improper multiple dependent claims not drafted in accordance with the second and third sentences of Rule 6.4(a).

☐ the claims, or said claims Nos. _____ are so inadequately supported by the description that no meaningful opinion could be formed (*specify*):

☒ no international search report has been established for said claims Nos. 5-9, 13, 14

☐ a meaningful opinion could not be formed without the sequence listing; the applicant did not, within the prescribed time limit:

☐ furnish a sequence listing in the form of an Annex C/ST.25 text file, and such listing was not available to the International Searching Authority in the form and manner acceptable to it; or the sequence listing furnished did not comply with the standard provided for in Annex C of the Administrative Instructions.

☐ furnish a sequence listing on paper or in the form of an image file complying with the standard provided for in Annex C of the Administrative Instructions, and such listing was not available to the International Searching Authority in the form and manner acceptable to it; or the sequence listing furnished did not comply with the standard provided for in Annex C of the Administrative Instructions.

☐ pay the required late furnishing fee for the furnishing of a sequence listing in response to an invitation under Rule 13ter.1(a) or (b).

☐ See Supplemental Box for further details.

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.
PCT/US2018/040683

Box No. V	Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement			
1. Statement				
Novelty (N)	Claims	None		YES
	Claims	1-4, 10-12, 15		NO
Inventive step (IS)	Claims	None		YES
	Claims	1-4, 10-12, 15		NO
Industrial applicability (IA)	Claims	1-4, 10-12, 15		YES
	Claims	None		NO
2. Citations and explanations:				
<p>Claims 1-4, 10-12, and 15 lack novelty under PCT Article 33(2) as being anticipated by US Well Services LLC (hereinafter US Well).</p> <p>Regarding Claim 1, US Well discloses a hydraulic fracturing system for fracturing a subterranean formation (wireline power supply during electric powered fracturing operations; title) characterized by: an electric pump fluidly connected to a well associated with the subterranean formation, and 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 (Paragraph [0051] describes electric powered fracking pumps.); one or more ancillary units associated with the fluid pumped into the wellbore (Paragraph [0037] describes sand equipment 121, hydration unit 123, and blender 125.); a first motor electrically coupled to the electric pump to operate the electric pump (Paragraph [0061] describes fracking pumps being powered by electric motors.); and one or more second motors, each of the one or more second motors electrically coupled to at least one of the one or more ancillary units to operate the at least one of the one or more ancillary units (Paragraph [0037] describes sand equipment 121, hydration unit 123, and blender 125 all being powered by electricity, presumably electric motors.).</p> <p>Regarding Claim 2, US Well discloses the system of claim 1, further characterized by: an electric generator (Paragraph [0036] describes an electric power generator.), wherein the first motor is electrically coupled to the electric pump via the electric generator to generate electricity for use by the electric pump (Paragraph [0035] describes a generator providing power to electric fracking pumps.).</p> <p>Regarding Claim 3, US Well discloses the system of claim 1 or 2, wherein the one or more second motor comprises an electric motor (Paragraph [0037] describes sand equipment 121, hydration unit 123, and blender 125 all being powered by electricity, presumably electric motors.).</p> <p>Regarding Claim 4, US Well discloses the system of claim 3, wherein the electric motor is selected from the group consisting of any of a single-phase AC motor, a three-phase motor (Paragraph [0045] describes the use of three phase electrical power on the wireline equipment.), and a DC motor.</p> <p>Regarding Claim 10, US Well discloses a hydraulic fracturing system for fracturing a subterranean formation (wireline power supply during electric powered fracturing operations; title) characterized by: an electric pump fluidly connected to a well associated with the subterranean formation, and 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 (Paragraph [0051] describes electric powered fracking pumps.); one or more ancillary units associated with the fluid pumped into the wellbore (Paragraph [0037] describes sand equipment 121, hydration unit 123, and blender 125.); a first motor electrically coupled to the electric pump to operate the electric pump (Paragraph [0061] describes fracking pumps being powered by electric motors.); one or more second motors, the one or more second motors characterized by an electric motor (Paragraph [0037] describes sand equipment 121, hydration unit 123, and blender 125 all being powered by electricity, presumably electric motors.); and each of the one or more second motors electrically coupled to at least one of the one or more ancillary units to operate the at least one of the one or more ancillary units; and a plurality of variable-frequency drives (VFD), each VFD connected to at least one of the first motor or the one or more second motors to control the speed of the first motor or the one or more second motors (Paragraph [0048] describes blender discharge motor connected to a VFD and paragraph [0049] describes fracking pumps being connected to a VFD.).</p> <p>Regarding Claim 11, US Well discloses the system of claim 10, wherein the electric motor is selected from the group consisting of any of a single-phase AC motor, a three-phase motor (Paragraph [0045] describes the use of three phase electrical power on the wireline equipment.), and a DC motor.</p> <p>Regarding Claim 12, US Well discloses the system of claim 10 or 11, wherein each VFD frequently performs electric motor diagnostics to prevent damage to the first motor or the one or more second motors (Claim 2 describes the VFD frequently performing electric motor diagnostics to prevent damage to at least one electrical motor.).</p>				

Form PCT/ISA/237 (Box No. V) (January 2015)

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US2018/040683

Supplemental Box

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

Regarding Claim 15, US Well discloses a method for powering one or more ancillary units associated with a hydraulic fracturing system (wireline power supply during electric powered fracturing operations; title; the method being inherent in the description), the method characterized by: fluidly connecting an electric pump to a well associated with a subterranean formation, the electric 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 (Paragraph [0051] describes electric powered fracking pumps.); fluidly connecting the one or more ancillary units with the fluid pumped into the wellbore (Paragraph [0037] describes sand equipment 121, hydration unit 123, and blender 125.); electrically coupling a first motor to the electric pump to operate the electric pump (Paragraph [0051] describes fracking pumps being powered by electric motors.); electrically coupling one or more second motors to each of the one or more ancillary units to operate the one or more ancillary units, the one or more second motors characterized by an electric motor (Paragraph [0037] describes sand equipment 121, hydration unit 123, and blender 125 all being powered by electricity, presumably electric motors.); and connecting each of a plurality of variable-frequency drives (VFD) to at least one of the first motor or the one or more second motors to control the speed of the first motor or the one or more second motors (Paragraph [0048] describes blender discharge motor connected to a VFD and paragraph [0049] describes fracking pumps being connected to a VFD.).

Claims 1-4, 10-12, and 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)

02 JAN 2019

Applicant's or agent's file reference
047158.500029

FOR FURTHER ACTION See paragraphs 1 and 4 below

International application No.
PCT/US 18/54542

International filing date
(day/month/year) 05 October 2018 (05.10.2018)

Applicant U.S. WELL SERVICES, LLC

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

Filing of amendments and statement under Article 19:

The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

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

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

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

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

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

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

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

4. Reminders

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

Shortly after the expiration of 18 months from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90bis.1 and 90bis.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 45bis.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 W. Young

PCT Helpdesk: 571-272-4300
Telephone No. PCT OSP: 571-272-7774

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 047158.500029	FOR FURTHER ACTION see Form PCT/ISA/220 as well as, where applicable, item 5 below.	
International application No. PCT/US 18/54542	International filing date (day/month/year) 05 October 2018 (05.10.2018)	(Earliest) Priority Date (day/month/year) 05 October 2017 (05.10.2017)
Applicant U.S. WELL SERVICES, LLC		

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

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

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

1. Basis of the report

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

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

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

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

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

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

4. With regard to the title,

- ☒ the text is approved as submitted by the applicant.
☐ the text has been established by this Authority to read as follows:

5. With regard to the abstract,

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

6. With regard to the drawings,

- a. the figure of the drawings to be published with the abstract is Figure No. _____
☐ 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 18/54542

A. CLASSIFICATION OF SUBJECT MATTER IPC(8) - E21B 37/06, E21B 45/00, F04B 49/06, F04B 49/20, G01F 1/76, G01N 29/44, G05D 7/06 (2018.01) CPC - E21B 37/06, E21B 45/00, E21B 47/0007, E21B 49/08, E21B 49/081, E21B 49/087, F04B 49/06, F04B 49/20, F04B 2027/1827, F04B 2027/1831, E21B 2049/085, F04B 2203/1102, F04B 2205/01, F04B 2205/05, G01F 1/76, G01F 25/0007, G01N 29/44, G01N 29/4427, G01N 2030/324, G01N 2291/02836, G05B 23/0294, G05B 2219/32184, G05B 2219/36292, G05B 2219/41303, G05D 7/06, G06F 2201/81, G06F 2209/5022		
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 — A	US 2004/0040746 A1 (NIEDERMAYR et al.) 04 March 2004 (04.03.2004), para [0037]-[0040], [0051], [0052], [0066], [0069], [0070], [0090], [0165]-[0170]	1-4, 7, 15-17 5, 6, 8-14, 18-20
Y — A	US 2014/0379300 A1 (GHB PTY LTD) 25 December 2014 (25.12.2014), para [0001], [0007]-[0009], [0018], [0027], [0051], [0053], [0068], [0093]-[0103], [0110], [0114], [0151]-[0160]	1-4, 7, 15-17 5, 6, 8-14, 18-20
A	WO 2016/144939 A1 (SCHLUMBERGER TECHNOLOGIES CORPORATION) 15 September 2016 (15.09.2016), para [0030], [0036], [0057], [0066], [0067]	5, 6, 8-14, 18-20
A	US 2006/0052903 A1 (BASSETT) 09 March 2006 (09.03.2006), para [0014]-[0016], [0024], [0026], [0043]	5, 6, 8-14, 18-20
A	US 5,006,044 A (WALKER, SR., et al.) 09 April 1991 (09.04.1991), col 2, ln 44-63; col 11, ln 29-50; col 21, ln 48-58; col 31, ln 39-54; col 37, ln 43 to col 38, ln 37	5, 6, 8-14, 18-20
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search		Date of mailing of the international search report
23 November 2018		02 JAN 2019
Name and mailing address of the ISA/US		Authorized officer:
Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300		Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

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 43bis.1)

Date of mailing (day/month/year) 02 JAN 2019	
Applicant's or agent's file reference 047158.500029	FOR FURTHER ACTION See paragraph 2 below
International application No. PCT/US 18/54542	International filing date (day/month/year) 05 October 2018 (05.10.2018)
Priority date (day/month/year) 05 October 2017 (05.10.2017)	
International Patent Classification (IPC) or both national classification and IPC IPC(8) - E21B 37/06, E21B 45/00, F04B 49/06, F04B 49/20, G01F 1/76, G01N 29/44, G05D 7/06 (2018.01) CPC - E21B 37/06, E21B 45/00, E21B 47/0007, E21B 49/06, E21B 49/081, E21B 49/087, F04B 49/06, F04B 49/20, F04B 2027/1827, F04B 2027/1831, E21B 2049/085, F04B 2203/1102, F04B 2205/01, F04B 2205/05, G01F 1/76, G01F 25/0007, G01N 29/44, G01N 29/4427, G01N 2030/324, G01N 2291/02836, G05B 23/0294, G05B 2219/32184, G05B 2219/36292, G05B 2219/41303, G05D 7/06, G06F 2201/81, G06F 2209/5022	
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 43bis.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 66.1bis(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 Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-6300	Date of completion of this opinion 23 November 2018	Authorized officer Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774
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WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US 18/54542

Box No. 1 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 43bis.1(a)).

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

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

- ☐ in the form of an Annex C/ST.25 text file.
☐ on paper or in the form of an image file.

b. ☐ furnished together with the international application under PCT Rule 13ter.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 13ter.1(a)).
☐ on paper or in the form of an image file (Rule 13ter.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 15/54542

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

1. Statement

Novelty (N)	Claims	1-20	YES
	Claims	none	NO
Inventive step (IS)	Claims	5, 6, 8-14, 18-20	YES
	Claims	1-4, 7, 15-17	NO
Industrial applicability (IA)	Claims	1-20	YES
	Claims	none	NO

2. Citations and explanations:

Claims 1-4, 7, and 15-17 lack an inventive step under PCT Article 33(3) as being obvious over US 2004/0040746 A1 to Niedermayr, et al. (hereinafter "Niedermayr"), in view of US 2014/0379300 A1 to (GHD Pty Ltd).

Regarding Claim 1, Niedermayr discloses a method for monitoring a fracturing operation (para [0167], [0169]), comprising: positioning a pump (50) at a well site (12) where fracturing operations are being conducted (para [0165], [0170]); arranging one or more sensors (34, 36) at at least one of a pump inlet (52) or a pump outlet (54) (para [0038], [0040]), the one or more sensors (34, 36) monitoring a flow rate of a slurry (para [0040], [0066], [0170]); determining an efficiency (para [0050]); and adjusting one or more operating parameters of the pump (50) (para [0051], [0052], [0070]); but does not specifically disclose arranging one or more sensors (34, 36) at at least one of a pump inlet (52) or a pump outlet (54), the one or more sensors (34, 36) monitoring a flow rate of a slurry; receiving flow data from the one or more sensors (34, 36); determining a pump efficiency, based at least in part on the flow data, is below a threshold; and adjusting one or more operating parameters of the pump (50). However, GHD Pty Ltd discloses a method for monitoring a pump (para [0007]-[0009]), comprising arranging one or more sensors (34, 36) at at least one of a pump inlet (52) or a pump outlet (54) (para [0093]-[0103]), the one or more sensors (34, 36) monitoring a flow rate of a liquid (para [0096], [0102], [0156]); receiving flow data from the one or more sensors (34, 36) (para [0114], [0156]); and determining a pump efficiency, based at least in part on the flow data, is below a threshold (para [0158]-[0160]). To a person of ordinary skill in the art, monitoring a pump as taught by GHD Pty Ltd would have been obvious for use in the method for monitoring a fracturing operation as in Niedermayr in order to provide in-situ determination of pump performance so that system operators are alerted to declining performance of a pump proactively (GHD Pty Ltd: para [0001]), because Niedermayr and GHD Pty Ltd are directed towards monitoring flow rate of a pump.

Regarding Claim 2, Niedermayr further discloses the method of claim 1, further comprising: receiving operating data indicative of one or more operating parameters from a second sensor (34, 36) (para [0037], [0040], [0066]); wherein adjusting one or more operating parameters of the pump (50) is based at least in part on the operating data (para [0051], [0052], [0070]).

Regarding Claim 3, Niedermayr further discloses the method of claim 1, further comprising: receiving second flow data from the one or more sensors (34, 36), after the one or more operating parameters are adjusted (para [0069], [0090], continuous operations and control determined in real time.); but does not specifically disclose determining a second pump efficiency. However, GHD Pty Ltd discloses a method for monitoring a pump (para [0007]-[0009]), further comprising determining pump efficiency in real time (para [0018], [0068], [0110]). To a person of ordinary skill in the art, monitoring a pump as taught by GHD Pty Ltd would have been obvious for use in the method for monitoring a fracturing operation as in Niedermayr in order to provide in-situ determination of pump performance so that system operators are alerted to declining performance of a pump proactively (GHD Pty Ltd: para [0001]), because Niedermayr and GHD Pty Ltd are directed towards monitoring flow rate of a pump.

Regarding Claim 4, GHD Pty Ltd further discloses the method of claim 3, further comprising: determining the second pump efficiency is above the threshold (para [0051], [0053], [0151], [0152], pump not taken off line or alert not sent when the efficiency is above a threshold.); and storing the one or more operating parameters of the pump (50) (para [0018], [0027], [0051], pump efficiency stored.).

Regarding Claim 7, Niedermayr further discloses the method of claim 1, wherein the one or more operating parameters of the pump (50) include a speed (para [0040]), a suction pressure, a discharge pressure, or a combination thereof.

Regarding Claim 15, Niedermayr discloses a method for adjusting a pump (50) during a fracturing operation, comprising: receiving first data from a first sensor (34, 36) of the pump (50) (para [0038], [0040]); determining efficiency, based at least in part on the first data (para [0050]-[0052]); and performing an action associated with the pump (50) (para [0051], [0052], [0070]); but does not specifically disclose receiving first data from a first sensor (34, 36) arranged at a suction side (52) of the pump (50); receiving second data from a second sensor (34, 36) arranged at a discharge side (54) of the pump (50); determining a pump efficiency, based at least in part on the first data and the second data; comparing the pump efficiency to a threshold, the threshold being a pre-determined value indicative of an operational condition of the pump (50); and determining the pump efficiency is below the threshold. However, GHD Pty Ltd discloses a method for monitoring a pump (para [0007]-[0009]), comprising receiving first data from a first sensor (34, 36) arranged at a suction side (52) of the pump (50) (para [0013], [0016], [0026], [0064]); receiving second data from a second sensor (34, 36) arranged at a discharge side (54) of the pump (50) (para [0013], [0016], [0026], [0064]); ... (continued)

-- Please See Supplemental Box --

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US 18/54542

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.) ... determining a pump efficiency, based at least in part on the first data and the second data (para [0013], [0016], [0026], [0064]); comparing the pump efficiency to a threshold, the threshold being a pre-determined value indicative of an operational condition of the pump (50) (para [0158]-[0160]); and determining the pump efficiency is below the threshold (para [0020], [0029], [0151]). To a person of ordinary skill in the art, monitoring a pump as taught by GHD Pty Ltd would have been obvious for use in the method for monitoring a fracturing operation as in Niedermayr in order to provide in-situ determination of pump performance so that system operators are alerted to declining performance of a pump proactively (GHD Pty Ltd: para [0001]), because Niedermayr and GHD Pty Ltd are directed towards monitoring flow rate of a pump.

Regarding Claim 16, Niedermayr further discloses the method of claim 15, wherein the action comprises adjusting one or more operating parameters of the pump (50) (para [0040], [0043], [0051], [0052]).

Regarding Claim 17, Niedermayr further discloses the method of claim 15, wherein the action comprises taking the pump (50) offline (para [0010], [0151]).

Claims 5, 6, 8-14, and 18-20 meet the criteria set forth in PCT Article 33(2) and PCT Article 33(3) because the prior art fails to teach or fairly suggest the claimed inventions.

Regarding Claim 5. The method of claim 1, wherein the one or more sensors (34, 36) are non-contact sensors arranged exterior of a tubular (70) transporting the slurry.

Regarding Claim 8. A system for monitoring a hydraulic fracturing operation, comprising:
a pump (50) arranged a well site (12) where hydraulic fracturing is to be performed, the pump (50) being fluidly coupled to a slurry supply (26) at a suction end (52) and to discharge piping (32) at a discharge end (54);
a first sensor (34, 36) arranged at at least one of the suction end (52) or the discharge end (52), the first sensor (34, 36) determining a flow rate of the slurry;
a second sensor (34, 36) arranged proximate the pump (50) to measure one or more operating parameters of the pump (50); and
a controller (56) communicatively coupled to the pump (50), the first sensor (34, 36), and the second sensor (34, 36), wherein the controller (56) adjusts the one or more operating parameters based at least in part on information received from the first sensor (34, 36).

Regarding Claim 18. The method of claim 15, further comprising:
receiving third data from a third sensor (34, 36) measuring one or more operating parameters of the pump (50);
determining the one or more operating parameters associated with the third data are outside of a pre-determined range; and
adjusting the one or more operating parameters.

Regarding Claim 19. The method of claim 15, further comprising:
associating the first data with a damage threshold;
associating the second data with a second damage threshold; and
determining at least one of the first data or the second data exceeds the respective first or second damage thresholds; and
adjusting one or more operating parameters of the pump (50).

Regarding Claim 20. The method of claim 15, wherein the first sensor (34, 36) and the second sensor (34, 36) are arranged proximate the pump (50) such that no intermediate equipment is positioned between the first sensor (34, 36) and a pump inlet and no intermediate equipment is positioned between the second sensor (34, 36) and a pump outlet.

Accordingly, regarding Claims 5, 8, and 18-20, Niedermayr discloses the methods as discussed above and further comprises a range (para [0145]) and an intermediate system (para [0045]); but does not specifically disclose the one or more sensors (34, 36) are non-contact sensors arranged exterior of a tubular (70) transporting the slurry;
a system for monitoring a hydraulic fracturing operation, comprising: a pump (50) arranged a well site (12) where hydraulic fracturing is to be performed, the pump (50) being fluidly coupled to a slurry supply (26) at a suction end (52) and to discharge piping (32) at a discharge end (54); a first sensor (34, 36) arranged at at least one of the suction end (52) or the discharge end (52), the first sensor (34, 36) determining a flow rate of the slurry; a second sensor (34, 36) arranged proximate the pump (50) to measure one or more operating parameters of the pump (50); and a controller (56) communicatively coupled to the pump (50), the first sensor (34, 36), and the second sensor (34, 36), wherein the controller (56) adjusts the one or more operating parameters based at least in part on information received from the first sensor (34, 36);
receiving third data from a third sensor (34, 36) measuring one or more operating parameters of the pump (50); determining the one or more operating parameters associated with the third data are outside of a pre-determined range; and adjusting the one or more operating parameters;
associating the first data with a damage threshold; associating the second data with a second damage threshold; and determining at least one of the first data or the second data exceeds the respective first or second damage thresholds; and adjusting one or more operating parameters of the pump (50); and
the first sensor (34, 36) and the second sensor (34, 36) are arranged proximate the pump (50) such that no intermediate equipment is positioned between the first sensor (34, 36) and a pump inlet and no intermediate equipment is positioned between the second sensor (34, 36) and a pump outlet.

-- Please See Supplemental Box --

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 18/54542

Supplemental Box

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

Continuation of:
Box V.2., Citations and explanations.

Accordingly, regarding Claims 3, 5, 6, and 18-20, GHD Pty Ltd discloses the methods as discussed above and further discloses measuring pressure at suction and discharge sides of a pump (Fig. 2; para [0013], [0026], [0113]); but does not specifically disclose the one or more sensors (34, 36) are non-contact sensors arranged exterior of a tubular (70) transporting the slurry; a system for monitoring a hydraulic fracturing operation, comprising: a pump (50) arranged a well site (12) where hydraulic fracturing is to be performed, the pump (50) being fluidly coupled to a slurry supply (26) at a suction end (52) and to discharge piping (32) at a discharge end (54); a first sensor (34, 36) arranged at at least one of the suction end (52) or the discharge end (52), the first sensor (34, 36) determining a flow rate of the slurry; a second sensor (34, 36) arranged proximate the pump (50) to measure one or more operating parameters of the pump (50); and a controller (56) communicatively coupled to the pump (50), the first sensor (34, 36), and the second sensor (34, 36), wherein the controller (56) adjusts the one or more operating parameters based at least in part on information received from the first sensor (34, 36); receiving third data from a third sensor (34, 36) measuring one or more operating parameters of the pump (50); determining the one or more operating parameters associated with the third data are outside of a pre-determined range; and adjusting the one or more operating parameters; associating the first data with a damage threshold; associating the second data with a second damage threshold; and determining at least one of the first data or the second data exceeds the respective first or second damage thresholds; and adjusting one or more operating parameters of the pump (50); and the first sensor (34, 36) and the second sensor (34, 36) are arranged proximate the pump (50) such that no intermediate equipment is positioned between the first sensor (34, 36) and a pump inlet and no intermediate equipment is positioned between the second sensor (34, 36) and a pump outlet.

Accordingly, regarding Claims 3, 5, 6, and 18-20, WO 2016/144939 A1 (Schlumberger Technology Corporation), Schlumberger Technology Corporation discloses a system for monitoring a hydraulic fracturing operation (para [0030]), comprising: a pump (para [0030]), sensor (para [0036]), controller (para [0057]), a predetermined threshold (para [0066]), a range (para [0067]), and operational parameters (para [0067]); but does not specifically disclose the one or more sensors (34, 36) are non-contact sensors arranged exterior of a tubular (70) transporting the slurry; a system for monitoring a hydraulic fracturing operation, comprising: a pump (50) arranged a well site (12) where hydraulic fracturing is to be performed, the pump (50) being fluidly coupled to a slurry supply (26) at a suction end (52) and to discharge piping (32) at a discharge end (54); a first sensor (34, 36) arranged at at least one of the suction end (52) or the discharge end (52), the first sensor (34, 36) determining a flow rate of the slurry; a second sensor (34, 36) arranged proximate the pump (50) to measure one or more operating parameters of the pump (50); and a controller (56) communicatively coupled to the pump (50), the first sensor (34, 36), and the second sensor (34, 36), wherein the controller (56) adjusts the one or more operating parameters based at least in part on information received from the first sensor (34, 36); receiving third data from a third sensor (34, 36) measuring one or more operating parameters of the pump (50); determining the one or more operating parameters associated with the third data are outside of a pre-determined range; and adjusting the one or more operating parameters; associating the first data with a damage threshold; associating the second data with a second damage threshold; and determining at least one of the first data or the second data exceeds the respective first or second damage thresholds; and adjusting one or more operating parameters of the pump (50); and the first sensor (34, 36) and the second sensor (34, 36) are arranged proximate the pump (50) such that no intermediate equipment is positioned between the first sensor (34, 36) and a pump inlet and no intermediate equipment is positioned between the second sensor (34, 36) and a pump outlet.

Accordingly, regarding Claims 3, 5, 6, and 18-20, US 2006/0052903 A1 (Bassett), Bassett discloses a system for monitoring a hydraulic fracturing operation (para [0024]), comprising: a pump (para [0024]), sensors (para [0026]), threshold value (para [0043]), predetermined value (para [0014]-[0016]), and operating parameters (para [0026]); but does not specifically disclose the one or more sensors (34, 36) are non-contact sensors arranged exterior of a tubular (70) transporting the slurry; a system for monitoring a hydraulic fracturing operation, comprising: a pump (50) being fluidly coupled to a slurry supply (26) at a suction end (52) and to discharge piping (32) at a discharge end (54); a first sensor (34, 36) arranged at at least one of the suction end (52) or the discharge end (52), the first sensor (34, 36) determining a flow rate of the slurry; a second sensor (34, 36) arranged proximate the pump (50) to measure one or more operating parameters of the pump (50); and a controller (56) communicatively coupled to the pump (50), the first sensor (34, 36), and the second sensor (34, 36); receiving third data from a third sensor (34, 36) measuring one or more operating parameters of the pump (50); determining the one or more operating parameters associated with the third data are outside of a pre-determined range; and adjusting the one or more operating parameters; associating the first data with a damage threshold; associating the second data with a second damage threshold; and determining at least one of the first data or the second data exceeds the respective first or second damage thresholds; and adjusting one or more operating parameters of the pump (50); and the first sensor (34, 36) and the second sensor (34, 36) are arranged proximate the pump (50) such that no intermediate equipment is positioned between the first sensor (34, 36) and a pump inlet and no intermediate equipment is positioned between the second sensor (34, 36) and a pump outlet.

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WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 15/54542

Supplemental Box

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

Continuation of:

Box V.2., Citations and explanations,

Accordingly, regarding Claims 3, 5, 8, and 18-20, US 5,006,044 A to Walker, Sr., et al. (hereinafter "Walker, Sr."), Walker, Sr. discloses a system for monitoring a hydraulic fracturing operation (col 2, in 44-63), comprising: a pump (50) arranged at a well site (12) where hydraulic fracturing is to be performed (col 11, in 29-50), comprising a sensor (col 21, in 48-58), a controller (col 37, in 43 to col 38, in 37), and adjusting the one or more operating parameters based at least in part on information received from the first sensor (col 31, in 39-54); but does not specifically disclose the one or more sensors (34, 36) are non-contact sensors arranged exterior of a tubular (70) transporting the slurry;

a system for monitoring a hydraulic fracturing operation, comprising: a pump (50) being fluidly coupled to a slurry supply (26) at a suction end (52) and to discharge piping (32) at a discharge end (54); a first sensor (34, 36) arranged at at least one of the suction end (52) or the discharge end (52), the first sensor (34, 36) determining a flow rate of the slurry; a second sensor (34, 36) arranged proximate the pump (50) to measure one or more operating parameters of the pump (50); and a controller (56) communicatively coupled to the pump (50), the first sensor (34, 36), and the second sensor (34, 36);

receiving third data from a third sensor (34, 36) measuring one or more operating parameters of the pump (50); determining the one or more operating parameters associated with the third data are outside of a pre-determined range; and adjusting the one or more operating parameters;

associating the first data with a damage threshold; associating the second data with a second damage threshold; and determining at least one of the first data or the second data exceeds the respective first or second damage thresholds; and adjusting one or more operating parameters of the pump (50); and

the first sensor (34, 36) and the second sensor (34, 36) are arranged proximate the pump (50) such that no intermediate equipment is positioned between the first sensor (34, 36) and a pump inlet and no intermediate equipment is positioned between the second sensor (34, 36) and a pump outlet.

Thus, Niedermayr, GHD Pty Ltd, Schlumberger Technology Corporation, Bassett, and Walker, Sr., each individually and in combination fail to teach or fairly suggest the method of Claim 5, the system of Claim 6, and the methods of Claims 18-20.

Regarding Claims 6 and 9-14, these are dependent claims depending from Claims 5 and 8, respectively, and therefore meet the criteria set forth in PCT Article 33(2) and PCT Article 33(3).

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

SEARCH HISTORY

Application Number	PCT/US 18/54542
Search Conducted By	SRH
Search Approved By	SRH

IPC, CPC, USPC Classifications Searched	<p>IPC(8)- E21B 37/06, E21B 45/00, F04B 49/06, F04B 49/20, G01F 1/76, G01N 29/44, G05D 7/06 (2018.01)</p> <p>CPC- E21B 37/06, E21B 45/00, E21B 47/0007, E21B 49/08, E21B 49/081, E21B 49/087, F04B 49/06, F04B 49/20, F04B 2027/1827, F04B 2027/1831, E21B 2049/085, F04B 2203/1102, F04B 2205/01, F04B 2205/05, G01F 1/76, G01F 25/0007, G01N 29/44, G01N 29/4427, G01N 2030/324, G01N 2291/02836, G05B 23/0294, G05B 2219/32184, G05B 2219/36292, G05B 2219/41303, G05D 7/06, G06F 2201/81, G06F 2209/5022</p> <p>USPC- 73/198, 73/861.12, 134/22.12, 134/102.1, 134/102.2, 134/166C, 134/169C, 299/1.9, 417/20, 700/282</p>
Date Conducted	23 November 2018

Documentation Searched	Patent Literature and Non-Patent Literature
Search Terms Used	<p>pump, efficiency, performance, sense, flow, rate, monitor, detect, measure, determine, threshold, slurry, wellbore, bore, subterranean, frack, frac, fracturing, drilling, control, adjust, non-contact, sensor, volumetric, operating, performance, parameter, suction, discharge</p>
Date Conducted	23 November 2018

Electronic Database Searched	Google
Files Searched	Google Patent
Date Conducted	23 November 2018
<p style="text-align: center;">Search Logic:</p> <p>(slurry flow rate) (pump efficiency) (monitor OR detect OR measure OR sense) (control OR adjust)</p> <p>About 108,000 results (0.44 seconds)</p> <p>(wellbore OR bore OR drilling OR frack OR fracturing) (flow rate) ("pump efficiency"~2) (monitor OR detect OR measure OR sense OR determine) (control OR adjust)</p> <p>About 2,370 results (0.47 seconds)</p>	

(wellbore OR bore OR drilling OR frack OR fracturing) ((flow OR pump) (rate OR speed)) (pump efficiency) (monitor OR detect OR measure OR sense OR determine) (control OR adjust OR parameter)
 About 255,000 results (0.75 seconds)
 (wellbore OR bore OR drilling OR frack OR fracturing) ((flow OR pump) (rate OR speed OR volumetric)) (pump (efficiency OR performance)) (monitor OR detect OR measure OR sense OR determine) (control OR adjust OR parameter) (suction discharge)
 About 77,800 results (0.66 seconds)
 (wellbore OR bore OR drilling OR frack OR frac OR fracturing) ((flow OR pump) (rate OR speed OR volumetric OR parameter OR operating)) (pump efficiency) (monitor OR detect OR measure OR sense OR determine) (non contact sensor)
 About 130,000 results (0.60 seconds)

Electronic Database Searched	Google
Files Searched	Google Scholar
Date Conducted	23 November 2018
Search Logic:	
(slurry flow rate) (pump efficiency) (monitor OR detect OR measure OR sense) (control OR adjust) About 85,800 results (0.20 sec) (wellbore OR bore OR drilling OR frack OR fracturing) (flow rate) ("pump efficiency"~2) (monitor OR detect OR measure OR sense OR determine) (control OR adjust) About 5,560 results (0.26 sec) (wellbore OR bore OR drilling OR frack OR fracturing) ((flow OR pump) (rate OR speed)) (pump efficiency) (monitor OR detect OR measure OR sense OR determine) (control OR adjust OR parameter) About 319,000 results (0.19 sec) (wellbore OR bore OR drilling OR frack OR fracturing) ((flow OR pump) (rate OR speed OR volumetric)) (pump (efficiency OR performance)) (monitor OR detect OR measure OR sense OR determine) (control OR adjust OR parameter) (suction discharge) About 31,900 results (0.19 sec) (wellbore OR bore OR drilling OR frack OR frac OR fracturing) ((flow OR pump) (rate OR speed OR volumetric OR parameter OR operating)) (pump efficiency) (monitor OR detect OR measure OR sense OR determine) (non contact sensor) About 56,600 results (0.22 sec)	

Electronic Database Searched	Free Patents Online
Files Searched	(US Pat, PgPub, EPO, JPO, WIPO: classification, keyword)
Date Conducted	23 November 2018
Search Logic:	
(slurry flow rate) (pump efficiency) (monitor OR detect OR measure OR sense) (control OR adjust)	

Matches 1 - 50 out of 140151

(wellbore OR bore OR drilling OR frack OR fracturing) (flow rate) ("pump efficiency"~2) (monitor OR detect OR measure OR sense OR determine) (control OR adjust)

Matches 1 - 50 out of 2634

(wellbore OR bore OR drilling OR frack OR fracturing) ((flow OR pump) (rate OR speed)) (pump efficiency) (monitor OR detect OR measure OR sense OR determine) (control OR adjust OR parameter)

Matches 1 - 50 out of 256277

(wellbore OR bore OR drilling OR frack OR fracturing) ((flow OR pump) (rate OR speed OR volumetric)) (pump (efficiency OR performance)) (monitor OR detect OR measure OR sense OR determine) (control OR adjust OR parameter) (suction discharge)

Matches 1 - 50 out of 50654

(wellbore OR bore OR drilling OR frack OR frac OR fracturing) ((flow OR pump) (rate OR speed OR volumetric OR parameter OR operating)) (pump efficiency) (monitor OR detect OR measure OR sense OR determine) (non contact sensor)

Matches 1 - 50 out of 72437

Electronic Database Searched	Pat Base
Files Searched	Full-text: AU BE BR CA CH CN DE DK EP ES FI FR GB IN JP KR SE TH TW US WO Bibliographic: (Europe) AT BA BE BG CH CS CY CZ DD DK EE ES FI GE GR HR HU IE IS IT LT LU LV MC MD MT NL NO PL PT RO RS SE SI SK SM TR UA YU (Asia) EA GC HK ID IL IN KZ MN MY PH RU SG SU TH TJ TW UZ VN (North America) CA CR CU DO GT HN MX NI PA SV TT (South America) AR BR CL CO EC PE UY (Australasia) AU NZ (Africa) AP DZ EG KE MA MW OA ZA ZM ZW
Date Conducted	23 November 2018
Search Logic:	
Search 1: IC=(E21B37/06 or E21B45/00 or F04B49/06 or F04B49/20 or G01F1/76 or G01N29/44 or G05D7/06) (Results 39592)	
Search 2: CPC=(E21B37/06 or E21B45/00 or E21B47/0007 or E21B49/08 or E21B49/081 or E21B49/087 or F04B49/06 or F04B49/20 or F04B2027/1827 or F04B2027/1831 or E21B2049/085 or F04B2203/1102 or F04B2205/01 or F04B2205/05 or G01F1/76 or G01F25/0007 or G01N29/44 or G01N29/4427 or G01N2030/324 or G01N2291/02836 or G05B23/0294 or G05B2219/32184 or G05B2219/36292 or G05B2219/41303 or G05D7/06 or G06F2201/81 or G06F2209/5022) (Results 15608)	
Search 3: UC=(73/198 or 73/861.12 or 134/22.12 or 134/102.1 or 134/102.2 or 134/166C or 134/169C or 299/1.9 or 417/20 or 700/282) (Results 5688)	
Search 4: 3 or 2 or 1 (Results 53809)	
Search 5: PA=("U.S." or WELL or SERVICES) (Results 217141)	
Search 6: INV=(Oehring or Christinzio or Hinderliter) (Results 193)	
Search 7: 6 or 5 (Results 217322)	
Search 8: SP=(pump* and (effici* or perform*)) (Results 630514)	
Search 9: 8 and sens* (Results 115981)	
Search 10: 8 and (flow* near rate*) (Results 34495)	
Search 11: 8 and (monitor* OR detect* OR measur* OR sens* or determin*) (Results 212253)	
Search 12: 8 and threshold* (Results 19154)	

Search 13: 12 and 11 and 10 and 9 (Results 1724)
Search 14: 12 and 11 and 10 and 9 and 7 (Results 68)
Search 15: 12 and 11 and 10 and 9 and 4 (Results 196)
Search 16: 8 and slurr* (Results 13213)
Search 17: 8 and (wellbor* or bore* or subterranean* or frack* or fracturing*) (Results 35517)
Search 18: 8 and (control* or adjust*) (Results 292944)
Search 19: 18 and 17 and 16 and 12 and 11 and 10 and 9 (Results 7)
Search 20: 18 and 17 and 16 and 12 and 11 and 10 and 7 (Results 4)
Search 21: 18 and 17 and 16 and 12 and 11 and 10 and 4 (Results 5)
Search 22: 18 and 17 and 12 and 11 and 10 and 9 (Results 157)
Search 23: 18 and 17 and 12 and 11 and 10 and 9 and 7 (Results 31)
Search 24: 18 and 17 and 12 and 11 and 10 and 9 and 4 (Results 44)
Search 25: 24 not 23 (Results 34)
Search 26: 8 and (pump* near effic*) (Results 20486)
Search 27: 26 and 18 and 17 and 16 (Results 12)
Search 28: 26 and 18 and 17 and 16 and 10 (Results 6)
Search 29: 26 and 18 and 17 and 10 (Results 66)
Search 30: 26 and 18 and 17 and 10 and 4 (Results 12)

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

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

PCT

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

(PCT Rule 44.1)

Date of mailing
(day/month/year)

02 JAN 2019

Applicant's or agent's file reference
047158.500030

FOR FURTHER ACTION See paragraphs 1 and 4 below

International application No.
PCT/US 18/54548

International filing date
(day/month/year) 05 October 2018 (05.10.2018)

Applicant U.S. WELL SERVICES, LLC

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

Filing of amendments and statement under Article 19:

The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

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

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

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

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

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

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

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

4. Reminders

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

Shortly after the expiration of 18 months from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90bis.1 and 90bis.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 36 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 36 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 45bis.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 W. Young

PCT Helpdesk: 571-272-4300
Telephone No. PCT OSP: 571-272-7774

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 047158.500030	FOR FURTHER ACTION	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. PCT/US 18/54548	International filing date (day/month/year) 05 October 2018 (05.10.2018)	(Earliest) Priority Date (day/month/year) 05 October 2017 (05.10.2017)
Applicant U.S. WELL SERVICES, LLC		

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

This international search report consists of a total of 3 sheets.

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

1. Basis of the report

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

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

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

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

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

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

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

4. With regard to the title,

☒ the text is approved as submitted by the applicant.

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

5. With regard to the abstract,

☒ the text is approved as submitted by the applicant.

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

6. With regard to the drawings,

a. the figure of the drawings to be published with the abstract is Figure No. 2

☐ 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 18/54548

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:
because they are dependent claims that fail to further describe or clarify the independent claim.

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:

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.:

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 18/54548

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - E21B 43/26, F04B 47/02, F04B 17/03, F04D 29/044 (2018.01)

CPC - E21B 43/26, F04B 47/02, F04B 17/03, F04D 29/044

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

See Search History Document

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

See Search History Document

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

See Search History Document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2018/0290114 A1 (US Well Services LLC) 6 October 2018 (06.10.2018) Entire document especially para [0022]-[0026] and fig. 3	1-3, 5-8, 8-10, 12, 16-18, 20
Y		4, 7, 11, 13-15, 19
Y	US 2015/0211524 A1 (US Well Services LLC) 30 July 2015 (30.07.2015) Entire document especially para [0033], [0044], [0047] and figs. 1-3	4, 11, 19
Y	US 2014/0135079 A1 (US Well Services LLC) 22 May 2014 (22.05.2014) Entire document especially para [0014], [0016], [0022] and fig. 1	7, 13-15
A	US 9,562,420 B2 (Evolution Well Services, LLC) 7 February 2017 (07.02.2017) Entire document	1-20
A	US 2014/0010671 A1 (Cryer et al.) 9 January 2014 (09.01.2014) Entire document	1-20
A	US 2014/0251623 A1 (Prostim Labs, LLC) 11 September 2014 (11.09.2014) Entire document	1-20
A	US 2015/0252661 A1 (Glass) 10 September 2015 (10.09.2015) Entire document	1-20

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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

"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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

"&" document member of the same patent family

Date of the actual completion of the international search

21 November 2018

Date of mailing of the international search report

02 JAN 2019

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 W. Young

PCT Helpdesk: 571-272-4300

PCT OSP: 571-272-7774

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 43bis.1)

Date of mailing
(day/month/year)

02 JAN 2019

Applicant's or agent's file reference
047158.500030

FOR FURTHER ACTION

See paragraph 2 below

International application No.

PCT/US 18/54548

International filing date (day/month/year)

05 October 2018 (05.10.2018)

Priority date (day/month/year)

05 October 2017 (05.10.2017)

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

IPC(8) - E21B 43/26, F04B 47/02, F04B 17/03, F04D 29/044 (2018.01)

CPC - E21B 43/26, F04B 47/02, F04B 17/03, F04D 29/044

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 43bis.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 66.1bis(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
Mail Stop PCT, Attn: ISA/US
Commissioner for Patents
P.O. Box 1450, Alexandria, Virginia 22313-1450
Facsimile No. 571-273-8300

Date of completion of this opinion

21 November 2018

Authorized officer

Lee W. Young

PCT Helpdesk: 571-272-4300
PCT QSP: 571-272-7774

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US 18/54548

Box No. 1 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 43bis.1(a)).

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

- a. ☐ forming part of the international application as filed:
☐ in the form of an Annex C/ST.25 text file.
☐ on paper or in the form of an image file.
b. ☐ furnished together with the international application under PCT Rule 13ter.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 13ter.1(a)).
☐ on paper or in the form of an image file (Rule 13ter.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 18/54548

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

1. Statement

Novelty (N)	Claims	4, 7, 11, 13-15, 19	YES
	Claims	1-3, 5-6, 8-10, 12, 16-18, 20	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 1-3, 5-6, 8-10, 12, 16-18 and 20 lack novelty under PCT Article 33(2) as being anticipated by US 2016/0280114 A1 to US Well Services LLC (hereinafter "Well114").

Regarding Claim 1, Well114 teaches a hydraulic fracturing system (See fig. 3; para [0023]) for fracturing a subterranean formation (64 - "subterranean formation", fig. 3) comprising:
an electric pump (84 - "pump", fig. 3; para [0022]-[0024] - pump is driven by an electric generator 50 and an electric motor 88) fluidly connected to a well (60 - "wellbore", fig. 3) associated with the subterranean formation and powered by at least one electric motor (88 - "electric motor", fig. 3; para [0023]), and configured to pump fluid into a wellbore (60 - "wellbore", fig. 3) associated with the well at a high pressure so that the fluid passes from the wellbore into the subterranean formation (para [0023]) and fractures (62 - "fractures", fig. 3; para [0023]) the subterranean formation;
at least one generator (50 - "generator", fig. 2; para [0022]) electrically coupled (108 - "line", fig. 3; para [0025]) to the electric motor so as to generate electricity for use by the electric pump (para [0025]);
wherein a shaft of the motor (88 - "electric motor", fig. 3) is directly coupled to a crankshaft of the pump (84 - "pump", fig. 3) without an intermediate gear reduction system (para [0023] - "In one example, the connection 90 is a direct coupling between an electric motor 88 and a hydraulic fracturing pump 84.") such that the shaft of the motor rotates at substantially the same speed as the crankshaft of the pump (See fig. 3; para [0023] - a direct coupling between the motor 88 and pump 84 means the speed would be transferred from the shaft of the motor to the crankshaft of the pump).

Regarding Claim 2, Well114 teaches the system of claim 1, further comprising: a coupling device (90 - "connection", fig. 3) connecting the shaft of the motor to the crankshaft (para [0023]).

Regarding Claim 3, Well114 teaches the system of claim 2, wherein the coupling device (90 - "connection", fig. 3) is a flexible coupling device or a rigid coupling device (all couplings must be either rigid or flexible).

Regarding Claim 5, Well114 teaches the system of claim 1, further comprising: a variable frequency drive (91 - "variable frequency drive", fig. 3) connected to the at least one electric motor to control the speed of the at least one electric motor (para [0024]).

Regarding Claim 6, Well114 teaches the system of claim 1, wherein the at least one generator (50 - "generator", fig. 2; para [0022]) comprises one of a turbine generator (44 - "turbine", fig. 2; para [0022]) or a reciprocating engine generator, or a combination thereof.

Regarding Claim 8, Well114 teaches a hydraulic fracturing system (See fig. 3; para [0023]) for fracturing a subterranean formation (64; See fig. 3; para [0023]) comprising:
an electric pump (84 - "pump", fig. 3; para [0022]-[0024] - pump is driven by an electric generator 50 and an electric motor 88) fluidly connected to a well (60 - "wellbore", fig. 3) associated with the subterranean formation and configured to pump fluid into a wellbore (60 - "wellbore", fig. 3) associated with the well at a high pressure so that the fluid passes from the wellbore into the subterranean formation (para [0023]) and fractures (62 - "fractures", fig. 3; para [0023]) the subterranean formation;
at least one electric motor (88 - "electric motor", fig. 3; para [0023]) providing operational energy to the electric pump (para [0023]);
at least one generator (50 - "generator", fig. 2; para [0022]) electrically coupled (108 - "line", fig. 3) to the electric motor so as to generate electricity for use by the electric pump (para [0025]);
a variable frequency drive (91 - "variable frequency drive", fig. 3) connected to the at least one electric motor to control the speed of the at least one electric motor (para [0024]);
wherein a shaft of the motor (88 - "electric motor", fig. 3) is directly coupled (para [0023] - "In one example, the connection 90 is a direct coupling between an electric motor 88 and a hydraulic fracturing pump 84.") to a crankshaft of the pump (84 - "pump", fig. 3) such that the shaft of the motor rotates at substantially the same speed as the crankshaft of the pump (See fig. 3; para [0023] - a direct coupling between the motor 88 and pump 84 means the speed would be transferred from the shaft of the motor to the crankshaft of the pump).

Regarding Claim 9, Well114 teaches the system of claim 8, further comprising: a coupling device (90 - "connection", fig. 3) connecting the shaft of the motor to the crankshaft (para [0023]).

Regarding Claim 10, Well114 teaches the system of claim 9, wherein the coupling device (90 - "connection", fig. 3) is a flexible coupling device or a rigid coupling device (all couplings must be either rigid or flexible).

^Continued in Supplemental Box.^

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US 18/54548

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 12 and 13: The recitations "The system of claim 1" is confusing because claim 1 already has two dependent claims with the exact same wording as claims 12 and 13 (See claims 6 and 7). It appears as though the author of the claims made an error and wrote that claims 12 and 13 were dependent from the wrong independent claim. Accordingly, for purposes of this opinion, the recitations have been interpreted to be "The system of claim 8."

Claim 20: The recitation "The system of claim 1" is confusing because claim 1 already has language and a dependent claim with the exact same wording as claim 20 (See claims 1 and 6). It appears as though the author of the claim made an error and wrote that claim 20 was dependent from the wrong independent claim. Accordingly, for purposes of this opinion, the recitation has been interpreted to be "The system of claim 16."

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US 18/54548

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 12, Well114 teaches the system of claim 8 (Note: See Box VIII), wherein the at least one generator (50 - "generator", fig. 2; para [0022]) comprises one of a turbine generator (44 - "turbine", fig. 2; para [0022]) or a reciprocating engine generator, or a combination thereof.

Regarding Claim 16, Well114 teaches a hydraulic fracturing system (See fig. 3; para [0023]) for fracturing a subterranean formation (64; See fig. 3; para [0023]) comprising:
an electric pump (84 - "pump", fig. 3; para [0022]-[0024] - pump is driven by an electric generator 50 and an electric motor 88 fluidly connected to a well (60 - "wellbore", fig. 3) associated with the subterranean formation and configured to pump fluid into a wellbore (60 - "wellbore", fig. 3) associated with the well at a high pressure so that the fluid passes from the wellbore into the subterranean formation (para [0023]) and fractures (62 - "fractures", fig. 3; para [0023]) the subterranean formation;
at least one electric motor (88 - "electric motor", fig. 3; para [0023]) providing operational energy to the electric pump (para [0023]);
a variable frequency drive (91 - "variable frequency drive", fig. 3) connected to the at least one electric motor to control the speed of the at least one electric motor (para [0024]);
wherein a shaft (88 - "electric motor", fig. 3) of the motor is directly coupled (para [0023] - "In one example, the connection 90 is a direct coupling between an electric motor 88 and a hydraulic fracturing pump 84.") to a crankshaft of the pump (84 - "pump", fig. 3) such that the shaft of the motor rotates at substantially the same speed as the crankshaft of the pump and a torque output of the at least one electric motor is directly transmitted to the electric pump (See fig. 3; para [0023] - a direct coupling between the motor 88 and pump 84 means the torque would be transferred from the shaft of the motor to the crankshaft of the pump).

Regarding Claim 17, Well114 teaches the system of claim 16, further comprising: a coupling device (90 - "connection", fig. 3) connecting the shaft of the motor to the crankshaft (para [0023]).

Regarding Claim 18, Well114 teaches the system of claim 17, wherein the coupling device (90 - "connection", fig. 3) is a flexible coupling device or a rigid coupling device (all couplings must be either rigid or flexible).

Regarding Claim 20, Well114 teaches the system of claim 16 (Note: See Box VIII), further comprising: at least one generator (50 - "generator", fig. 2; para [0022]) electrically coupled (108 - "line", fig. 3) to the electric motor so as to generate electricity for use by the electric pump (para [0023], [0025]), wherein the at least one generator comprises one of a turbine generator (44 - "turbine", fig. 2; para [0022]) or a reciprocating engine generator, or a combination thereof.

Claims 4, 11 and 19 lack an inventive step under PCT Article 33(3) as being obvious over Well114 in view of US 2015/0211524 A1 to US Well Services LLC (hereinafter "Well524")

Regarding Claim 4, Well114 teaches the system of claim 2, but does not specifically teach wherein the coupling device is at least one of a beam coupling, a bellows coupling, a chain coupling, a jaw coupling, a diaphragm coupling, a disc coupling, a gear coupling, a grid coupling, an Oldham coupling, a Schmidt coupling, or clamping coupling. Further, Well524 teaches a hydraulic fracturing system (See fig. 1; para [0033]) comprising a coupling device (152 - "torsional coupling", figs. 2A-C; para [0040]) for connecting a shaft of a motor (para [0041] - "motor shaft") to a crankshaft of a pump (para [0041] - "pump shaft") wherein the coupling device is a jaw coupling (para [0045]-[0047]; See fig. 3; see how motor coupling claws 170 are designed to fit within the areas between adjacent elastomeric inserts 164). Accordingly, it would have been obvious to one of ordinary skill in the art to use the coupling device taught by Well524 instead of the coupling device taught by Well114 to directly couple the motor to the pump in order to allow for a misalignment of shafts while still maintaining full torque and speed transfer.

Regarding Claim 11, Well114 teaches the system of claim 9, but does not specifically teach wherein the coupling device is at least one of a beam coupling, a bellows coupling, a chain coupling, a jaw coupling, a diaphragm coupling, a disc coupling, a gear coupling, a grid coupling, an Oldham coupling, a Schmidt coupling, or clamping coupling. Further, Well524 teaches a hydraulic fracturing system (See fig. 1; para [0033]) comprising a coupling device (152 - "torsional coupling", figs. 2A-C; para [0040]) for connecting a shaft of a motor (para [0041] - "motor shaft") to a crankshaft of a pump (para [0041] - "pump shaft") wherein the coupling device is a jaw coupling (para [0045]-[0047]; See fig. 3; see how motor coupling claws 170 are designed to fit within the areas between adjacent elastomeric inserts 164). Accordingly, it would have been obvious to one of ordinary skill in the art to use the coupling device taught by Well524 instead of the coupling device taught by Well114 to directly couple the motor to the pump in order to allow for a misalignment of shafts while still maintaining full torque and speed transfer.

Regarding Claim 19, Well114 teaches the system of claim 17, but does not specifically teach wherein the coupling device is at least one of a beam coupling, a bellows coupling, a chain coupling, a jaw coupling, a diaphragm coupling, a disc coupling, a gear coupling, a grid coupling, an Oldham coupling, a Schmidt coupling, or clamping coupling. Further, Well524 teaches a hydraulic fracturing system (See fig. 1; para [0033]) comprising a coupling device (152 - "torsional coupling", figs. 2A-C; para [0040]) for connecting a shaft of a motor (para [0041] - "motor shaft") to a crankshaft of a pump (para [0041] - "pump shaft") wherein the coupling device is a jaw coupling (para [0045]-[0047]; See fig. 3; see how motor coupling claws 170 are designed to fit within the areas between adjacent elastomeric inserts 164). Accordingly, it would have been obvious to one of ordinary skill in the art to use the coupling device taught by Well524 instead of the coupling device taught by Well114 to directly couple the motor to the pump in order to allow for a misalignment of shafts while still maintaining full torque and speed transfer.

Continued in next Supplemental Box.-

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 18/54548

Supplemental Box

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

Continuation of:

Supplemental Box - Box V.2 - Citations and Explanations -

Claims 7 and 13-15 lack an inventive step under PCT Article 33(3) as being obvious over Well114 in view of US 2014/0138079 A1 to US Well Services LLC (hereinafter 'Well079')

Regarding Claim 7, Well114 teaches the system of claim 1, but does not specifically teach wherein the electric pump comprises limited gearing. Further, Well079 teaches a hydraulic fracturing system (See fig. 1; para [0018]) comprising an electric motor (14 - "electric motor", fig. 1) for providing operational energy (para [0014]) to a pump (10 - "pump", fig. 1) wherein the pump comprises limited gearing (para [0022]). Accordingly, it would have been obvious to one of ordinary skill in the art to use the limited gearing in the pump taught by Well079 on the pump taught by Well114 in order to allow for the pump to have greater variability in its output despite the same input.

Regarding Claim 13, Well114 teaches the system of claim 8 (Note: See Box VIII), but does not specifically teach wherein the electric pump comprises limited gearing. Further, Well079 teaches a hydraulic fracturing system (See fig. 1; para [0018]) comprising an electric motor (14 - "electric motor", fig. 1) for providing operational energy (para [0014]) to a pump (10 - "pump", fig. 1) wherein the pump comprises limited gearing (para [0022]). Accordingly, it would have been obvious to one of ordinary skill in the art to use the limited gearing in the pump taught by Well079 on the pump taught by Well114 in order to allow for the pump to have greater variability in its output despite the same input.

Regarding Claim 14, Well114, in view of Well079, teaches but does not specifically teach the system of claim 13, wherein the limited gearing is internal to the electric pump. However, using routine experimentation and design principles, it would have been obvious to one of ordinary skill in the art that the limited gearing can only be either internal to the pump or external to the pump. Accordingly, it would have been obvious to one of ordinary skill in the art to place the limited gearing internal to the pump in order to protect it from any other components of the system or from the wellbore.

Regarding Claim 15, Well114, in view of Well079, teaches but does not specifically teach the system of claim 13, wherein the limited gearing is external to the electric pump. However, using routine experimentation and design principles, it would have been obvious to one of ordinary skill in the art that the limited gearing can only be either internal to the pump or external to the pump. Accordingly, it would have been obvious to one of ordinary skill in the art to place the limited gearing external to the pump in order to save room inside the pump and allow for a more modular assembly to aid assembly and disassembly.

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

SEARCH HISTORY

Application Number	PCT/US 18/54548
Search Conducted By	MFG
Search Approved By	SCL

CPC/IPC Classifications Searched	IPC(8): E21B 43/26, F04B 47/02, F04B 17/03, F04D 29/044 (2018.01) CPC: E21B 43/26, F04B 47/02, F04B 17/03, F04D 29/044
Date Conducted	21 November 2018 (21.11.2018)

Documentation Searched	IPC(8): E21B 43/26, F04B 47/02, F04B 17/03, F04D 29/044 (2018.01) CPC: (Keyword limited; see below)
Search Terms Used	electric powered hydraulic fracturing system limited gearing US Well Services LLC pump motor wellbore variable frequency drive turbine generator crankshaft coupling
Date Conducted	21 November 2018 (21.11.2018)

Electronic Database Searched	PatBase
Files Searched	Full-text: AU BE BR CA CH CN DE DK EP ES FI FR GB IN JP KR SE TH TW US WO Bibliographic: (European) AT BA BE BG CH CS CY CZ DD DK EE ES FI GE GR HR HU IE IS IT LT LU LV MC MD MT NL NO PL PT RO RS SE SI SK SM TR UA YU (Asia) EA GC HK ID IL IN KZ MN MY PH RU SG SU TH TJ TW UZ VN (North America) CA CR CU DO GT HN MX NI PA SV TT (South America) AR BR CL CO EC PE UY (Australasia) AU NZ (Africa) AP DZ EG KE MA MW OA ZA ZM ZW
Date Conducted	21 November 2018 (21.11.2018)
Search Logic:	

#	Search query	Results
<u>1</u>	IC=(F04B47/02) OR CPC=(F04B47/02)	5047
<u>2</u>	1 AND FT=(pump* NEAR (gear*))	241
<u>3</u>	2 AND FT=(electric* NEAR motor*)	110
<u>4</u>	IC=(E21B43/26) OR CPC=(E21B43/26)	9654
<u>5</u>	4 AND FT=((electric* NEAR motor*) AND (motor* NEAR pump*))	109
<u>6</u>	IC=(F04B17/03) OR CPC=(F04B17/03)	7904
<u>7</u>	6 AND FT=((electric* NEAR motor*) AND (motor* NEAR pump*))	1417
<u>8</u>	7 AND FT=(coupling* OR (gear* NEAR limited*))	456
<u>9</u>	IC=(F04D29/044) OR CPC=(F04D29/044)	1301
<u>10</u>	9 AND FT=((electric* NEAR motor*) AND (motor* NEAR pump*))	134
<u>11</u>	pn=(US20160290114 OR US20150211524 OR us2014138079)	1
<u>12</u>	CTB 11 OR CTF 11	204
<u>13</u>	12 AND FT=((electric* NEAR motor*) AND (motor* NEAR pump*))	45

Electronic Database Searched	Google
Files Searched	Patents
Date Conducted	21 November 2018 (21.11.2018)
Search Logic: electric powered hydraulic fracturing system -gear - About 29,900 results assignee:(US Well Services LLC) - About 42 results electric powered hydraulic fracturing system limited gearing - About 15,200 results pump "limited gearing" - 7 results pump with additional spacing - About 208,000 results electric fracturing systems with motor and pump - About 131,000 results coupling for motor shaft and pump crankshaft - About 110,000 results electric pump and motor for wellbore - About 45,900 results electric powered hydraulic fracturing with variable frequency drive - About 63,200 results electric powered hydraulic fracturing with turbine generator - About 199,000 results	

Electronic Database Searched	Google
Files Searched	Web

Date Conducted	21 November 2018 (21.11.2018)
Search Logic:	
<p>"limited gearing" - About 3,980 results</p> <p>"limited gearing" pump - About 647 results</p> <p>electric powered hydraulic fracturing system -gear - About 765,000 results</p> <p>US Well Services LLC - About 780,000,000 results</p> <p>electric powered hydraulic fracturing system limited gearing - About 705,000 results</p> <p>pump with additional spacing - About 7,570,000 results</p> <p>electric fracturing systems with motor and pump - About 10,900,000 results</p> <p>coupling for motor shaft and pump crankshaft - About 4,980,000 results</p> <p>electric powered hydraulic fracturing with variable frequency drive - About 1,300,000 results</p> <p>electric powered hydraulic fracturing with turbine generator - About 1,020,000 results</p>	

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 047158.500031	Date of mailing (day/month/year) 31 DEC 2018
International application No. PCT/US 18/55913	International filing date (day/month/year) 15 October 2018 (15.10.2018)
Applicant U.S. WELL SERVICES, LLC	

1. ☒ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.
 Filing of amendments and statement under Article 19:
 The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):
 When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.
 How? Directly to the International Bureau of WIPO preferably through ePCT or on paper to, 34 chemin des Colombettes
 1211 Geneva 20, Switzerland, Facsimile No.: +41 22 338 82 70
 For more detailed instructions, see *PCT Applicant's Guide*, International Phase, paragraphs 9.004 – 9.011.
2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.
3. ☐ With regard to any protest against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:
 - ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with any request to forward the texts of both the protest and the decision thereon to the designated Offices.
 - ☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. Reminders

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

Shortly after the expiration of 18 months from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90bis.1 and 90bis.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 45bis.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 W. Young PCT Helpdesk: 571-272-4300 Telephone No. PCT OSP: 571-272-7774
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PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 047158.500031	FOR FURTHER ACTION	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. PCT/US 18/55913	International filing date (day/month/year) 15 October 2016 (15.10.2016)	(Earliest) Priority Date (day/month/year) 13 October 2017 (13.10.2017)
Applicant U.S. WELL SERVICES, LLC		

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

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

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

1. Basis of the report

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

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

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

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

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

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

4. With regard to the title,

- ☒ the text is approved as submitted by the applicant.
☐ the text has been established by this Authority to read as follows:

5. With regard to the abstract,

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

6. With regard to the drawings,

- a. the figure of the drawings to be published with the abstract is Figure No. 2 _____
☐ 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 18/55913

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - E21B 44/00, E21B 43/26, E21B 43/267 (2018.01)

CPC - E21B 44/00, E21B 43/26, E21B 43/267, E21B 44/005

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

See Search History Document

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

See Search History Document

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

See Search History Document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X — Y	US 2017/0037717 A1 (US Well Services LLC) 9 February 2017 (09.02.2017) Entire document especially para [0022], [0023], [0030] and fig. 1	1-7, 9-13, 17, 19 ----- 8, 14-16, 18, 20
Y	US 2017/0226842 A1 (Schlumberger Technology Corporation) 10 August 2017 (10.08.2017) Entire document especially para [0028]-[0030], [0075], [0090], [0094], [0142]-[0143] and figs. 1 and 2	8, 14-16, 18, 20
Y	US 2011/0247878 A1 (Rasheed) 13 October 2011 (13.10.2011) Entire document especially para [0041], [0066], [0076], [0078] and figs. 1 and 3	15
A	US 2016/0230524 A1 (Dumolt et al.) 11 August 2016 (11.08.2016) Entire document	1-20
A	US 2017/0114625 A1 (Lord Corporation) 27 April 2017 (27.04.2017) Entire document	1-20
A	US 2017/0022807 A1 (Landmark Graphics Corporation) 26 January 2017 (26.01.2017) Entire document	1-20
A	US 2017/0030178 A1 (US Well Services LLC) 2 February 2017 (02.02.2017) Entire document	1-20

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"I" 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

5 December 2018

Date of mailing of the international search report

31 DEC 2018

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 W. Young

PCT Helpdesk: 571-272-4300

PCT OSP: 571-272-7774

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 43bis.1)

Date of mailing
(day/month/year)

31 DEC 2018

Applicant's or agent's file reference
047158.500031

FOR FURTHER ACTION

See paragraph 2 below

International application No.

PCT/US 18/55913

International filing date (day/month/year)

15 October 2018 (15.10.2018)

Priority date (day/month/year)

13 October 2017 (13.10.2017)

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

IPC(8) - E21B 44/00, E21B 43/26, E21B 43/267 (2018.01)

CPC - E21B 44/00, E21B 43/26, E21B 43/267, E21B 44/005

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 43bis.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 66.1bis(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.

<p>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</p>	<p>Date of completion of this opinion 5 December 2018</p>	<p>Authorized officer Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774</p>
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WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US 18/55913

Box No. 1 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 43bis.1(a)).

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

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

- ☐ in the form of an Annex C/ST.25 text file.
☐ on paper or in the form of an image file.

b. ☐ furnished together with the international application under PCT Rule 13ter.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 13ter.1(a)).
☐ on paper or in the form of an image file (Rule 13ter.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 18/55913

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

1. Statement

Novelty (N)	Claims	1-8, 11, 13-20	YES
	Claims	9, 10, 12	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 9-10 and 12 lack novelty under PCT Article 33(2) as being anticipated by US 2017/0037717 A1 to US Well Services LLC (hereinafter "Well").

Regarding Claim 9, Well teaches an automated hydraulic fracturing system (10 - "hydraulic fracturing system", fig. 1; para [0022], [0030]), comprising:

a pump system (36 - "fracturing pump", fig. 1) fluidly coupled to a wellhead (41 - "wellhead assembly", fig. 1) at a wellsite to pump a fracturing fluid into the wellhead (para [0022]);

a blender (28 - "blender", fig. 1) configured to mix together proppant and a fluid mixture to form the fracturing fluid (para [0022]);

a proppant storage and delivery system (32 - "proppant source", 34 - "line", fig. 1) configured to provide the proppant for the blender (para [0022]);

a hydration unit (18 - "hydration unit", fig. 1) configured to mix an additive into a fluid to form the fluid mixture and provide the fluid mixture to the blender (para [0022]);

a fluid storage and delivery system (20 - "fluid source", 22 - "line", fig. 1) configured to provide the fluid for the hydration unit (para [0022]);

an additive storage and delivery system (24 - "additive source", 26 - "line", fig. 1) configured to provide the additive to the hydration unit (para [0022]); and

an automated control system (160 - "controller", 154 - "sensors", 156 - "information handling system", 158, 162 - "communication means", fig. 1; para [0022], [0030] - "variable frequency drive") comprising a plurality of sensing devices (154 - "sensors", fig. 1; para [0030]) and a plurality of control devices (160 - "controller", fig. 1; para [0022] - "variable frequency drive") integrated into the pump system (para [0022]), the blender system (para [0030]), the proppant storage and delivery system, the fluid storage and delivery system, and the additive storage and delivery system, the automated control system configured to monitor one or more parameters of the automated hydraulic fracturing system via the plurality of sensing devices and transmit control instructions for one or more of the plurality of control devices to control an aspect of the automated hydraulic fracturing system (para [0030]).

Regarding Claim 10, Well teaches the system of claim 9, further comprising one or more of a plurality of components including a manifold, a manifold trailer, a discharge piping, flow lines conveyance devices, a turbine (44 - "turbine", fig. 1; para [0023]), a motor (39 - "motor", fig. 1), a variable frequency drive, a generator (50 - "generator", fig. 1), or a fuel source, wherein the automated control system (160 - "controller", 154 - "sensors", 156 - "information handling system", 158, 162 - "communication means", fig. 1; para [0022], [0030] - "variable frequency drive") comprises sensors and control devices integrated into the one or more of the plurality of components (para [0030] - sensors 154 can be placed in the power end of the hydraulic fracturing fleet which includes turbine 44 and generator 50).

Regarding Claim 12, Well teaches the system of claim 9, wherein the automated control system (160 - "controller", 154 - "sensors", 156 - "information handling system", 158, 162 - "communication means", fig. 1; para [0022] - "variable frequency drive") comprises processing devices (156 - "information handling system", fig. 1; para [0030]) located at the wellsite (See fig. 1; para [0030]), remote from the wellsite, or both.

-*-Continued in Supplemental Box*-*

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US 18/55913

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

Claim 8: The term "the central processing system" is confusing and lacks proper antecedent basis. The term is properly introduced in claim 7. As written, claim 8 depends from claim 1. Accordingly, for purposes of this opinion, claim 8 has been interpreted to depend from claim 7.

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US 18/55913

Supplemental Box

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

Continuation of:

-. Supplemental Box - Box V.2 - Citations and Explanations -.

Claims 1-7, 11, 13, 17 and 19 lacks an inventive step under PCT Article 33(3) as being obvious over Well

Regarding Claim 1, Well teaches an automated hydraulic fracturing system (10 - "hydraulic fracturing system", fig. 1; para [0022], [0030]), comprising:

a pump system (36 - "fracturing pump", fig. 1) fluidly coupled to a wellhead (41 - "wellhead assembly", fig. 1) to pump a fracturing fluid into the wellhead (para [0022]), wherein the pump is instrumented with a pump controller (para [0022] - variable frequency drive controls motor 39 which controls pump 36);

a blender system (28 - "blender", fig. 1) fluidly coupled to the pump (See fig. 1), the blender mixing together one or more materials to form the fracturing fluid (para [0022]), wherein the blender is instrumented with a blender sensor (para [0030] - "In one example, a sensor is mounted near the blender discharge pump");

a source system (20 - "fluid source", 22 - "line", 32 - "proppant source", 34 - "line", fig. 1) for providing at least one of the one or more materials to the blender (para [0022]); and

a component (53 - "turbine generator", fig. 1; para [0023]), the component instrumented with at least one of a component sensor (para [0030] - sensors 154 can be placed in the power end of the hydraulic fracturing fleet which includes turbine 44 and generator 50) and a component controller,

and a controller (160 - "controller", fig. 1; para [0030]; para [0023] - "variable frequency drive"), wherein the controller controls a aspects of the automated hydraulic fracturing system based at least in part on automated instructions (para [0030]), the automated instructions generated based on measurements received from the at least one of the blender sensor and the component sensor (para [0030] - "controller 160 can be used for sending control commands for operation of the system 10, and thus can utilize vibration information from sensors 154 to adjust control commands.") but does not specifically teach wherein the pump system or the source system have their own sensors; wherein the blender system or the source system each have their own controller; or wherein each controller controls their own respective aspect of the automated hydraulic fracturing system.

However, Well does teach that the sensors (154 - "sensors", fig. 1; para [0030]) can comprise multiple sensors located on multiple parts of the hydraulic fracturing system (para [0030]) and also teaches that the controller is able to control the entire system (para [0030]). The separation and rearrangement of parts falls within the ordinary skill of one in the art using routine experimentation and design principles. Accordingly, it would have been obvious to one of ordinary skill in the art to provide the pump system and the source system with their own sensors and to provide the pump system, the blender system, the component and the source system with their own controllers in order to provide the information handling system with information about all components of the system as well as improving the speed at which the controllers are able to actually control their respective aspect of the system.

Regarding Claim 2, Well teaches the system of claim 1, wherein the pump system (36 - "fracturing pump", fig. 1) comprises a motor (39 - "motor", fig. 1) controlled by the pump controller (para [0023] - "variable frequency drive") based at least in part on the automated instructions (para [0022], [0030]).

Regarding Claim 3, Well teaches the system of claim 1, wherein the blender (28 - "blender", fig. 1) comprises at least one of a chemical pump (para [0022] - "Blender 28 can have an onboard chemical additive system, such as with chemical pumps and augers."), a cooling system, an auger, a blender discharge pump, a valve, or an actuator, the at least one controlled by the blender controller based at least in part on the automated instructions (para [0022], [0030]).

Regarding Claim 4, Well teaches the system of claim 1, wherein the source (20 - "fluid source", 22 - "line", 32 - "proppant source", 34 - "line", fig. 1) comprises at least one of a gate, a valve, an actuator, a delivery belt, a delivery line (22, 34 - "line", fig. 1; para [0023]), or a chemical pump, the at least one controlled by the source controller based at least in part on the automated instructions (para [0022], [0030]).

Regarding Claim 5, Well teaches the system of claim 1, wherein the component (53 - "turbine generator", fig. 1; para [0023]) comprises at least one of a turbine (44 - "turbine", para [0023]), a generator, a hydration unit, a distribution system, a fuel source, or a wellhead.

Regarding Claim 6, Well teaches the system of claim 5, wherein the component sensor (para [0030] - sensors 154 can be placed in the power end of the hydraulic fracturing fleet which includes turbine 44 and generator 50) measures at least one parameter associated with the turbine (44 - "turbine", fig. 1; para [0023], [0030]), the generator, the hydration unit, the distribution system, the fuel source, or the wellhead, and the component controller (para [0030]; see treatment of claim 1) controls at least one aspect of the turbine, the generator, the hydration unit, the distribution system, the fuel source, or the wellhead, based at least in part on the automated instructions (para [0030]).

Regarding Claim 7, Well teaches the system of claim 1, further comprising a central processing system (160 - "controller", 156 - "information handling system", fig. 1) configured to receive the measurements from the pump sensor, the blender sensor, the source sensor, and the component sensor, and generate the automated instructions based on the measurements (para [0030]; see treatment of claim 1).

Regarding Claim 11, Well teaches the system of claim 9, but does not specifically teach wherein the control instructions cause the one or more of the plurality of control devices to automatically adjust one or more of a flow rate, a pressure, power, motor speed, gates, valve, actuators, delivery lines and conveyance devices, pump rates, or cooling systems. Further, Well does teach that the pressure or pump rate of the slurry can be adjusted by the pump system (36 - "pump", fig. 1; para [0022]), that a sensor (154 - "sensor", fig. 1) can be associated with the pump (para [0030]) and that the controller is able to send control commands to operate the system. Accordingly, it would have been obvious to one of ordinary skill in the art that the pressure and flow rate of the pump system could be adjusted using the control instructions in order to allow for automatic adjustment of the pump, thus reducing the chances of user error.

-. Continued in next Supplemental Box -.

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 18/55913

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, Well teaches an automated hydraulic fracturing method (10 - "hydraulic fracturing system", fig. 1; para [0022], [0030]), comprising:

initiating a hydraulic fracturing operation using an automated hydraulic fracturing system (See fig. 1; para [0022]);

providing a first material (para [0022] - "fluid") for a fracturing fluid from a first source (20 - "fluid source", fig. 1) to a blender (28 - "blender", fig. 1);

providing a second material (para [0022] - "additives") for the fracturing fluid from a second source (24 - "additive source", fig. 1) to the blender (para [0022]);

mixing the first material and the second material at the blender to form the fracturing fluid (See fig. 1; para [0022]), the blender comprising a blender sensor (para [0030] - "In one example, a sensor is mounted near the blender discharge pump") for measuring one or more parameters associated with the blender (para [0030]);

providing the fracturing fluid from the blender to a pump (36 - "fracturing pump", fig. 1), the pump comprising a pump controller (para [0022] - variable frequency drive controls motor 39 which controls pump 36) for controlling one or more functions of the pump (para [0022]);

injecting the fracturing fluid from the pump into a wellhead (41 - "wellhead assembly", fig. 1) coupled to a well (12 - "wellbore", fig. 1; para [0022]);

monitoring the one or more parameters via the blender sensor (para [0030]);

generating automated instructions for at least one of a controller (160 - "controller", fig. 1; para [0030]) based at least in part on the one or more parameters (para [0030]); and

controlling at least one of the one or more functions of the first source, the blender, or the pump via the controller or the pump controller, respectively, based at least in part on the automated instructions (para [0030]) but does not specifically teach wherein the first source or the pump each comprise their own sensor for measuring their respective parameters; wherein the first source or the blender have their own controller for controlling their respective functions.

However, Well does teach that the sensors (154 - "sensors", fig. 1; para [0030]) can comprise multiple sensors located on multiple parts of the hydraulic fracturing system (para [0030]) and also teaches that the controller is able to control the entire system (para [0030]). The separation and rearrangement of parts falls within the ordinary skill of one in the art using routine experimentation and design principles.

Accordingly, it would have been obvious to one of ordinary skill in the art to provide the pump system and the source system with their own sensors and to provide the pump system, the blender system, the component and the source system with their own controllers in order to provide the information handling system with information about all components of the system as well as improving the speed at which the controllers are able to actually control their respective aspect of the system.

While Well does not explicitly disclose the positive recitation of a method, the device taught by Well is inherently 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 Well as a whole, effectively providing a method of use through enabling the use of an automated hydraulic fracturing system.

Regarding Claim 17, Well teaches the method of claim 13, further comprising:

transmitting information (para [0030] - "information sensed by sensors") derived from the one or more measured parameters to a remote control center (para [0030] - "the IHS 156 communicates with the World Wide Web to allow for remote reviewing of the information");

receiving control instructions from the remote control center; and automatically controlling at least one aspect of the hydraulic fracturing system based at least in part on the received control instructions (para [0030] - HIS 156 and controller 160 are used to send control commands for the operation of the system which can be done remotely using the world wide web).

Regarding Claim 19, Well teaches the method of claim 13, further comprising:

controlling a pressure or rate at which the fracturing fluid is injected into the wellhead based on the automated instructions (para [0022] - "In an example, the pressure of the slurry in line 38 ranges from around 80 psi to around 100 psi. The pressure of the slurry can be increased up to around 15,000 psi by pump 36."; para [0030] - "controller 160 can be used for sending control commands for operation of the system 10, and thus can utilize vibration information from sensors 154 to adjust control commands.")

While Well does not explicitly disclose the positive recitation of a method, the device taught by Well is inherently 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 Well as a whole, effectively providing a method of use through enabling the use of an automated hydraulic fracturing system.

Claims 8, 14, 16, 18 and 20 lack an inventive step under PCT Article 33(3) as being obvious over Well in view of US 2017/0226842 A1 to Schlumberger Technology Corporation (hereinafter "Schlumberger")

Regarding Claim 6, Well teaches the system of claim 7 (Note: See Box VIII), but does not specifically teach wherein the central processing system is configured to generate alerts or notifications based on the measurements, the alerts or notifications indicating a condition of a certain component or operation. Further, Schlumberger teaches an automatic hydraulic fracturing system (See figs. 1 and 2; para [0028], [0029]) comprising a source system (200 - "additive system", fig. 2; para [0030]) instrumented with a source sensor (204 - "sensor", fig. 2; para [0030]) configured to generate alerts based on measurements indicating a condition of the source system (para [0075], [0080], [0094]). Accordingly, it would have been obvious to one of ordinary skill in the art to incorporate the alert sending function taught in the sensors of Schlumberger into the sensors taught by Well in order to allow operators to quickly identify problem areas and fix said problems to maximize efficiency of the wellsite.

-Continued in next Supplemental Box-

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 16/55913

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 14, Well teaches the method of claim 13, but does not specifically teach the method further comprising: detecting that at least one of the one or more parameters is outside of an acceptable threshold; and automatically stopping or adjusting at least one of the one or more functions in response to the detection. Further, Schlumberger teaches an automatic hydraulic fracturing system (See figs. 1 and 2; para [0028], [0029]) comprising a source system (200 - "additive system", fig. 2; para [0030]) instrumented with a source sensor (204 - "sensor", fig. 2; para [0030]) for detecting that at least one parameter is outside an acceptable threshold (para [0142], [0143]) and automatically adjusting the a function in response (para [0143] - a parameter is monitored (615, fig. 6), compared to a threshold (625, fig. 6) and an output signal for controlling an additive system component is outputted). Accordingly, it would have been obvious to one of ordinary skill in the art to have the sensor send a signal and the controller read said signal and adjust the system as need be as taught by Schlumberger be incorporated into the sensors and controller taught by Well in order to allow for automatic adjustment of parameters without waiting on operator intervention in order to maximize efficiency at the wellsite.

While Well, in view of Schlumberger, does not explicitly disclose the positive recitation of a method, the device taught by Well, in view of Schlumberger, is inherently 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 Well, in view of Schlumberger, as a whole, effectively providing a method of use through enabling the use of an automated hydraulic fracturing system.

Regarding Claim 15, Well teaches the method of claim 13, but does not specifically teach the method further comprising: detecting that at least one performance issue of the automated hydraulic fracturing system; and providing troubleshooting codes or alerts indicative of one or more sources of the performance issue. Further, Schlumberger teaches an automatic hydraulic fracturing system (See figs. 1 and 2; para [0028], [0029]) comprising a source system (200 - "additive system", fig. 2; para [0030]) instrumented with a source sensor (204 - "sensor", fig. 2; para [0030]) configured to detect at least one performance issue of the source system and provide trouble shooting codes or alerts indicative of the performance issue (para [0075], [0090], [0094], [0099]). Accordingly, it would have been obvious to one of ordinary skill in the art to incorporate the alert sending function and troubleshooting codes taught in the sensors of Schlumberger into the sensors taught by Well in order to allow operators to quickly identify problem areas and fix said problems to maximize efficiency of the wellsite.

While Well, in view of Schlumberger, does not explicitly disclose the positive recitation of a method, the device taught by Well, in view of Schlumberger, is inherently 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 Well, in view of Schlumberger, as a whole, effectively providing a method of use through enabling the use of an automated hydraulic fracturing system.

Regarding Claim 18, Well teaches the method of claim 13, but does not specifically teach the method further comprising: automatically starting, stopping, or adjusting the rate of delivery of the first source to the blender based at least in part on the automated instructions.

Further, Schlumberger teaches an automatic hydraulic fracturing system (See figs. 1 and 2; para [0028], [0029]) comprising a source system (200 - "additive system", fig. 2; para [0030]) instrumented with a source sensor (204 - "sensor", fig. 2; para [0030]) for detecting that at least one parameter is outside an acceptable threshold (para [0142], [0143]) and automatically adjusting the a function in response (para [0143] - a parameter is monitored (615, fig. 6), compared to a threshold (625, fig. 6) and an output signal for controlling an additive system component is outputted). Accordingly, it would have been obvious to one of ordinary skill in the art to have used the teachings of Schlumberger to have the source sensor and the blender sensor taught by Well be used to monitor flow parameters and automatically adjust the flow rate if one of the sensors senses a parameter outside the threshold in order to allow for automatic adjustment of parameters without waiting on operator intervention in order to maximize efficiency at the wellsite.

While Well, in view of Schlumberger, does not explicitly disclose the positive recitation of a method, the device taught by Well, in view of Schlumberger, is inherently 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 Well, in view of Schlumberger, as a whole, effectively providing a method of use through enabling the use of an automated hydraulic fracturing system.

Regarding Claim 20, Well teaches the method of claim 13, further comprising:

providing the fracturing fluid from the blender to a plurality of pumps (See fig. 1; para [0022]);

providing the fracturing fluid from the plurality of pumps to a distribution system (42 - "discharge piping", fig. 1; para [0022]);

injecting the fracturing fluid from the distribution system into the wellbore (See fig. 1; para [0022]); but does not specifically teach the method comprising

automatically adjusting individual pressures or pump rates of the plurality of pumps and/or a pressure or pump rate of the distribution system based on the automated instructions.

Further, Schlumberger teaches an automatic hydraulic fracturing system (See figs. 1 and 2; para [0028], [0029]) comprising a source system (200 - "additive system", fig. 2; para [0030]) instrumented with a source sensor (204 - "sensor", fig. 2; para [0030]) for detecting that at least one parameter is outside an acceptable threshold (para [0142], [0143]) and automatically adjusting the a function in response (para [0143] - a parameter is monitored (615, fig. 6), compared to a threshold (625, fig. 6) and an output signal for controlling an additive system component is outputted). Accordingly, it would have been obvious to one of ordinary skill in the art to have used the teachings of Schlumberger to have the pump sensors taught by Well be used to monitor flow parameters and automatically adjust the flow rate of one of the pumps based on the instructions in order to allow for automatic adjustment of parameters without waiting on operator intervention in order to maximize efficiency at the wellsite.

While Well, in view of Schlumberger, does not explicitly disclose the positive recitation of a method, the device taught by Well, in view of Schlumberger, is inherently 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 Well, in view of Schlumberger, as a whole, effectively providing a method of use through enabling the use of an automated hydraulic fracturing system.

-Continued in next Supplemental Box-*

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 18/55913

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 15 lacks an inventive step under PCT Article 33(3) as being obvious over Well in view of Schlumberger in view of US 2011/0247878 A1 to Rasheed

Regarding Claim 15, Well teaches the method of claim 13, but does not specifically teach the method further comprising:
detecting substandard performance in one or more areas of the automated hydraulic fracturing system;
automatically troubleshooting the automated hydraulic fracturing system based on live data from a plurality of sensors or previous data collected by the sensors;
determining one or more causes or suspected causes of the substandard performance; and
automatically adjusting one or more components of the automated hydraulic fracturing system to resolve the substandard performance.
Further, Schlumberger teaches an automatic hydraulic fracturing system (See figs. 1 and 2; para [0028], [0029]) comprising a source system (200 - “additive system”, fig. 2; para [0030]) instrumented with a source sensor (204 - “sensor”, fig. 2; para [0030]) configured to detect substandard performance of the system (para [0094], [0099]) and allows for trouble shooting based on the data from the sensors (para [0094], [0099]) to determine the cause of the substandard performance and automatically adjusts the system to resolve it (para [0142], [0143]). Accordingly, it would have been obvious to one of ordinary skill in the art to incorporate the alert sending function and troubleshooting codes taught in the sensors of Schlumberger into the sensors taught by Well in order to allow operators to quickly identify problem areas and fix said problems to maximize efficiency of the wellsite.
Further, any combination of the above references fails to teach wherein the troubleshooting is done automatically. However, Rasheed teaches a system (See fig. 1; para [0076]) comprising sensors (76 - “vibration sensor”, fig. 3; para [0078]) wherein when the sensor detects substandard performance, the problem is automatically troubleshooted (para [0041], [0066], [0080]). Accordingly, it would have been obvious to one of ordinary skill in the art to use the automatic troubleshooting taught by Rasheed in the system taught by Well, in view of Schlumberger, instead of the manual troubleshooting in order to reduce the need for operator intervention and maximize the efficiency of the wellsite.

While Well, in view of Schlumberger and Rasheed, does not explicitly disclose the positive recitation of a method, the device taught by Well, in view of Schlumberger and Rasheed, is inherently 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 Well, in view of Schlumberger and Rasheed, as a whole, effectively providing a method of use through enabling the use of an automated hydraulic fracturing system.

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

SEARCH HISTORY

Application Number	PCT/US 18/55913
Search Conducted By	MFG
Search Approved By	SCL

CPC/IPC Classifications Searched	IPC(8): E21B 44/00, E21B 43/26, E21B 43/267 (2018.01) CPC: E21B 44/00, E21B 43/26, E21B 43/267, E21B 44/005
Date Conducted	5 December 2018 (05.12.2018)

Documentation Searched	IPC(8): E21B 44/00, E21B 43/26, E21B 43/267 (2018.01) CPC: (keyword limited; see below)
Search Terms Used	automatic fracturing system and method wellbore US Well Services LLC instructions sensor alerts troubleshooting remote processor additives
Date Conducted	5 December 2018 (05.12.2018)

Electronic Database Searched	PatBase
Files Searched	Full-text: AU BE BR CA CH CN DE DK EP ES FI FR GB IN JP KR SE TH TW US WO Bibliographic: (European) AT BA BE BG CH CS CY CZ DD DK EE ES FI GE GR HR HU IE IS IT LT LU LV MC MD MT NL NO PL PT RO RS SE SI SK SM TR UA YU (Asia) EA GC HK ID IL IN KZ MN MY PH RU SG SU TH TJ TW UZ VN (North America) CA CR CU DO GT HN MX NI PA SV TT (South America) AR BR CL CO EC PE UY (Australasia) AU NZ (Africa) AP DZ EG KE MA MW OA ZA ZM ZW
Date Conducted	5 December 2018 (05.12.2018)
Search Logic:	

##	Search query	Results
<u>1</u>	pA=(US Well Services LLC)	7
<u>2</u>	IC=(E21B43/267) OR CPC=(E21B43/267)	3359
<u>3</u>	2 AND FT=(sensor* NEAR (alert* OR notif* OR troubleshoot*))	5
<u>4</u>	2 AND FT=(sensor* AND ((troubleshoot* OR trouble shoot*) W3 automatic*))	0
<u>5</u>	2 AND FT=(sensor* AND ((troubleshoot* OR trouble shoot*) NEAR automatic*))	0
<u>6</u>	IC=(E21B44/00) OR CPC=(E21B44/00)	6382
<u>7</u>	6 AND FT=(sensor* AND ((troubleshoot* OR trouble shoot*) W3 automatic*))	2
<u>8</u>	IC=(E21B43/26) OR CPC=(E21B43/26)	9708
<u>9</u>	8 AND FT=(sensor* AND ((troubleshoot* OR trouble shoot*) NEAR automatic*))	1
<u>10</u>	pn=(us2017037717 OR us2017226842 OR us2011247878)	3
<u>11</u>	CTB 10 OR CTF 10	432
<u>12</u>	11 AND TAC=(well*) AND FT=(sensor*)	118
<u>13</u>	TAC=(well* AND fractur*) AND FT=(sensor* AND (controller* OR automat*))	1548
<u>14</u>	13 AND FT=((instruct* OR control*) NEAR (sens*))	717
<u>15</u>	14 AND FT=(pump* AND blender*)	90
<u>16</u>	CPC=(E21B44/005)	466
<u>17</u>	16 AND FT=(sens* NEAR control*)	149

Electronic Database Searched	Google
Files Searched	Patents
Date Conducted	5 December 2018 (05.12.2018)
Search Logic:	
automatic fracturing system and method - About 187,000 results	
automatic fracturing system and method wellbore - About 41,100 results	
inassignee:"Us Well Services Llc" - About 26 results	
inassignee:"Us Well Services Llc" sensor - About 17 results	
"automated hydraulic fracturing" - 1 result	
hydraulic fracturing with automated instructions - About 8,930 results	
hydraulic fracturing with automated instructions and alerts - About 10,600 results	
hydraulic fracturing with automated instructions for troubleshooting - About 72,600 results	

remote processor for hydraulic fracturing - About 13,600 results
remote processor for hydraulic fracturing with additives - About 8,850 results

Electronic Database Searched	Google
Files Searched	Web
Date Conducted	5 December 2018 (05.12.2018)
Search Logic:	
automatic fracturing system and method - About 15,600,000 results	
automatic fracturing system and method wellbore - About 703,000 results	
"Us Well Services Llc" - About 13,200 results	
"Us Well Services Llc" sensor - About 2,860 results	
"automated hydraulic fracturing" - About 406 results	
hydraulic fracturing with automated instructions - About 524,000 results	
hydraulic fracturing with automated instructions and alerts - About 634,000 results	
hydraulic fracturing with automated instructions for troubleshooting - About 30,400,000 results	
remote processor for hydraulic fracturing - About 442,000 results	
remote processor for hydraulic fracturing with additives - About 323,000 results	

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 047158.500032	Date of mailing <i>(day/month/year)</i> <div style="font-size: 1.2em; font-weight: bold;">04 JAN 2019</div>
International application No. PCT/US 18/57539	International filing date <i>(day/month/year)</i> 25 October 2018 (25.10.2018)
Applicant U.S. WELL SERVICES, LLC	

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

Filing of amendments and statement under Article 19:

The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

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

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

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

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

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

4. Reminders

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

Shortly after the expiration of 18 months from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90bis.1 and 90bis.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 45bis.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 <div style="text-align: right;">Lee W. Young</div> <div style="text-align: right; font-size: 0.8em;"> PCT Helpdesk: 571-272-4300 Telephone No. PCT QSP: 571-272-7774 </div>
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Form PCT/ISA/220 (July 2014)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 047158.500032	FOR FURTHER ACTION	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. PCT/US 18/57539	International filing date (day/month/year) 25 October 2018 (25.10.2018)	(Earliest) Priority Date (day/month/year) 25 October 2017 (25.10.2017)
Applicant U.S. WELL SERVICES, LLC		

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

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

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

1. Basis of the report

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

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

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

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

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

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

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

4. With regard to the title,

☒ the text is approved as submitted by the applicant.

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

5. With regard to the abstract,

☒ the text is approved as submitted by the applicant.

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

6. With regard to the drawings,

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

☐ as suggested by the applicant.

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

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

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

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 18/57539

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - E21B 44/00, E21B 43/26, E21B 43/267 (2018.01)

CPC - E21B 44/00, 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	US 2017/0037717 A1 (US Well Services LLC) 9 February 2017 (09.02.2017) Entire document especially para [0022], [0024], [0030] and figs. 1-2	1, 3, 7, 14-16 ----- 2, 4-6, 8-13, 17-20
Y	WO 2016/160458 A1 (Schlumberger Technology Corporation) 6 October 2016 (06.10.2016) Entire document especially para [0028], [0038], [0039] and figs. 1, 2, 5 and 7	2, 4-6, 8-12, 17-20
Y	US 2016/0032703 A1 (US Well Services LLC) 4 February 2016 (04.02.2016) Entire document especially para [0014], [0023], [0063]-[0064] and fig. 1	9, 10, 13, 20
Y	US 2017/0226842 A1 (Schlumberger Technology Corporation) 10 August 2017 (10.08.2017) Entire document especially para [0028]-[0030], [0075], [0080], [0094], [0119] and fig. 2	12, 13
A	US 2016/0256267 A1 (Stewart & Stevenson, LLC) 8 September 2016 (08.09.2016) Entire document	1-20
A	US 2015/0144336 A1 (Data Automated Water Systems, LLC) 26 May 2015 (26.05.2015) Entire document	1-20
A	US 2016/0208595 A1 (Yang et al.) 21 July 2016 (21.07.2016) Entire document	1-20
A	US 2015/0075778 A1 (Halliburton Energy Services, Inc.) 19 March 2015 (19.03.2015) Entire document	1-20

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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

"&" document member of the same patent family

Date of the actual completion of the international search

12 December 2018

Date of mailing of the international search report

04 JAN 2019

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 W. Young

PCT Helpdesk: 571-272-4300

PCT OSP: 571-272-7774

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 43bis.1)

Date of mailing
(day/month/year)

04 JAN 2019

Applicant's or agent's file reference
047158.500032

FOR FURTHER ACTION

See paragraph 2 below

International application No.

PCT/US 18/57539

International filing date (day/month/year)

25 October 2018 (25.10.2018)

Priority date (day/month/year)

25 October 2017 (25.10.2017)

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

IPC(8) - E21B 44/00, E21B 43/26, E21B 43/267 (2018.01)

CPC - E21B 44/00, 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 43bis.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 66.1bis(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
Mail Stop PCT, Attn: ISA/US
Commissioner for Patents
P.O. Box 1450, Alexandria, Virginia 22313-1450
Facsimile No. 571-273-8300

Date of completion of this opinion

12 December 2018

Authorized officer

Lee W. Young

PCT Helpdesk: 571-272-4300
PCT OSP: 571-272-7774

Form PCT/ISA/237 (cover sheet) (January 2015)

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US 18/57539

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 43bis.1(a)).
3. ☐ With regard to any nucleotide and/or amino acid sequence disclosed in the international application, this opinion has been established on the basis of a sequence listing:
 - a. ☐ forming part of the international application as filed:
 - ☐ in the form of an Annex C/ST.25 text file.
 - ☐ on paper or in the form of an image file.
 - b. ☐ furnished together with the international application under PCT Rule 13ter.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 13ter.1(a)).
 - ☐ on paper or in the form of an image file (Rule 13ter.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 18/57539

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or 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, 3, 7 and 14-16 lack an inventive step under PCT Article 33(3) as being obvious over US 2017/0037717 A1 to US Well Services LLC (hereinafter "Well717")

Regarding Claim 1, Well717 teaches a hydraulic fracturing system (10 - "hydraulic fracturing system", fig. 1; para [0022], [0030]), comprising:
a plurality of pumps (36 - "fracturing pump", fig. 1; para [0024]; see fig. 2) positioned at a wellsite (12 - "wellbore", fig. 1) and configured to pressurize a fracturing fluid (para [0022]);
a distribution system (38 - "line", 42 - "discharge piping", 76 - "suction manifold", 80 - "discharge manifold", figs. 1 and 2) fluidly coupled to receive and consolidate fracturing fluid from the plurality of pumps for injection (para [0024]) into a wellhead (41 - "wellhead assembly", fig. 1); and
a control system (154 - "sensors", 156 - "information handling system", 160 - "controller", 158, 162 - "communication means", fig. 1; para [0030]) comprising:
a plurality of sensing devices (154 - "sensors", fig. 1) configured to measure one or more parameters (para [0030]);
one or more processing devices (156 - "information handling system", fig. 1) configured to receive and analyze the one or more parameters measured by the plurality of sensing devices and generate control instructions based at least in part on the one or more parameters (para [0030]); and
one or more control devices (160 - "controller", fig. 1) configured to receive the control instructions and control one or more aspects based on the control instructions (para [0030]) but does not specifically teach wherein the control system measures a parameter or controls aspects of the pumps and the distribution system.
However, Well717 does teach that the sensors (154 - "sensors", fig. 1; para [0030]) can comprise multiple sensors located on multiple parts of the hydraulic fracturing system (para [0030]) in order to adjust control commands for the system (para [0030]). Accordingly, it would have been obvious to one of ordinary skill in the art to include sensors on the pumps and distribution system in order to allow for constant monitoring and adjustment of fracturing fluid entering wellhead because the pumps and distribution system are key members of the hydraulic fracturing system.

Regarding Claim 3, Well717 teaches the system of claim 1, wherein the plurality of pumps or the distribution system (38 - "line", 42 - "discharge piping", 76 - "suction manifold", 80 - "discharge manifold", figs. 1 and 2) includes at least one of a gate, valve, actuator, motor, suction pipe, discharge pipe (42 - "discharge piping", fig. 1), engine, transmission, or temperature regulation device, controllable via the one or more control devices (160 - "controller", fig. 1; para [0030]) - controller 160 uses measurements from sensors 154 to adjust control commands. Since the pump and distribution system has sensors now, they can be monitored and controlled by the controller 160.

Regarding Claim 7, Well717 teaches a hydraulic fracturing method (10 - "hydraulic fracturing system", fig. 1; para [0022], [0030]), comprising:
providing a fracturing fluid (para [0022]) - line 38 provides a fracturing slurry to pumps 36 to a plurality of pumps (36 - "fracturing pump", fig. 1; para [0024]; see fig. 2);
pumping the fracturing fluid (para [0022]) into a distribution system (38 - "line", 42 - "discharge piping", 76 - "suction manifold", 80 - "discharge manifold", figs. 1 and 2);
injecting the fracturing fluid (para [0022]) into a wellhead (41 - "wellhead assembly", fig. 1);
measuring one or more parameters (para [0030]) of the plurality of pumps, the distribution system, or the wellhead via a plurality of sensing devices (154 - "sensors", fig. 1; para [0030]) instrumented thereon (See fig. 1);
generating automated instructions (para [0030]) - information handling system 156 generates instructions for one or more control devices (160 - "controller", fig. 1) based at least in part on the one or more parameters (para [0030]); and
controlling one or more functions of the plurality of pumps, the distribution system, or the wellhead based at least in part on the automated instructions (para [0030]) - controller 160 controls the devices based on the instructions of the information handling system which is based on the parameter measurements of sensors 154).
While Well717 does not explicitly disclose the positive recitation of a method, the device taught by Well717 is inherently 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 Well717 as a whole, effectively providing a method of use through enabling the use of an automated hydraulic fracturing system.

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Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

Claim 16: The term "the distribution system" is confusing and lacks proper antecedent basis. The term is properly introduced in claim 15. As written, claim 16 depends from claim 17. Accordingly, for purposes of this opinion, claim 16 has been interpreted to be dependent on claim 15.

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Supplemental Box

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

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Regarding Claim 14, Well717 teaches a hydraulic fracturing method (10 - "hydraulic fracturing system", fig. 1; para [0022], [0030]), comprising:
receiving a first data from a first sensing device (154 - "sensors", fig. 1; para [0030]; see how one sensor 154 is located on the wellhead assembly 41) of a hydraulic fracturing system (10 - "hydraulic fracturing system", fig. 1);
receiving second data from a second sensing device (154 - "sensors", fig. 1; para [0030] - a sensor 154 can be placed near blender discharge pump) of a blender system (28 - "blender", fig. 1) of the hydraulic fracturing system, the blender system mixing together materials to form a fracturing fluid (para [0022] - "fracturing slurry") and delivering the fracturing fluid to a pump system (36 - "pumps", fig. 1; para [0022]), and the second data indicative of a condition of the blender system (para [0030]);
generating automated instructions para [0030] - information handling system 156 generates instructions for one or more control devices (160 - "controller", fig. 1) of the blender system based at least in part on the first and second data (para [0030]); and
controlling one or more functions of the blender system based at least in part on the automated instructions (para [0030] - controller 160 controls the devices based on the instructions of the information handling system which is based on the parameter measurements of sensors 154) but does not specifically teach wherein the first sensing device measures data indicative of a condition of the pump system. However, Well717 does teach that the sensors (154 - "sensors", fig. 1; para [0030]) can comprise multiple sensors located on multiple parts of the hydraulic fracturing system (para [0030]) in order to adjust control commands for the system (para [0030]). Accordingly, it would have been obvious to one of ordinary skill in the art to include sensors on the pumps for monitoring a condition thereof in order to allow for constant monitoring and adjustment of fracturing fluid entering wellhead because the pumps and distribution system are key members of the hydraulic fracturing system.
While Well717 does not explicitly disclose the positive recitation of a method, the device taught by Well717 is inherently 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 Well717 as a whole, effectively providing a method of use through enabling the use of an automated hydraulic fracturing system.

Regarding Claim 15, Well717 teaches the method of claim 14, wherein the pump system comprises:
one or more pumps (36 - "fracturing pump", fig. 1; para [0024]; see fig. 2); and
a distribution system (38 - "line", 42 - "discharge piping", 76 - "suction manifold", 80 - "discharge manifold", figs. 1 and 2) that receives and consolidates the fracturing fluid from the one or more pumps (para [0024]) for injection into a wellhead (41 - "wellhead assembly", fig. 1). While Well717 does not explicitly disclose the positive recitation of a method, the device taught by Well717 is inherently 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 Well717 as a whole, effectively providing a method of use through enabling the use of an automated hydraulic fracturing system.

Regarding Claim 16, Well717 teaches the method of claim 15 (Note: See Box VIII), but does not specifically teach the method further comprising:
controlling one or more functions of the distribution system based on the automated instructions.
However, Well717 does teach that the sensors (154 - "sensors", fig. 1; para [0030]) can comprise multiple sensors located on multiple parts of the hydraulic fracturing system (para [0030]) in order to adjust control commands for the system (para [0030]). Accordingly, it would have been obvious to one of ordinary skill in the art to include sensors on the distribution system and allow the controller to control functions based on readings from the sensors in order to allow for constant monitoring and adjustment of fracturing fluid entering wellhead because the pumps and distribution system are key members of the hydraulic fracturing system.
While Well717 does not explicitly disclose the positive recitation of a method, the device taught by Well717 is inherently 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 Well717 as a whole, effectively providing a method of use through enabling the use of an automated hydraulic fracturing system.

Claims 2, 4-6, 8, 11 and 17-19 lack an inventive step under PCT Article 33(3) as being obvious over Well717 in view of WO 2016/160458 A1 to Schlumberger Technology Corporation (hereinafter "Schlumberger458")

Regarding Claim 2, Well717 teaches the system of claim 1, wherein the plurality of sensing devices (154 - "sensors", fig. 1) are installed on the plurality of pumps and the distribution system (para [0030]; See treatment of claim 1), but does not specifically teach wherein the sensing devices include at least one of flow sensors, accelerometers, pressure transducer, or tachometers. Further, Schlumberger458 teaches a hydraulic fracturing system (100 - "wellsite system", fig. 1; para [0028]) comprising a plurality of pumps (241, 242 - "high pressure pump units", fig. 2; para [0038]) comprising a plurality of sensing devices (244, 245, 246, 247 - "flow sensors", fig. 1; para [0039]) in communication with a controller (410 - "controller", fig. 2; para [0049]). Accordingly, it would have been obvious to use the flow sensing devices taught by Schlumberger458 in association with the pumps and controller taught by Well717 in order to allow the control system to quickly identify which pumps are operating efficiently and which may require maintenance.

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Regarding Claim 4, Well717 teaches the system of claim 1, further comprising:

a suction line (76 - "suction manifold", fig. 1) through which fracturing fluid is supplied (para [0024]); and
a discharge line (80 - "discharge line", fig. 1) through which fracturing fluid is discharged (para [0024]), but does not specifically teach wherein the plurality of sensing devices includes one or more flow sensors configured to measure flow through the suction line and the discharge line.

Further, Schlumberger458 teaches a hydraulic fracturing system (100 - "wellsite system", fig. 1; para [0028]) comprising a plurality of pumps (241, 242 - "high pressure pump units", fig. 2; para [0038]) comprising a plurality of sensing devices (244, 245, 246, 247 - "flow sensors", fig. 1; para [0039]) in communication with a controller (410 - "controller", fig. 2; para [0049]). Accordingly, it would have been obvious to use the flow sensing devices taught by Schlumberger458 in association with the pumps, suction line, discharge line and controller taught by Well717 in order to allow the control system to quickly identify which pumps are operating efficiently and which may require maintenance.

Regarding Claim 5, Well717 teaches the system of claim 1, further comprising:

one or more blenders (28 - "blender", fig. 1) configured to mix together one or more materials to form the fracturing fluid (para [0022]), wherein the fracturing fluid is provided from the blender to the plurality of pumps via a manifold (38 - "line", fig. 1), but does not specifically teach wherein the plurality of sensing devices includes one or more pressure or flow sensors for measuring flow and/or pressure conditions at the one or more blenders, the manifold, the plurality of pumps, or the distribution system.

Further, Schlumberger458 teaches a hydraulic fracturing system (100 - "wellsite system", fig. 1; para [0028]) comprising a plurality of pumps (241, 242 - "high pressure pump units", fig. 2; para [0038]) comprising a plurality of sensing devices (244, 245, 246, 247 - "flow sensors", fig. 1; para [0039]) in communication with a controller (410 - "controller", fig. 2; para [0049]). Accordingly, it would have been obvious to use the flow sensing devices taught by Schlumberger458 in association with the pumps and controller taught by Well717 in order to allow the control system to quickly identify which pumps are operating efficiently and which may require maintenance.

Regarding Claim 6, Well717, in view of Schlumberger458, teaches the system of claim 5, and Well717 further teaches that the one or more control device (Well717: 160 - "controller", fig. 1) is configured to control the one or more blenders, the manifold, the plurality of pumps and the distribution system based on the flow and/or pressure conditions (para [0030] - controller 160 controls the devices based on the instructions of the information handling system which is based on the parameter measurements of sensors 154).

Regarding Claim 8, Well717 teaches the method of claim 7, but does not specifically teach further comprising:

detecting that a first parameter of the one or more parameters is outside of an acceptable threshold, wherein the first parameter is associated with a first pump of the plurality of pumps; and
automatically adjusting or turning off the first pump.

Further, Schlumberger458 teaches a hydraulic fracturing method (See fig. 5; para [0081]) comprising a system (100 - "wellsite system", fig. 1; para [0028]) comprising a plurality of pumps (241, 242 - "high pressure pump units", fig. 2; para [0038]) comprising a plurality of sensing devices (244, 245, 246, 247 - "flow sensors", fig. 1; para [0039]) wherein the method comprises detecting that a parameter associated with the plurality of pumps is outside an acceptable threshold (para [0090]) and automatically turning the pump off (para [0090]). Accordingly, it would have been obvious to one of ordinary skill in the art to use the method of shutting off a pump when a parameter is outside an acceptable threshold as taught by Schlumberger458 with the hydraulic fracturing method taught by Well717 in order to ensure that no faulty pumps continue to operate and create dangerous working conditions at the wellsite.

While Well717, in view of Schlumberger458, does not explicitly disclose the positive recitation of a method, the device taught by Well717, in view of Schlumberger458, is inherently 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 Well717, in view of Schlumberger458, as a whole, effectively providing a method of use through enabling the use of an automated hydraulic fracturing system.

Regarding Claim 11, Well717 teaches the method of claim 7, but does not specifically teach the method further comprising:

determining that the one or more parameters are indicative of a potential failure condition; and
determining a source of the potential failure condition.

Further, Schlumberger458 teaches a hydraulic fracturing method (700 - "method", fig. 8; para [0099]) comprising a hydraulic fracturing system (100 - "wellsite system", fig. 1; para [0028]) comprising a plurality of pumps (241, 242 - "high pressure pump units", fig. 2; para [0038]) comprising a plurality of sensing devices (244, 245, 246, 247 - "flow sensors", fig. 1; para [0039]) in communication with a controller (410 - "controller", fig. 2; para [0049]), the method comprising determining that a parameter is indicative of a potential failure condition (para [00104]) - "The method (700) may also comprise confirming (760) that safety parameters are within predetermined ranges..." and determining the source of the failure (para [00104] - controller 410 checks through all the sensors to find the issue). Accordingly, it would have been obvious to one of ordinary skill in the art to use the failure condition sensing method as taught by Schlumberger458 with the method taught by Well717 in order to allow an operator or controller to quickly identify the exact location of the wellsite that requires maintenance.

While Well717, in view of Schlumberger458, does not explicitly disclose the positive recitation of a method, the device taught by Well717, in view of Schlumberger458, is inherently 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 Well717, in view of Schlumberger458, as a whole, effectively providing a method of use through enabling the use of an automated hydraulic fracturing system.

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Regarding Claim 17, Well717 teaches the method of claim 14, but does not specifically teach wherein the pump system comprises a plurality of pumps, and the first data includes measurements of each of the plurality of pumps. Further, Schlumberger458 teaches a hydraulic fracturing system (100 - "wellsite system", fig. 1; para [0028]) comprising a plurality of pumps (241, 242 - "high pressure pump units", fig. 2; para [0038]) comprising a plurality of sensing devices (244, 245, 246, 247 - "flow sensors", fig. 1; para [0039]) in communication with a controller (410 - "controller", fig. 2; para [0049]). Accordingly, it would have been obvious to use the flow sensing devices taught by Schlumberger458 in association with each of the pumps and the controller taught by Well717 in order to allow the control system to quickly identify which pumps are operating efficiently and which may require maintenance.

While Well717, in view of Schlumberger458, does not explicitly disclose the positive recitation of a method, the device taught by Well717, in view of Schlumberger458, is inherently 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 Well717, in view of Schlumberger458, as a whole, effectively providing a method of use through enabling the use of an automated hydraulic fracturing system.

Regarding Claim 18, Well717, in view of Schlumberger458, teaches the method of claim 17, and Well717 teaches the method further comprising:

controlling one or more of the plurality of pumps (36 - "fracturing pump", fig. 1; para [0024]; see fig. 2) individually based on the automated instructions (para [0030]).

While Well717, in view of Schlumberger458, does not explicitly disclose the positive recitation of a method, the device taught by Well717, in view of Schlumberger458, is inherently 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 Well717, in view of Schlumberger458, as a whole, effectively providing a method of use through enabling the use of an automated hydraulic fracturing system.

Regarding Claim 19, Well717, in view of Schlumberger458, teaches the method of claim 18, but does not specifically teach the method further comprising:

detecting that a measurement associated with a first pump of the plurality of pumps is outside of an acceptable threshold; and automatically taking the first pump offline in response to the detection.

Further, Schlumberger458 teaches a hydraulic fracturing method (See fig. 5; para [0081]) comprising a system (100 - "wellsite system", fig. 1; para [0028]) comprising a plurality of pumps (241, 242 - "high pressure pump units", fig. 2; para [0038]) comprising a plurality of sensing devices (244, 245, 246, 247 - "flow sensors", fig. 1; para [0039]) wherein the method comprises detecting that a parameter associated with the plurality of pumps is outside an acceptable threshold (para [0090]) and automatically turning the pump off (para [0090]). Accordingly, it would have been obvious to one of ordinary skill in the art to use the method of shutting off a pump when a parameter is outside an acceptable threshold as taught by Schlumberger458 with the hydraulic fracturing method taught by Well717 in order to ensure that no faulty pumps continue to operate and create dangerous working conditions at the wellsite.

While Well717, in view of Schlumberger458, does not explicitly disclose the positive recitation of a method, the device taught by Well717, in view of Schlumberger458, is inherently 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 Well717, in view of Schlumberger458, as a whole, effectively providing a method of use through enabling the use of an automated hydraulic fracturing system.

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Claims 9-10 and 20 lack an inventive step under PCT Article 33(3) as being obvious over Well717 in view of Schlumberger458 in view of US 2016/0032703 A1 to US Well Services LLC (hereinafter 'Well703')

Regarding Claim 9, Well717, in view of Schlumberger458, teaches the method of claim 8, but does not specifically teach the method further comprising:

adjusting one or more of the other pumps in the plurality of pumps to compensate for the first pump.

Further, Well703 teaches a hydraulic fracturing system (See fig. 1; para [0014]) comprising a plurality of pumps (10 - "plurality of pumps",

fig. 1) comprising a plurality of sensors (para [0023]) associated with a controller (para [0063] - "pump control station") wherein the controller is operable to adjust the flow rates of pumps in order to compensate for a pump with no flow rate (para [0064] - pump control station works to ensure the combined flow rate remains constant, so if one pump were to stop pumping, the pump control station would adjust the other pumps to compensate). Accordingly, it would have been obvious to one of ordinary skill in the art to use the teaching of adjusting pump rates of individual pumps to maintain a total combined flow rate as taught by Well703 on the method taught by Well717, in view of Schlumberger458, in order to allow for automatic, consistent flow into the wellbore during a hydraulic fracturing operation.

While Well717, in view of Schlumberger458 and Well703, does not explicitly disclose the positive recitation of a method, the device taught by Well717, in view of Schlumberger458 and Well703, is inherently 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 Well717, in view of Schlumberger458 and Well703, as a whole, effectively providing a method of use through enabling the use of an automated hydraulic fracturing system.

Regarding Claim 10, Well717, in view of Schlumberger458 and Well703, teaches the method of claim 9, but does not specifically teach the method further comprising:

selecting the one or more of the other pumps to adjust based at least in part on the conditions of the other pumps as indicated by one or more of the one or more parameters.

Further, Schlumberger458 teaches a hydraulic fracturing method (See fig. 5; para [0061]) comprising a system (100 - "wellsite system", fig. 1; para [0028]) comprising a plurality of pumps (241, 242 - "high pressure pump units", fig. 2; para [0036]) comprising a plurality of sensing devices (244, 245, 246, 247 - "flow sensors", fig. 1; para [0039]) wherein the method comprises detecting that a parameter associated with the plurality of pumps is outside an acceptable threshold (para [0090]) and automatically turning the pump off (para [0090]).

Further still, Well703 teaches a hydraulic fracturing system (See fig. 1; para [0014]) comprising a plurality of pumps (10 - "plurality of pumps", fig. 1) comprising a plurality of sensors (para [0023]) associated with a controller (para [0063] - "pump control station") wherein the controller is operable to adjust the flow rates of pumps in order to compensate for a pump with no flow rate (para [0064] - pump control station works to ensure the combined flow rate remains constant, so if one pump were to stop pumping, the pump control station would adjust the other pumps to compensate). Accordingly, it would have been obvious to one of ordinary skill in the art that the controller would monitor the flow of each working pump using the flow sensors and determine which pumps are most capable of picking up the slack and adjusting said pumps in order to more evenly balance the flow through each pump so as to avoid exceeding the threshold for shutdown.

While Well717, in view of Schlumberger458 and Well703, does not explicitly disclose the positive recitation of a method, the device taught by Well717, in view of Schlumberger458 and Well703, is inherently 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 Well717, in view of Schlumberger458 and Well703, as a whole, effectively providing a method of use through enabling the use of an automated hydraulic fracturing system.

Regarding Claim 20, Well717, in view of Schlumberger458, teaches the method of claim 19, but does not specifically teach the method further comprising:

adjusting one or more of the other pumps in the plurality of pumps to compensate for taking the first pump offline.

Further, Well703 teaches a hydraulic fracturing system (See fig. 1; para [0014]) comprising a plurality of pumps (10 - "plurality of pumps",

fig. 1) comprising a plurality of sensors (para [0023]) associated with a controller (para [0063] - "pump control station") wherein the controller is operable to adjust the flow rates of pumps in order to compensate for a pump with no flow rate (para [0064] - pump control station works to ensure the combined flow rate remains constant, so if one pump were to stop pumping, the pump control station would adjust the other pumps to compensate). Accordingly, it would have been obvious to one of ordinary skill in the art to use the teaching of adjusting pump rates of individual pumps to maintain a total combined flow rate as taught by Well703 on the method taught by Well717, in view of Schlumberger458, in order to allow for automatic, consistent flow into the wellbore during a hydraulic fracturing operation.

While Well717, in view of Schlumberger458 and Well703, does not explicitly disclose the positive recitation of a method, the device taught by Well717, in view of Schlumberger458 and Well703, is inherently 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 Well717, in view of Schlumberger458 and Well703, as a whole, effectively providing a method of use through enabling the use of an automated hydraulic fracturing system.

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Claim 12 lacks an inventive step under PCT Article 33(3) as being obvious over Well717 in view of Schlumberger458 in view of US 2017/0226842 A1 to Schlumberger Technology Corporation (hereinafter 'Schlumberger842')

Regarding Claim 12, Well717, in view of Schlumberger458, teaches the method of claim 11, but does not specifically teach the method further comprising:

generating an alert or notification indicative of the potential failure condition and the source.

Further, Schlumberger842 teaches a hydraulic fracturing system (See figs. 1 and 2; para [0028], [0029]) comprising a source system (200 - "additive system", fig. 2; para [0030]) instrumented with a source sensor (204 - "sensor", fig. 2; para [0030]) configured to generate alerts based on measurements indicating a condition of the source system (para [0075], [0090], [0094]). Accordingly, it would have been obvious to one of ordinary skill in the art to incorporate the alert sending function taught in the sensors of Schlumberger842 into the sensors taught by Well717 in order to allow operators to quickly identify problem areas and fix said problems to maximize efficiency of the wellsite.

While Well717, in view of Schlumberger458 and Schlumberger842, does not explicitly disclose the positive recitation of a method, the device taught by Well717, in view of Schlumberger458 and Schlumberger842, is inherently 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 Well717, in view of Schlumberger458 and Schlumberger842, as a whole, effectively providing a method of use through enabling the use of an automated hydraulic fracturing system.

Claim 13 lacks an inventive step under PCT Article 33(3) as being obvious over Well717 in view of Well703 in view of Schlumberger842

Regarding Claim 13, Well717 teaches the method of claim 7, but does not specifically teach the method further comprising:

logging operation data including a number of strokes and pumping hours performed by a pump of the plurality of pumps; and determining a maintenance schedule based at least in part on the operation data.

Further, Well703 teaches a hydraulic fracturing system (See fig. 1; para [0014]) comprising a plurality of pumps (10 - "plurality of pumps", fig. 1) comprising a plurality of sensors (para [0023]) associated with a controller (para [0063] - "pump control station") wherein the sensor logs operational data including the number of strokes performed by a pump (para [0051]). Accordingly, it would have been obvious to one of ordinary skill in the art to use the sensor for logging operational strokes as taught by Well703 on the system taught by Well717 in order to allow an operator to quickly determine which pumps might most quickly need to be shut down for maintenance.

Any combination of the above references fails to teach wherein the method comprises determining a maintenance schedule based at least in part on the operation data.

However, Schlumberger842 teaches a hydraulic fracturing system (See figs. 1 and 2; para [0028], [0029]) comprising a predictive maintenance tool (565 - "predictive maintenance tool", fig. 5; para [0119]) that determines a maintenance schedule based on logged parameters exceeding thresholds or live parameters exceeding thresholds. Accordingly, it would have been obvious to one of ordinary skill in the art to use the predictive maintenance tool taught by Schlumberger842 on the pumps taught by Well717 in order to allow an operator to perform maintenance on a pump before it fails and hurts the efficiency of the wellsite.

While Well717, in view of Well703 and Schlumberger842, does not explicitly disclose the positive recitation of a method, the device taught by Well717, in view of Well703 and Schlumberger842, is inherently 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 Well717, in view of Well703 and Schlumberger842, as a whole, effectively providing a method of use through enabling the use of an automated hydraulic fracturing system.

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

SEARCH HISTORY

Application Number	PCT/US 18/57539
Search Conducted By	MFG
Search Approved By	SCL

CPC/IPC Classifications Searched	IPC(8): E21B 44/00, E21B 43/26, E21B 43/267 (2018.01) CPC: E21B 44/00, E21B 43/26, E21B 43/267
Date Conducted	12 December 2018 (12.12.2018)

Documentation Searched	IPC(8): E21B 44/00, E21B 43/26, E21B 43/267 (2018.01) CPC: (keyword limited; see below)
Search Terms Used	Smart fracturing system and method multiple pumps controller and sensors flow US Well Services LLC threshold hydraulic logging pump strokes maintenance schedule
Date Conducted	12 December 2018 (12.12.2018)

Electronic Database Searched	PatBase
Files Searched	Full-text: AU BE BR CA CH CN DE DK EP ES FI FR GB IN JP KR SE TH TW US WO Bibliographic: (European) AT BA BE BG CH CS CY CZ DD DK EE ES FI GE GR HR HU IE IS IT LT LU LV MC MD MT NL NO PL PT RO RS SE SI SK SM TR UA YU (Asia) EA GC HK ID IL IN KZ MN MY PH RU SG SU TH TJ TW UZ VN (North America) CA CR CU DO GT HN MX NI PA SV TT (South America) AR BR CL CO EC PE UY (Australasia) AU NZ (Africa) AP DZ EG KE MA MW OA ZA ZM ZW
Date Conducted	12 December 2018 (12.12.2018)
Search Logic:	

#	Search query	Results
1	IC=(E21B44/00) OR CPC=(E21B44/00)	6397
2	1 AND FT=(pump* NEAR automat*)	134
3	2 AND FT=(sensor*)	97
4	3 AND FT=((process* OR control*) NEAR pump*)	77
5	4 AND FT=(hydraul* NEAR fractur*)	7
6	5 AND FT=(pump* NEAR flow sens*)	0
7	4 AND FT=(pump* NEAR flow sens*)	2
8	5 AND FT=(flow sens*)	1
9	4 AND FT=(alert* OR troubleshoot* OR failure condition*)	19
10	4 AND FT=((mainten* OR repair*) NEAR pump*)	9
11	IC=(E21B43/26 OR E21B43/267) OR CPC=(E21B43/26 OR E21B43/267)	11494
12	11 AND FT=(pump* NEAR (autom* OR sens*))	348
13	12 AND FT=(mainten* NEAR schedule*)	3
14	pn=(us2017037717 OR us2016032703 OR wo16160458)	2
15	CTB 14 OR CTF 14	214
16	15 AND FT=(pump* NEAR automat*)	16

Electronic Database Searched	Google
Files Searched	Patents
Date Conducted	12 December 2018 (12.12.2018)
Search Logic: Smart fracturing system and method - About 45,800 results Smart fracturing system and method multiple pumps- About 20,300 results automated fracturing system with controller and sensors - About 108,000 results automated fracturing system with flow sensors - About 106,000 results "US Well Services LLC" - About 667 results "US Well Services LLC" hydraulic fracturing automated - About 390 results controller "hydraulic fracturing" threshold - About 5,100 results controller "hydraulic fracturing" alert system - About 3,060 results controller "hydraulic fracturing" logging pump strokes - About 529 results controller "hydraulic fracturing" "maintenance schedule" - About 23 results	

Electronic Database Searched	Google
Files Searched	Web
Date Conducted	12 December 2018 (12.12.2018)
Search Logic:	
Smart fracturing system and method - About 10,200,000 results Smart fracturing system and method multiple pumps- About 4,050,000 results automated fracturing system with controller and sensors - About 9,950,000 results automated fracturing system with flow sensors - About 12,600,000 results "US Well Services LLC" - About 11,400 results "US Well Services LLC" hydraulic fracturing automated - About 1,120 results controller "hydraulic fracturing" threshold - About 232,000 results controller "hydraulic fracturing" alert system - About 352,000 results controller "hydraulic fracturing" logging pump strokes - About 83,700 results controller "hydraulic fracturing" "maintenance schedule" - About 282,000 results	

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)

15 FEB 2019

Applicant's or agent's file reference

047158.500036

FOR FURTHER ACTION See paragraphs 1 and 4 below

International application No.

PCT/US2018/063977

International filing date
(day/month/year)

05 December 2018

Applicant **U.S. WELL SERVICES, INC.**

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

Filing of amendments and statement under Article 19:

The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

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

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

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

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

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

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

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

4. Reminders

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

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

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

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

Name and mailing address of the ISA/US
Mail Stop PCT, Attn: ISA/US
Commissioner for Patents
P.O. Box 1450, Alexandria, VA 22313-1450
Facsimile No. 571-273-8300

Authorized officer

Blaine R. Copenheaver

Telephone No. PCT Helpdesk: 571-272-4300
PCT Q&A: 571-272-7774

Form PCT/ISA/220 (July 2017)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 047158.500036	FOR FURTHER ACTION		<i>see Form PCT/ISA/220</i> as well as, where applicable, item 5 below.
International application No. PCT/US2018/063977	International filing date (<i>day/month/year</i>) 05 December 2018	(Earliest) Priority Date (<i>day/month/year</i>) 05 December 2017	
Applicant U.S. WELL SERVICES, INC.			

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

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

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

1. Basis of the report

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

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

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

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

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

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

4. With regard to the title,

- ☒ the text is approved as submitted by the applicant.
☐ the text has been established by this Authority to read as follows:

5. With regard to the abstract,

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

6. With regard to the drawings,

- a. the figure of the drawings to be published with the abstract is Figure No. 1
☐ as suggested by the applicant.
☒ as selected by this Authority, because the applicant failed to suggest a figure.
☐ as selected by this Authority, because this figure better characterizes the invention.
- b. ☐ none of the figures is to be published with the abstract.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2018/063877

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - E21B 43/12; E21B 43/26; B60P 3/00; B62D 63/06; E21B 33/068; F04B 15/00 (2019.01)

CPC - E21B 43/12; E21B 43/26; B60P 3/00; B62D 63/06; F04B 47/02; F04B 49/06 (2019.01)

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)

See Search History document

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

USPC - 166/66.4; 166/177.5; 166/250.1; 166/271; 166/308.1; 417/410.1 (keyword delimited)

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

See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2016/0177675 A1 (EVOLUTION WELL SERVICES, LLC) 23 June 2016 (23.06.2016) entire document	1-20
A	US 2007/0277982 A1 (SHAMPINE et al) 06 December 2007 (06.12.2007) entire document	1-20
A	US 2016/0258267 A1 (STEWART & STEVENSON, LLC) 08 September 2016 (08.09.2016) entire document	1-20
A	US 2014/0138079 A1 (US WELL SERVICES LLC) 22 May 2014 (22.05.2014) entire document	1-20

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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

"&" document member of the same patent family

Date of the actual completion of the international search

24 January 2019

Date of mailing of the international search report

15 FEB 2019

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents
P.O. Box 1450, Alexandria, VA 22313-1450

Facsimile No. 571-273-8300

Authorized officer

Blaine R. Copenheaver

PCT Helpdesk: 571-272-4300
PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (January 2015)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

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

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

Date of mailing
(day/month/year)

15 FEB 2019

Applicant's or agent's file reference
047158.500036

FOR FURTHER ACTION

See paragraph 2 below

International application No.

PCT/US2018/063977

International filing date (day/month/year)

05 December 2018

Priority date (day/month/year)

05 December 2017

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

IPC(8) - E21B 43/12; E21B 43/26; B60P 3/00; B62D 63/06; E21B 33/068; F04B 15/00 (2019.01)

CPC - E21B 43/12; E21B 43/26; B60P 3/00; B62D 63/06; F04B 47/02; F04B 49/06 (2019.01)

Applicant **U.S. WELL SERVICES, INC.**

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 43bis.1(s)(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 66.1bis(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
Mail Stop PCT, Attn: ISA/US
Commissioner for Patents
P.O. Box 1450, Alexandria, VA 22313-1450
Facsimile No. 571-273-8300

Date of completion of this opinion

24 January 2019

Authorized officer

Blaine R. Copenheaver

PCT Helpdesk: 571-272-4300
PCT OSP: 571-272-7774

Form PCT/ISA/237 (cover sheet) (January 2015)

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US2018/063977

Box No. I Basis of this opinion

1. With regard to the language, this opinion has been established on the basis of:
 - ☒ the international application in the language in which it was filed.
 - ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).
2. ☐ This opinion has been established taking into account the rectification of an obvious mistake authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a)).
3. ☐ With regard to any nucleotide and/or amino acid sequence disclosed in the international application, this opinion has been established on the basis of a sequence listing:
 - a. ☐ forming part of the international application as filed:
 - ☐ in the form of an Annex C/ST.25 text file.
 - ☐ on paper or in the form of an image file.
 - b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.
 - c. ☐ furnished subsequent to the international filing date for the purposes of international search only:
 - ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).
 - ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).
4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
5. Additional comments:

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/US2018/063977

Box No. V	Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement			
1. Statement				
Novelty (N)	Claims	None		YES
	Claims	1-20		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:				
<p>Claims 1-20 lack novelty under PCT Article 33(2) as being anticipated by Evolution Well Services, Lic.</p> <p>Regarding Claim 1, Evolution Well Services, Lic discloses a hydraulic fracturing system for fracturing a subterranean formation (a system for pumping and pressurizing fracturing fluid, Para. [0008]), comprising: an electric pump, arranged on a first support structure (fracturing pump transport 108 (first support structure) includes a dual shaft electric motor that drives two different pumps, Para. [0046] & Fig. 2), the electric pump coupled to a well associated with the subterranean formation and powered by at least one electric motor (a plurality of fracturing pump transports 108 that deliver fracturing fluid through wellhead 101 to subsurface geological formations, Para. [0043] & Fig. 2), and 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 mobile fracturing system 103 may be moved onto the well site 100 to perform fracturing operations that force relatively high pressure fracturing fluid through wellhead 101 into subsurface geological formations to create fissures and cracks within the rock, Para. [0041] & Fig. 1); and support equipment, arranged on a second support structure, electrically coupled to the electric pump (auxiliary power transport 106 integral with drive power transports 104 (second support structure) may comprise a transformer and a control system to control, monitor, and provide power to the electrically connected fracturing equipment, Para. [0044] & Fig. 2), wherein the support equipment includes at least a transformer for distributing power to the electric pump (auxiliary power transport 106 integral with drive power transports 104 may comprise a transformer and a control system to control, monitor, and provide power to the electrically connected fracturing equipment, Para. [0044] & Fig. 2, and, drive power transports 104 may be configured to monitor and control one or more electrical motors located on the fracturing pump transports 108 via a plurality of connections, such as electrical connections (e.g., copper wires), fiber optics, wireless, and/or combinations thereof, Para. [0045] & Fig. 2), the power being received from at least one generator at a voltage higher than an operating voltage of the electric pump (mobile fracturing system comprises an auxiliary gas turbine generator transport 206, Para. [0050] & Fig. 2, and, auxiliary power transport 106 may receive the 13.8 KV electrical connection and step down the voltage to 4.6 KV, which is provided to other fracturing equipment, such as the fracturing pump transport 108, Para. [0044] & Fig. 2).</p> <p>Regarding Claim 2, Evolution Well Services, Lic discloses the system of claim 1, wherein the second support structure is separated from and distinct from the first support structure (auxiliary power transport 106 integral with drive power transports 104 (second support structure) separate from fracturing pump transport 108 (first support structure), Fig. 2).</p> <p>Regarding Claim 3, Evolution Well Services, Lic discloses the system of claim 1, wherein the first support structure and the second support structure are at least one of a trailer, a skid, a pad, a truck bed, or a combination thereof (the term "transport" refers to any transportation assembly, including, but not limited to, a trailer, truck, skid, and/or barge used to transport relatively heavy structures, such as fracturing equipment, Para. [0032]).</p> <p>Regarding Claim 4, Evolution Well Services, Lic discloses the system of claim 1, further comprising: a variable frequency drive connected to the at least one electric motor to control the speed of the at least one electric motor (one or more electrical motors located on the fracturing pump transports 108, one or more variable frequency drives (VFDs) used to monitor and control the prime movers on the fracturing pump transports 108, Para. [0045] & Fig. 2).</p> <p>Regarding Claim 5, Evolution Well Services, Lic discloses the system of 4, wherein the variable frequency drive is mounted on the second support structure (each of the drive power transports 104 comprise one or more variable frequency drives (VFDs) integral with auxiliary power transport 106(second support structure), Para. [0045] & Fig. 2).</p> <p>Regarding Claim 6, Evolution Well Services, Lic discloses the system of claim 1, wherein the first support structure includes a plurality of electric pumps (fracturing pump transport 108 may receive the electric power received from the drive power transport 104 to power a prime mover, the prime mover converts electric power to mechanical power for driving one or more pumps, Para. [0046] & Fig. 2), the plurality of electric pumps having a combined horsepower of between 5,000 and 6,000 horsepower (a fracturing pump transport that comprises a dual shaft electric motor configured to drive at least two pumps, each of the pumps may be configured to operate within a desired mechanical power range, such as about 1,500 HP to about 5,000 HP, to discharge fracturing fluid at relatively high pressures, Para. [0039]).</p> <p>Regarding Claim 7, Evolution Well Services, Lic discloses the system of claim 1, further comprising: a switch gear (switch gear transport 112, Fig. 2) positioned separate from the second support structure and between the at least one generator and the transformer (switch gear transport 112 located between auxiliary gas turbine generator transport 206 and auxiliary power transport 106 integral with drive power transports 104 (second support structure), Fig. 2).</p>				

Form PCT/ISA/237 (Box No. V) (January 2015)

Supplemental Box

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

Continuation of:

Regarding Claim 8, Evolution Well Services, Llc discloses a hydraulic fracturing system for fracturing a subterranean formation (a system for pumping and pressurizing fracturing fluid, Para. [0008]), comprising: a first support structure, forming a pumping trailer (fracturing pump transport 108 (first support structure) includes a dual shaft electric motor that drives two different pumps, Para. [0046] & Fig. 2), comprising: an electric pump fluidly connected to a well associated with the subterranean formation and 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 (fracturing pump transport 108 (first support structure) includes a dual shaft electric motor that drives two different pumps, Para. [0046] & Fig. 2, and, a mobile fracturing system 103 may be moved onto the well site 100 to perform fracturing operations that force relatively high pressure fracturing fluid through wellhead 101 into subsurface geological formations to create fissures and cracks within the rock, Para. [0041] & Fig. 1); at least one electric motor providing operational energy to the electric pump (a dual shaft electric motor that drives two different pumps, Para. [0046] & Fig. 2); and a first support component, the first support component regulating operation of the electric pump (drive power transports 104 (first support) may be configured to monitor and control one or more electrical motors located on the fracturing pump transports 108 via a plurality of connections, such as electrical connections (e.g., copper wires), fiber optics, wireless, and/or combinations thereof, Para. [0045] & Fig. 2); and a second support structure, forming a support trailer (auxiliary power transport 106 (second support), Para. [0044] & Fig. 2, and, the term "transport" refers to any transportation assembly, including, but not limited to, a trailer, truck, skid, and/or barge used to transport relatively heavy structures, such as fracturing equipment, Para. [0032]), comprising: a second support component, the second support component regulating electric power transmission to the electric pump (auxiliary power transport 106 may comprise a transformer and a control system to control, monitor, and provide power to the electrically connected fracturing equipment, Para. [0044] & Fig. 2).

Regarding Claim 9, Evolution Well Services, Llc discloses the system of claim 8, wherein the second support component comprises at least one of a transformer, a variable frequency drive, or a motor control center (auxiliary power transport 106 may comprise a transformer and a control system to control, monitor, and provide power to the electrically connected fracturing equipment, Para. [0044] & Fig. 2).

Regarding Claim 10, Evolution Well Services, Llc discloses the system of claim 8, wherein the first support structure and the second support structure are separate components arranged remote from and not in contact with one another (drive power transports 104 (first support) and auxiliary power transport 106 (second support) located separate from one another, Fig. 2).

Regarding Claim 11, Evolution Well Services, Llc discloses the system of claim 8, wherein the first support structure and the second support structure are at least one of a trailer, a skid, a pad, a truck bed, or a combination thereof (drive power transports 104 (first support) and auxiliary power transport 106 (second support), Fig. 2, and, the term "transport" refers to any transportation assembly, including, but not limited to, a trailer, truck, skid, and/or barge used to transport relatively heavy structures, such as fracturing equipment, Para. [0032]).

Regarding Claim 12, Evolution Well Services, Llc discloses the system of claim 8, wherein the second support component is a transformer for distributing power to the electric pump (auxiliary power transport 106 may comprise a transformer and a control system to control, monitor, and provide power to the electrically connected fracturing equipment, Para. [0044] & Fig. 2), the power being received from at least one generator at a voltage higher than an operating voltage of the electric pump (mobile fracturing system comprises an auxiliary gas turbine generator transport 206, Para. [0050] & Fig. 2, and, auxiliary power transport 106 may receive the 13.8 KV electrical connection and step down the voltage to 4.8 KV, which is provided to other fracturing equipment, such as the fracturing pump transport 108, Para. [0044] & Fig. 2).

Regarding Claim 13, Evolution Well Services, Llc discloses the system of claim 8, wherein the first support structure includes a plurality of electric pumps (fracturing pump transport 108 (first support structure) includes a dual shaft electric motor that drives two different pumps, Para. [0046] & Fig. 2), the plurality of electric pumps having a combined horsepower of between 5,000 and 6,000 horsepower (a fracturing pump transport that comprises a dual shaft electric motor configured to drive at least two pumps, each of the pumps may be configured to operate within a desired mechanical power range, such as about 1,500 HP to about 5,000 HP, to discharge fracturing fluid at relatively high pressures, Para. [0039]).

Regarding Claim 14, Evolution Well Services, Llc discloses the system of claim 8, wherein the electric pump has a horsepower rating of between approximately 1,750 and approximately 3,000 (each of the pumps may be configured to operate within a desired mechanical power range, such as about 1,500 HP to about 5,000 HP, Para. [0039]).

Regarding Claim 15, Evolution Well Services, Llc discloses the system of claim 8, further comprising a plurality of pumping trailers and a plurality of support trailers arranged at well site (plural fracturing pump transports 108, drive power transports 104 (first support) and auxiliary power transports 106 (second support), Fig. 2, and, the term "transport" refers to any transportation assembly, including, but not limited to, a trailer, truck, skid, and/or barge used to transport relatively heavy structures, such as fracturing equipment, Para. [0032]), wherein a combined horsepower of the respective electric pumps of the plurality of pumping trailers is approximately 30,000 (fracturing pump transport 108 includes prime mover may be a dual shaft electric motor that drives two different pumps, Para. [0046] & Fig. 2, and, each dual shaft electric motor may be an electric motor configured to operate within a desired mechanical power range, such as about 1,500 horsepower (HP) to about 10,000 HP, Para. [0039] & Fig. 2).

Regarding Claim 16, Evolution Well Services, Llc discloses the system of claim 8, wherein the first support component comprises at least one of a transformer, a variable frequency drive, or a motor control center (drive power transports 104 (first support) may be configured to monitor and control one or more electrical motors (motor control center) located on the fracturing pump transports 108 via a plurality of connections, such as electrical connections (e.g., copper wires), fiber optics, wireless, and/or combinations thereof, Para. [0045] & Fig. 2).

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US2016/063977

Supplemental Box

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

Continuation of:

Regarding Claim 17, Evolution Well Services, Llc discloses a hydraulic fracturing system for fracturing a subterranean formation (a system for pumping and pressurizing fracturing fluid, Para. [0008]), comprising: at least one generator (turbine generator transport 206, Para. [0050] & Fig. 2); at least one switch gear receiving electrical power from the generator (switch gear transport 112 may receive the electricity generated from the mobile source of electric power via one or more electrical connections, Para. [0043] & Fig. 1 and 2); an electric pump, arranged on a first support structure (fracturing pump transport 106 (first support structure) includes a dual shaft electric motor that drives two different pumps, Para. [0046] & Fig. 2), the electric pump coupled to a well associated with the subterranean formation and powered by at least one electric motor arranged on the first support structure (fracturing pump transport 106 (first support structure) associated with wellhead 101 includes a dual shaft electric motor that drives two different pumps, Para. [0046] & Fig. 2), the electric 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 (fracturing pump transport 106 (first support structure) associated with wellhead 101 includes a dual shaft electric motor that drives two different pumps, Para. [0046] & Fig. 2, and, mobile fracturing system 103 may be moved onto the well site 100 to perform fracturing operations that force relatively high pressure fracturing fluid through wellhead 101 into subsurface geological formations to create fissures and cracks within the rock, Para. [0041] & Fig. 1 and 2); and a transformer, arranged on a second support structure (auxiliary power transport 106 (second support structure) may comprise a transformer and a control system to control, monitor, and provide power to the electrically connected fracturing equipment, Para. [0044] & Fig. 2), positioned between the switch gear and at least one electric motor (auxiliary power transport 106 (second support structure) positioned between switch gear transport 112 and fracturing pump transport 106 including a dual shaft electric motor that drives two different pumps, Para. [0046] & Fig. 2), the transformer reducing a voltage output from the at least one switch gear (auxiliary power transport 106 (second support structure) may comprise a transformer and a control system to control, monitor, and provide power to the electrically connected fracturing equipment, auxiliary power transport 106 may receive the 13.8 KV electrical connection and step down the voltage to 4.8 KV, which is provided to other fracturing equipment, such as the fracturing pump transport 106, Para. [0044] & Fig. 2).

Regarding Claim 18, Evolution Well Services, Llc discloses the system of claim 17, wherein the first support structure and the second support structure are separate components arranged remote from and not in contact with one another (drive power transports 104 (first support) and auxiliary power transport 106 (second support) located separate from one another, Fig. 2).

Regarding Claim 19, see claim 3.

Regarding Claim 20, see claim 6.

Claims 1-20 meet the criteria set out in PCT Article 33(4), and thus have industrial applicability because the subject matter claimed can be made or used in industry.

Search History:

Limited Classification Search

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

CPC Class/Subclass(es): E21B 43/12; E21B 43/26; B60P 3/00; B62D 63/06; F04B 47/02; F04B 49/06 (2019.01)

IPC (8) Class/Subclass(es): E21B 43/12; E21B 43/26; B60P 3/00; B62D 63/06; E21B 33/068; F04B 15/00; F04B 17/03; F04B 47/02; F04B 49/06; F04D 13/06 (2019.01)

U.S. Class/Subclass(es): 166/66.4; 166/177.5; 166/250.1; 166/271; 166/308.1; 417/410.1

See Global Search Results.

Global Patent Literature Text Search

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

Minesoft PatBase: <https://www.patbase.com>

#	Search query	Results
1	INV=(OEHRING, JARED)	7
2	PN=(US10020711 BB OR US10036238 BB OR US10107086 BB OR US10119381 BB OR US2017028368 AA OR US9650879 BB OR US9745840 BB OR US9840901 BB OR US9893500 BB OR US9970278 BB OR US9995218 BB OR US9650871 BB)	2
3	INV=(HINDERLITER, BRANDON)	6
4	INV=(ROBINSON, LON)	11
5	PA=(US WELL SERVICES)	8
6	PN=(US20120255734)	1
7	UC=(166/177.5)	304
8	UC=(166/308.1)	1405
9	UC=(166/308.1) and (support structure or trailer or skid or pad or truck bed)	312
10	9 not 7	261
11	UC=(166/308.1) and transformer% and variable frequency drive%	9
12	UC=(166/308.1) and generator and (switch gear or switchgear)	3
13	UC=(166/308.1) and voltage and pump	43
14	13 not (9 or 7)	23
15	UC=(166/66.4)	470

16	UC=(166/66.4) and (fracturing or fracking)	28
17	UC=(166/271)	409
18	UC=(166/271) and pump%	170
19	18 not (13 or 9 or 7)	157
20	UC=(166/250.1)	392
21	UC=(166/250.1) and pump%	234
22	21 not (18 or 13 or 9 or 7)	180
23	UC=(417/410.1)	1545
24	UC=(417/410.1) and (fracturing or fracking)	4
25	IC=(E21B43/26)	9399
26	IC=(E21B43/26) and (support structure or trailer or skid or pad or truck bed) and electr* and pump%	548
27	26 not (21 or 18 or 13 or 9 or 7)	397
28	IC=(E21B43/26) and (support structure or trailer or skid or pad or truck bed) and transformer% and variable frequency drive%	19
29	IC=(E21B43/26) and (support structure or trailer or skid or pad or truck bed) and generator and (switch gear or switchgear)	10
30	IC=(E21B43/26) and electr* and pump% and motor and high pressure	309
31	30 not (26 or 21 or 18 or 13 or 9 or 7)	113
32	IC=(E21B43/26) and (generator w10 voltage)	47
33	32 not (30 or 26 or 21 or 18 or 13 or 9 or 7)	26
34	IC=(E21B43/12)	9614
35	IC=(E21B43/12) and (fracturing or fracking) and transformer% and variable frequency drive% and pump%	8
36	IC=(E21B43/12) and (fracturing or fracking) and generator and (switch gear or switchgear) and pump%	3
37	IC=(E21B43/12) and (fracturing or fracking) and (support structure or trailer or skid or pad or truck bed) and electr* and pump%	81
38	37 not (32 or 30 or 26 or 21 or 18 or 13 or 9 or 7)	48
39	IC=(E21B33/068)	963
40	IC=(E21B33/068) and (fracturing or fracking)	235
41	40 not (37 or 32 or 30 or 26 or 21 or 18 or 13 or 9 or 7)	192
42	IC=(F04B15/00)	4818
43	IC=(F04B15/00) and (fracturing or fracking)	21
44	IC=(F04B17/03)	7519
45	IC=(F04B17/03) and (fracturing or fracking)	44

46	45 not (43 or 40 or 37 or 32 or 30 or 26 or 21 or 18 or 13 or 9 or 7)	27
47	IC=(F04B47/02)	4535
48	IC=(F04B47/02) and (fracturing or fracking)	32
49	IC=(F04B49/06)	18587
50	IC=(F04B49/06) and (fracturing or fracking)	78
51	50 not (45 or 43 or 40 or 37 or 32 or 30 or 26 or 21 or 18 or 13 or 9 or 7)	53
52	IC=(F04B49/06) and ((support structure or trailer or skid or pad or truck bed) w10 remote)	10
53	IC=(F04D13/06)	17197
54	IC=(F04D13/06) and (fracturing or fracking)	18
55	IC=(B62D63/06)	6299
56	IC=(B62D63/06) and (fracturing or fracking)	13
57	IC=(B60P3/00)	17890
58	IC=(B60P3/00) and (fracturing or fracking)	63
59	58 not (50 or 45 or 43 or 40 or 37 or 32 or 30 or 26 or 21 or 18 or 13 or 9 or 7)	55
60	CPC=(E21B43/26)	4421
61	CPC=(E21B43/26) and (support structure or trailer or skid or pad or truck bed)	799
62	61 not (58 or 50 or 45 or 43 or 40 or 37 or 32 or 30 or 26 or 21 or 18 or 13 or 9 or 7)	272
63	CPC=(E21B43/26) and electr* and pump% and transformer% and variable frequency drive% and generator and (switch gear or switchgear)	8
64	CPC=(E21B43/26) and (generator w10 voltage)	32
65	CPC=(E21B43/26) and transformer% and variable frequency drive% and (remote or wireless)	13
66	CPC=(E21B43/12)	1952
67	CPC=(E21B43/12) and (fracturing or fracking) and (support structure or trailer or skid or pad or truck bed)	38
68	CPC=(F04B49/06)	3514
69	CPC=(F04B49/06) and (fracturing or fracking) and (support structure or trailer or skid or pad or truck bed) and electr* and pump%	13
70	CPC=(F04B49/06) and electr* and pump% and transformer% and variable frequency drive% and generator and (switch gear or switchgear)	2
71	CPC=(F04B47/02)	1601
72	CPC=(F04B47/02) and (fracturing or fracking) and electr* and pump%	41
73	72 not (61 or 58 or 50 or 45 or 43 or 40 or 37 or 32 or 30 or 26 or 21 or 18 or 13 or 9 or 7)	14

74	CPC=(B62D63/06)	807
75	CPC=(B62D63/06) and (fracturing or fracking)	4
76	CPC=(B60P3/00)	2073
77	CPC=(B60P3/00) and (fracturing or fracking)	13
78	RF=(18_63977)	22
79	ctb=78 or ctf=78	1068
80	79 not (78 or 72 or 61 or 58 or 50 or 45 or 43 or 40 or 37 or 32 or 30 or 26 or 21 or 18 or 13 or 9 or 7)	887
81	80 and (fracturing or fracking)	191

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

#	Search query	Results
1	hydraulic fracturing electric pump support equipment (trailer OR skid OR pad OR truck bed)	3783
2	fracturing electric pump motor transformer generator voltage	664
3	fracturing electric pump motor remote trailer power source	436
4	fracturing transformer variable frequency drive trailer	121
5	hydraulic fracking pumps electric motors	1466
6	hydrofracturing modular pumps electric drive	599
7	hydraulic fracturing independent skids	1635

Computer Accessed Text Databases Searched

The Patent Analyst searched the following computer accessed text databases:

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

#	Search query	Results
1	US WELL SERVICES hydraulic fracturing support equipment structure	31900000
2	hydraulic fracturing electric pump support equipment skids	784000

Google Scholar: <https://scholar.google.com/>

#	Search query	Results
1	US WELL SERVICES hydraulic fracturing support equipment structure	32500

YouTube: <https://youtube.com>

#	Search query	Results
1	US WELL SERVICES hydraulic fracturing support equipment structure	N/A

Date search was completed: 24 January 2019

RP/SS

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To: Taylor P. Evans Hogan Lovells US LLP 609 Main Street, Suite 4200 Houston, TX 77002 United States of America

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 047158.500035	Date of mailing <i>(day/month/year)</i> 05 MAR 2019
International application No. PCT/US18/63970	International filing date <i>(day/month/year)</i> 05 December 2018 (05.12.2018)
Applicant U.S. Well Services, Inc.	

1. ☒	<p>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.</p> <p>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):</p> <p>When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.</p> <p>How? Directly to the International Bureau of WIPO preferably through ePCT or on paper to, 34 chemin des Colombettes 1211 Geneva 20, Switzerland, Facsimile No.: +41 22 338 82 70</p> <p>For more detailed instructions, see <i>PCT Applicant's Guide</i>, International Phase, paragraphs 9.004 -- 9.011.</p>
2. ☐	<p>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.</p>
3. ☐	<p>With regard to any protest against payment of (an) additional fee(s) under Rule 40 2, the applicant is notified that:</p> <p>☐ 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.</p> <p>☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.</p>
4. Reminders	<p>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.</p> <p>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 90bis.1 and 90bis.3).</p> <p>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 <i>PCT Applicant's Guide</i>, National Chapters.</p> <p>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 45bis.1). The procedure for requesting supplementary international search is described in the <i>PCT Applicant's Guide</i>, International Phase, paragraphs 8.006-8.032.</p>

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 <div style="text-align: center; margin-top: 10px;">Shane Thomas</div> <div style="text-align: center; margin-top: 10px;"> <small>PCT Helpdesk: 571-272-4300</small> <small>Telephone No. PCT.GSP: 571-272-7774</small> </div>
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Form PCT/ISA/220 (July 2017)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 047158.500035	FOR FURTHER ACTION see Form PCT/ISA/220 as well as, where applicable, item 5 below.	
International application No. PCT/US18/63970	International filing date (day/month/year) 05 December 2018 (05.12.2018)	(Earliest) Priority Date (day/month/year) 05 December 2017 (05.12.2017)
Applicant U.S. Well Services, Inc.		

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

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

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

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

☒ the international application in the language in which it was filed.
☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).
 - b. ☐ This international search report has been established taking into account the rectification of an obvious mistake authorized by or notified to this Authority under Rule 91 (Rule 43.6bis(a)).
 - c. ☐ With regard to any nucleotide and/or amino acid sequence disclosed in the international application, see Box No. I.
2. ☐ Certain claims were found unsearchable (see Box No. II).
3. ☐ Unity of invention is lacking (see Box No. III).
4. With regard to the title,

☒ the text is approved as submitted by the applicant.
☐ the text has been established by this Authority to read as follows:
5. With regard to the abstract,

☒ the text is approved as submitted by the applicant.
☐ the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.
6. With regard to the drawings,
 - a. the figure of the drawings to be published with the abstract is Figure No. 1

☐ as suggested by the applicant.
☒ as selected by this Authority, because the applicant failed to suggest a figure.
☐ as selected by this Authority, because this figure better characterizes the invention.
 - b. ☐ none of the figures is to be published with the abstract.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US16/63970

A. CLASSIFICATION OF SUBJECT MATTER

IPC - E21B 43/20, 43/26, 37/00; F04B 49/20, 15/02, 47/02, 17/03; F16H 39/02 (2019.01)

CPC - E21B 43/20, 43/26, 37/00; F04B 49/20, 15/02, 47/02, 17/03, 53/006, 9/045; F04D 25/028; F16H 39/02

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.
Y	US 2017/0051732 A1 (BAKER HUGHES INCORPORATED) 23 February 2017; Figures 1-5; Paragraphs [0016] and [0021]	1-20
Y	US 4,100,822 A (ROSMAN, A) 18 July 1978; Figures 3-5; Column 4, Lines 57-59	1-20
Y	US 8,851,860 B1 (MAIL, J) 07 October 2014; Figure 1; Column 1, Lines 29-33, 39-48, 53-54, 64-67 and Column 2, Lines 1-3	4-5, 14 and 18
Y	US 2016/0258267 A1 (STEWART & STEVENSON, LLC) 08 September 2016; Figure 6; Paragraph [0062]	8-14 and 19-20
A	US 2016/0341281 A1 (ONESUBSEA IP UK LIMITED) 24 November 2016; Figure 5; entire document	1-20
A	US 2005/0274508 A1 (FOLK, R et al.) 15 December 2005; Figure 1; entire document	1-20
A	US 2007/0131410 A1 (HILL, F et al.) 14 June 2007; Figure 9; entire document	1-20

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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

"&" document member of the same patent family

Date of the actual completion of the international search

26 January 2019 (26.01.2019)

Date of mailing of the international search report

05 MAR 2019

Name and mailing address of the ISA/

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents

P.O. Box 1450, Alexandria, Virginia 22313-1450

Facsimile No. 571-273-8300

Authorized officer

Shane Thomas

PCT Helpdesk: 571-272-4300

PCT O&P: 571-272-7774

Form PCT/ISA/210 (second sheet) (January 2015)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

To: Taylor P. Evans
Hogan Lovells US LLP
609 Main Street, Suite 4200
Houston, TX 77002
United States of America

Date of mailing
(day/month/year)

05 MAR 2019

Applicant's or agent's file reference
047158.500035

FOR FURTHER ACTION

See paragraph 2 below

International application No.

PCT/US18/63970

International filing date (day/month/year)

05 December 2018 (05.12.2018)

Priority date (day/month/year)

05 December 2017 (05.12.2017)

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

IPC - E21B 43/20, 43/26, 37/00; F04B 49/20, 15/02, 47/02, 17/03; F16H 39/02 (2019.01)

CPC -

E21B 43/20, 43/26, 37/00; F04B 49/20, 15/02, 47/02, 17/03, 53/006, 9/045; F04D 25/028; F16H 39/02

Applicant U.S. Well Services, Inc.

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 43bis.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 66.1bis(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
Mail Stop PCT, Attn: ISA/US
Commissioner for Patents
P.O. Box 1450, Alexandria, Virginia 22313-1450
Facsimile No. 571-273-8300

Date of completion of this opinion

26 January 2019 (26.01.2019)

Authorized officer

Shane Thomas

PCT Helpdesk: 571-272-4300
PCT GSP: 571-272-7774

Form PCT/ISA/237 (cover sheet) (January 2015)

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US18/63970

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 43bis.1(a)).
3. ☐ With regard to any nucleotide and/or amino acid sequence disclosed in the international application, this opinion has been established on the basis of a sequence listing:
 - a. ☐ forming part of the international application as filed:
 - ☐ in the form of an Annex C/ST.25 text file.
 - ☐ on paper or in the form of an image file.
 - b. ☐ furnished together with the international application under PCT Rule 13ter.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 13ter.1(a)).
 - ☐ on paper or in the form of an image file (Rule 13ter.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/US16/33970

Box No. V	Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement			
1. Statement				
Novelty (N)	Claims	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:				
<p>Claims 1-3, 6-7 and 10-17 lack an inventive step under PCT Article 33(3) as being obvious over US 2017/0051732 A1 to BAKER HUGHES INCORPORATED, hereinafter "BAKER", in view of US 4,100,822 A (ROSMAN).</p> <p>As per claim 1, Baker discloses a hydraulic fracturing system for fracturing a subterranean formation (pump system 10 for hydraulic fracturing of a borehole in an adjacent earthen formation (subterranean); Figure 1; Paragraph [0016] and [0021]) comprising: a multi-plunger hydraulic fracturing pump fluidly connected to a well associated with the subterranean formation (pump 50 for hydraulic fracturing of a borehole in an adjacent earthen formation (subterranean), which may be a quintuplex pump having five pistons 146 (plungers); Figure 3; Paragraphs [0016] and [0021]), the multi-plunger pump (50) 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 (pump 50 for pumping pressurized fluid into a borehole (wellbore) in an adjacent earthen formation (subterranean) for hydraulic fracturing; Figure 3; Paragraphs [0016] and [0021]); a plurality of motors positioned to power the multi-plunger pump (motors 34, 58 positioned to power the pump 50 (multi-plunger pump); Figure 1); and a planetary gear train having an input pinion gear in rotational contact with the plurality of motors (planetary gear system 170 having an input pinion sun gear 174 in rotational contact with motor 58 through drive shaft 60 and motor 34 through gear train 62 to drive shaft 52; Figures 1 and 4; Paragraph [0024]), wherein a gear ratio of the planetary gear train and a speed at which the plurality of motors operate are selected so as to limit a maximum pump speed associated with the multi-plunger pump (the gear ratio of planetary gear system 170 allows for gear reduction, allowing for the rotational speed of the drive shaft 60 to convert to a slower rotational speed on the drive shaft 52 of the pump 50 (thereby limiting maximum pump speed); Figures 1 and 4; Paragraph [0024]). Baker fails to disclose a plurality of input pinion gears in rotational contact with each of the plurality of motors. Rosman discloses a plurality of motors and a plurality of input pinion gears in rotational contact with each of the plurality of motors (see Figures 3-5 wherein pinions 23 having gear teeth 34 are connected rotationally to hydraulic drive motors 21). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the planetary gearing of Baker by having a motor for each associated planet gear as taught by Rosman for the purpose of having smaller motors wherein there is an advantage that the system is less expensive with respect to initial capitalization and maintenance (Rosman; Column 4, Lines 57-59).</p> <p>As per claim 2, Baker as modified by Rosman discloses the system of claim 1. Baker fails to disclose the system further comprising a plurality of speed reduction gearboxes positioned between the plurality of input pinion gears and the plurality of motors so as to achieve a desired pump rate. Rosman discloses a plurality of speed reduction gearboxes positioned between a plurality of input pinion gears and a plurality of motors (gear boxes 22 are positioned between a plurality of pinions 23 having gear teeth 23 and a plurality of hydraulic drive motors 21; gear boxes are designed to increase torque while reducing speed of the output shaft; Figures 3-5; Column 4, Lines 48-62). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the gearing of Baker by having a motor for each associated planet gear as well as gear boxes as taught by Rosman resulting in a desired pump rate for the purpose of having smaller motors wherein there is an advantage that the system is less expensive with respect to initial capitalization and maintenance (Rosman; Column 4, Lines 57-59) and developing the amount of torque necessary to rotate ring members with high loads (Rosman; Column 4, Lines 60-62).</p> <p>As per claim 3, Baker as modified by Rosman discloses the system of claim 1. Baker fails to disclose wherein a plurality of motors comprises one of a plurality of electric motors or a plurality of hydraulic motors. Rosman discloses wherein a plurality of motors comprises one of a plurality of electric motors or a plurality of hydraulic motors (hydraulic drive motors 21; Figure 4). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the motor of Baker with the plurality of hydraulic motors as taught by Rosman for the purpose of utilizing a motor which can generate high torques without excessive size.</p> <p>As per claim 6, Baker as modified by Rosman discloses the system of claim 1. Baker further discloses wherein the hydraulic pump comprises an odd number of plungers greater than or equal to five plungers (pump 50 for hydraulic fracturing of a borehole in an adjacent earthen formation (subterranean) with five pistons 146 (plungers); Figure 3; Paragraphs [0016] and [0021]).</p> <p>As per claim 7, Baker as modified by Rosman discloses the system of claim 6, wherein a stroke length of each of the plungers associated with the hydraulic pump is selected to inversely relate to a pump speed associated with the hydraulic pump so as to achieve a predetermined flow rate (see Figure 3 wherein the distance the crosshead 148 travels (stroke length) of the piston 146 (plunger) associated with the pump system 10 would be in an inversely related relation to pump speed since the longer the stroke length is, the lower the pump speed required to achieve a given flow rate; Figures 3-5; Paragraphs [0026] and [0019]).</p> <p>***Continued Within the Next Supplemental Box.***</p>				

Form PCT/ISA/237 (Box No. V) (January 2015)

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US18/63970

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 4-10, 14 and 18-20 are objected to under PCT Rule 66.2(a)(v) as lacking clarity under PCT Article 6 because claims 4-10, 14 and 18-20 are indefinite for the following reason: Claims 4-10, 14 and 18-20 refer to "the plurality of hydraulic pumps". There is a lack of antecedent basis for "the plurality of hydraulic pumps". For the purpose of this opinion, as best understood, the claim is interpreted to read "the hydraulic pump".

Claim 11 is objected to under PCT Rule 66.2(a)(v) as lacking clarity under PCT Article 6 because claim 11 is indefinite for the following reason: Claim 11 refers to "the plurality of electric motors" in line 8. There is a lack of antecedent basis for "electric motors". For the purpose of this opinion, as best understood, the claim is interpreted to read "the plurality of motors".

Claim 20 is objected to under PCT Rule 66.2(a)(v) as lacking clarity under PCT Article 6 because claim 20 is indefinite for the following reason: Claim 20 refers to "the plurality of VFDs" in line 3. There is a lack of antecedent basis for "the plurality of VFDs". For the purpose of this opinion, as best understood, the claim is interpreted to read "the VFD".

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US18/63970

Supplemental Box

In case the space in any of the preceding boxes is not sufficient,
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Continued from Box V: Citations and Explanations.

As per claim 15, Baker discloses a method for pumping fluid into a wellbore associated with a subterranean formation (pump system 10 for hydraulic (fluid) fracturing of a borehole in an adjacent earthen formation (subterranean); Figure 1; Paragraph [0016] and [0021]); the method comprising: fluidly connecting a multi-plunger hydraulic fracturing pump to a well associated with the subterranean formation (pump 50 is fluidly connected to a borehole and is used for hydraulic fracturing of a borehole in an adjacent earthen formation (subterranean), which may be a quintuplex pump having five pistons 146 (plungers); Figure 3; Paragraphs [0016] and [0021]) such that the multi-plunger pump pumps fluid into the wellbore at a high pressure so that fluid passes from the wellbore into the subterranean formation and fractures the subterranean formation (pump 50 for pumping pressurized fluid into a borehole (wellbore) in an adjacent earthen formation (subterranean) for hydraulic fracturing; Figure 3; Paragraphs [0016] and [0021]); powering the multi-plunger pump with a plurality of motors (motors 34, 58 positioned to power the pump 50 (multi-plunger pump); Figure 1); and a planetary gear train having an input pinion gear in rotational contact with the plurality of motors (planetary gear system 170 having an input pinion gear 174 in rotational contact with motor 58 through drive shaft 60 and motor 34 through gear train 62 to drive shaft 52; Figure 4; Paragraph [0024]) so as to translate power from the plurality of motors into a desired pump rate of the multi-plunger pump (planetary gear system 170, allows for gear reduction of the power coming from motor 34, allowing for the rotational speed of the drive shaft 60 connected to motor 58, to convert to a slower rotational speed on the drive shaft 52 of the pump 50 (desired pump rate); Figures 1 and 4; Paragraph [0024]). Baker fails to disclose a plurality of input pinion gears in rotational contact with each of the plurality of motors. Rosman discloses a plurality of motors and a plurality of input pinion gears in rotational contact with each of the plurality of motors (see Figures 3-5 wherein pinions 23 having gear teeth 34 are connected rotationally to hydraulic drive motors 21). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the planetary gearing of Baker by having a motor for each associated planet gear as taught by Rosman for the purpose of having smaller motors wherein there is an advantage that the system is less expensive with respect to initial capitalization and maintenance (Rosman; Column 4, Lines 57-59).

As per claim 16, Baker as modified by Rosman discloses the method of claim 15. Baker fails to disclose further comprising: positioning a plurality of speed reduction gearboxes between the plurality of input pinion gears and the plurality of motors so as to achieve the desired pump rate. Rosman discloses positioning a plurality of speed reduction gearboxes between a plurality of input pinion gears and a plurality of motors (gear boxes 22 are positioned between a plurality of pinions 23 having gear teeth 23 and a plurality of hydraulic drive motors 21; gear boxes are designed to increase torque while reducing speed of the output shaft; Figures 3-6; Column 4, Lines 46-62). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the gearing of Baker by having a motor for each associated planet gear as well as gear boxes as taught by Rosman resulting in a desired pump rate for the purpose of having smaller motors wherein there is an advantage that the system is less expensive with respect to initial capitalization and maintenance (Rosman; Column 4, Lines 57-59) and developing the amount of torque necessary to rotate ring members with high loads (Rosman; Column 4, Lines 60-62).

As per claim 17, Baker as modified by Rosman discloses the method of claim 15. Baker fails to disclose wherein a plurality of motors comprises one of a plurality of electric motors or a plurality of hydraulic motors. Rosman discloses wherein a plurality of motors comprises one of a plurality of electric motors or a plurality of hydraulic motors (hydraulic drive motors 21; Figure 4). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the motor of Baker with the plurality of hydraulic motors as taught by Rosman for the purpose of utilizing a motor which can generate high torques without excessive size.

Claims 4-5 and 18 lack an inventive step under PCT Article 33(3) as being obvious over BAKER in view of ROSMAN further in view of US 8,851,860 B1 (MAIL).

As per claim 4, Baker as modified by Rosman discloses the system of claim 1. Baker fails to disclose wherein the maximum pump speed correlates to a critical plunger speed associated with the hydraulic pump. Mail discloses wherein a maximum pump speed correlates to a critical plunger speed associated with a hydraulic pump (mainstream methods of subsurface downhole pumping (hydraulic pump) include mounted reciprocating mechanisms (plunger) in a casing tube; optimal speeds of up and down strokes can be defined as maximum speeds that will not cause overstressing of pump rod (critical plunger speed); therefore maximum pumping speed correlates to an operation at optimal up and down stroke speed (critical plunger speed) associated with the hydraulic pump; Column 1, Lines 29-33, 39-48, 53-54, 64-67 and Column 2, Lines 1-3). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the maximum pump speed of Baker by correlating it to the critical plunger speed as taught by Mail for the purpose of avoiding overstressing of structural parts and premature damage (Baker; Column 1, Lines 64-67 and Column 2, Lines 1-3).

As per claim 5, Baker as modified by Rosman discloses the system of claim 1. Baker fails to disclose wherein the maximum pump speed is 5% or less over a critical plunger speed associated with hydraulic pump. Mail discloses wherein the maximum pump speed is 5% or less over a critical plunger speed associated with hydraulic pump (mainstream methods of subsurface downhole pumping (hydraulic pump) include mounted reciprocating mechanisms (plunger) in a casing tube; optimal speeds of up and down strokes can be defined as maximum speeds that will not cause overstressing of pump rod (critical plunger speed); therefore maximum pumping speed would equate (less than 5%) to an operation at optimal up and down stroke speed (critical plunger speed) associated with the hydraulic pump; Column 1, Lines 29-33, 39-48, 53-54, 63-67 and Column 2, Lines 1-3). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the maximum pump speed of Baker by equating it to the critical plunger speed as taught by Mail for the purpose of avoiding overstressing of structural parts and premature damage (Baker; Column 1, Lines 63-67 and Column 2, Lines 1-3).

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WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US18/63970

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As per claim 18, Baker as modified by Rosman discloses the method of claim 15. Baker fails to disclose wherein the maximum pump speed correlates to a critical plunger speed associated with the hydraulic pump. Mail discloses wherein a maximum pump speed correlates to a critical plunger speed associated with a hydraulic pump (mainstream methods of subsurface downhole pumping (hydraulic pump) include mounted reciprocating mechanisms (plunger) in a casing tube; optimal speeds of up and down strokes can be defined as maximum speeds that will not cause overstressing of pump rod (critical plunger speed); therefore maximum pumping speed correlates to an operation at optimal up and down stroke speed (critical plunger speed) associated with the hydraulic pump; Column 1, Lines 29-33, 39-48, 53-54, 64-67 and Column 2, Lines 1-3). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the maximum pump speed of Baker by correlating it to the critical plunger speed as taught by Mail for the purpose of avoiding overstressing of structural parts and premature damage (Baker; Column 1, Lines 64-67 and Column 2, Lines 1-3).

Claims 8-13 and 19-20 lack an inventive step under PCT Article 33(3) as being obvious over BAKER in view of ROSMAN further in view of US 2016/0258267 A1 to STEWART & STEVENSON, LLC, hereinafter "STEWART".

As per claim 8, Baker as modified by Rosman discloses the system of claim 1. Baker discloses further comprising: a variable frequency drive (VFD) connected to a motor to control the speed of the motor, wherein the VFD is positioned to accelerate or decelerate pump rotational speeds associated with the hydraulic pump (variable frequency drive (VFD) 76 connected to motor 34 to control the speed thereof, wherein the VFD is positioned to adjust operating speeds of pump 50; Figure 2; Paragraph [0019-0020]). Baker fails to disclose a variable frequency drive (VFD) connected to a plurality of motors. Stewart discloses a variable frequency drive (VFD) connected to a plurality of motors (controlling, using one or more variable frequency drives (VFDs), a plurality of electrical motors to drive at least one fluid pump of the at least one hydraulic fracturing pump unit; Claim 31). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the other motor of Baker to be connected to the VFD as taught by Stewart for the purpose of utilizing the benefits of a VFD to the other motors in the system, the benefits including contributing to energy savings, increasing the efficiency and life of the motor, reducing mechanical wear upon the motor and thus the need for repair (Baker; Paragraph [0019]).

As per claim 9, Baker as modified by Rosman and Stewart discloses the system of claim 8. Baker further discloses a variable frequency drive (VFD), wherein the VFD is positioned to accelerate or decelerate pump rotational speeds associated with the hydraulic pump (variable frequency drive (VFD) 76 connected to motor 34 to control the speed thereof, wherein the VFD is positioned to adjust operating speeds of pump 50; Figure 2; Paragraph [0019-0020]). Baker fails to disclose wherein the VFD comprises a plurality of VFDs connected to a plurality of motors, wherein the plurality of VFDs are configured to share a load required to power the hydraulic pump. Stewart discloses wherein the VFD comprises a plurality of VFDs connected to a plurality of motors, wherein the plurality of VFDs are configured to share a load required to power the hydraulic pump (controlling, using one or more (plurality) variable frequency drives (VFDs), a plurality of electrical motors to drive at least one fluid pump of the at least one hydraulic fracturing pump unit (sharing the load); Claim 31). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the other motor of Baker to have a VFD for the purpose utilizing the benefits of a VFD to the other motors in the system, the benefits including contributing to energy savings, increasing the efficiency and life of the motor, reducing mechanical wear upon the motor and thus the need for repair (Baker; Paragraph [0019]).

As per claim 10, Baker as modified by Rosman and Stewart discloses the system of claim 9. Baker fails to disclose wherein a plurality of VFDs are configured to automatically shut off in the event of an overpressure event with respect to the plurality of hydraulic pumps. Stewart discloses wherein a plurality of VFDs are configured to automatically shut off in the event of an overpressure event with respect to a hydraulic pump (a RUN/STOP will control the fracturing pump unit 700 a in which an e-stop will be supplied to stop the entire fracturing pump unit 700 a, shutting down frac VFDs 410 a, 410 b of motors 411 a, 411 b; the RUN/STOP is initiated when frac VFD 410 a detects the discharge pressure exceeds a overpressure setpoint with respect to hydraulic fracturing pump 710 a, it stops the frac motor 411 as it activates a shutdown; Figures 3 and 6; Paragraphs [0054] and [0062]). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the VFD of Baker to automatically shut down during an overpressure event as taught by Stewart for the purpose of avoiding catastrophic failure in the system.

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As per claim 11, Baker discloses a hydraulic fracturing system for fracturing a subterranean formation (pump system 10 for hydraulic fracturing of a borehole in an adjacent earthen formation (subterranean); Figure 1; Paragraph [0016] and [0021]) comprising: a multi-plunger hydraulic fracturing pump fluidly connected to a well associated with the subterranean formation (pump 50 for hydraulic fracturing of a borehole in an adjacent earthen formation (subterranean), which may be a quintuplex pump having five pistons 146 (plungers); Figure 3; Paragraphs [0016] and [0021]); the multi-plunger 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 (pump 50 for pumping pressurized fluid into a borehole (wellbore) in an adjacent earthen formation (subterranean) for hydraulic fracturing; Figure 3; Paragraphs [0016] and [0021]); a plurality of motors positioned to power the multi-plunger pump (motors 34, 58 positioned to power the pump 50 (multi-plunger pump); Figure 1); a variable frequency drive connected to a motor to control the speeds of the motor (variable frequency drive (VFD) 76 connected to motor 34 to control the speed thereof, wherein the VFD is positioned to adjust operating speeds of pump 50; Figure 2; Paragraph [0019-0020]); and a planetary gear train having an input pinion gear in rotational contact with the plurality of motors (planetary gear system 170 having an input pinion sun gear 174 in rotational contact with motor 58 through drive shaft 60 and motor 34 through gear train 62 to drive shaft 52; Figure 4; Paragraph [0024]), wherein a gear ratio of the planetary gear train and a speed at which the plurality of motors operates are selected so as to limit a maximum pump speed associated with the multi-plunger pump (the gear ratio of planetary gear system 170 allows for gear reduction, allowing for the rotational speed of the drive shaft 60 to convert to a slower rotational speed on the drive shaft 52 of the pump 50 (thereby limiting maximum pump speed); Figures 1 and 4; Paragraph [0024]). Baker fails to disclose a plurality of input pinion gears in rotational contact with each of the plurality of motors. Baker also fails to disclose a variable frequency drive (VFD) connected to a plurality of motors. Rosman discloses a plurality of motors and a plurality of input pinion gears in rotational contact with each of the plurality of motors (see Figures 3-5 wherein pinions 23 having gear teeth 34 are connected rotationally to hydraulic drive motors 21). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the planetary gearing of Baker by having a motor for each associated planet gear as taught by Rosman for the purpose of having smaller motors wherein there is an advantage that the system is less expensive with respect to initial capitalization and maintenance (Rosman; Column 4, Lines 57-59). Stewart discloses a variable frequency drive (VFD) connected to a plurality of motors (controlling, using one or more variable frequency drives (VFDs), a plurality of electrical motors to drive at least one fluid pump of the at least one hydraulic fracturing pump unit; Claim 31). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the other motor of Baker to be connected to the VFD as taught by Stewart for the purpose of utilizing the benefits of a VFD to the other motors in the system, the benefits including contributing to energy savings, increasing the efficiency and life of the motor, reducing mechanical wear upon the motor and thus the need for repair (Baker; Paragraph [0019]).

As per claim 12, Baker as modified by Rosman and Stewart discloses the system of claim 11. Baker fails to disclose the system further comprising a plurality of speed reduction gearboxes positioned between the plurality of input pinion gears and the plurality of motors so as to achieve a desired pump rate. Rosman discloses a plurality of speed reduction gearboxes positioned between a plurality of input pinion gears and a plurality of motors (gear boxes 22 are positioned between a plurality of pinions 23 having gear teeth 23 and a plurality of hydraulic drive motors 21; gear boxes are designed to increase torque while reducing speed of the output shaft; Figures 3-5; Column 4, Lines 46-62). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the gearing of Baker by having a motor for each associated planet gear as well as gear boxes as taught by Rosman resulting in a desired pump rate for the purpose of having smaller motors wherein there is an advantage that the system is less expensive with respect to initial capitalization and maintenance (Rosman; Column 4, Lines 57-59) and developing the amount of torque necessary to rotate ring members with high loads (Rosman; Column 4, Lines 60-62).

As per claim 13, Baker as modified by Rosman and Stewart discloses the system of claim 11. Baker fails to disclose wherein a plurality of motors comprises one of a plurality of electric motors or a plurality of hydraulic motors. Rosman discloses wherein a plurality of motors comprises one of a plurality of electric motors or a plurality of hydraulic motors (hydraulic drive motors 21; Figure 4). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the motor of Baker with the plurality of hydraulic motors as taught by Rosman for the purpose of utilizing a motor which can generate high torques without excessive size.

As per claim 19, Baker as modified by Rosman discloses the method of claim 15. Baker discloses further comprising: connecting a variable frequency drive (VFD) to the motor so as to control the speed of the motor, wherein the VFD is positioned to accelerate or decelerate pump rotational speeds associated with each of the hydraulic pump (variable frequency drive (VFD) 76 connected to motor 34 to control the speed thereof, wherein the VFD is positioned to adjust operating speeds of pump 50; Figure 2; Paragraph [0019-0020]). Baker fails to disclose a variable frequency drive (VFD) connected to a plurality of motors. Stewart discloses a variable frequency drive (VFD) connected to a plurality of motors (controlling, using one or more variable frequency drives (VFDs), a plurality of electrical motors to drive at least one fluid pump of the at least one hydraulic fracturing pump unit; Claim 31). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the other motor of Baker to be connected to the VFD as taught by Stewart for the purpose of utilizing the benefits of a VFD to the other motors in the system, the benefits including contributing to energy savings, increasing the efficiency and life of the motor, reducing mechanical wear upon the motor and thus the need for repair (Baker; Paragraph [0019]).

As per claim 20, Baker as modified by Rosman and Stewart discloses the method of claim 19. Baker fails to disclose detecting an overpressure event with respect to the hydraulic pump; and automatically shutting off the VFD. Stewart discloses wherein a VFD is configured to automatically shut off in the event of an overpressure event with respect to a hydraulic pump (when frac VFD 410 detects the discharge pressure exceeds an overpressure setpoint with respect to hydraulic fracturing pump 710 a, it stops the frac motor 411 as it activates a shutdown; Figure 6; Paragraph [0062]). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the VFD of Baker to automatically shut down during an overpressure event as taught by Stewart for the purpose of avoiding catastrophic failure in the system.

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WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US15/63970

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Claim 14 lacks an inventive step under PCT Article 33(3) as being obvious over BAKER in view of ROSMAN further in view of STEWART further in view of MAIL.

As per claim 14, Baker as modified by Rosman and Stewart discloses the system of claim 11. Baker fails to disclose wherein the maximum pump speed correlates to a critical plunger speed associated with each of the plurality of hydraulic pumps. Mail discloses wherein a maximum pump speed correlates to a critical plunger speed associated with a hydraulic pump (mainstream methods of subsurface downhole pumping (hydraulic pump) include mounted reciprocating mechanisms (plunger) in a casing tube; optimal speeds of up and down strokes can be defined as maximum speeds that will not cause overstressing of pump rod (critical plunger speed); therefore maximum pumping speed correlates to an operation at optimal up and down stroke speed (critical plunger speed) associated with the hydraulic pump; Column 1, Lines 29-33, 39-48, 53-54, 64-67 and Column 2, Lines 1-3). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the maximum pump speed of Baker by correlating it to the critical plunger speed as taught by Mail for the purpose of avoiding overstressing of structural parts and premature damage (Baker; Column 1, Lines 64-67 and Column 2, Lines 1-3).

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)

Applicant's or agent's file reference 047158.500037	Date of mailing (day/month/year) 10 APR 2019
International application No. PCT/US2019/016635	International filing date (day/month/year) 05 February 2019
Applicant U.S. WELL SERVICES, INC.	

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

Filing of amendments and statement under Article 19:

The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

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

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

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

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

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

4. Reminders

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

Shortly after the expiration of 18 months from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90bis.1 and 90bis.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 45bis.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 <p style="text-align: center;">Blaine R. Copenheaver</p> PCT Helpdesk: 571-272-4300 Telephone No. PCT OSP: 571-272-7774
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Form PCT/ISA/220 (July 2017)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 047158.500037	FOR FURTHER ACTION	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. PCT/US2019/018635	International filing date (day/month/year) 05 February 2019	(Earliest) Priority Date (day/month/year) 05 February 2018
Applicant U.S. WELL SERVICES, INC.		

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 8 sheets.

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

1. Basis of the report

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

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

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

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

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

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

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

4. With regard to the title,

☒ the text is approved as submitted by the applicant.

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

5. With regard to the abstract,

☒ the text is approved as submitted by the applicant.

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

6. With regard to the drawings,

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

☐ as suggested by the applicant.

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

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

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

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2019/016635

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - H02J 3/14; E21B 43/26; F04D 13/06; H02J 3/12 (2019.01)

CPC - H02J 3/14; E21B 43/26; F04D 13/06; H02J 3/12 (2019.02)

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

USPC - 700/295; 166/305.1; 166/306.1; 700/293 (keyword delimited)

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

See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2016/0105022 A1 (US WELL SERVICES LLC) 14 April 2016 (14.04.2016) entire document	1-4, 15, 19, 20
Y		5, 7-12, 14, 16, 18
Y	US 2010/0019574 A1 (BALDASSARRE et al) 28 January 2010 (28.01.2010) entire document	5
Y	CA 2 964 593 A1 (US WELL SERVICES LLC) 15 October 2017 (15.10.2017) entire document	7-12, 14, 16, 18
A	US 2016/0369609 A1 (EVOLUTION WELL SERVICES, LLC) 22 December 2016 (22.12.2016) entire document	1-20

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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

"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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

"Z" document member of the same patent family

Date of the actual completion of the international search

25 March 2019

Date of mailing of the international search report

10 APR 2019

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents

P.O. Box 1450, Alexandria, VA 22313-1450

Facsimile No. 571-273-8300

Authorized officer

Blaine R. Copenheaver

PCT Helpdesk: 571-272-4300

PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (January 2015)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

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

Date of mailing
(day/month/year) **10 APR 2019**

Applicant's or agent's file reference
047158.500037

FOR FURTHER ACTION

See paragraph 2 below

International application No.
PCT/US2019/016635

International filing date (day/month/year)
05 February 2019

Priority date (day/month/year)
05 February 2018

International Patent Classification (IPC) or both national classification and IPC
IPC(8) - H02J 3/14; E21B 43/26; F04D 13/06; H02J 3/12 (2019.01)
CPC - H02J 3/14; E21B 43/26; F04D 13/06; H02J 3/12 (2019.02)

Applicant **U.S. WELL SERVICES, INC.**

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 43bis.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 66.1bis(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
Mail Stop PCT, Attn: ISA/US
Commissioner for Patents
P.O. Box 1450, Alexandria, VA 22313-1450
Facsimile No. 571-273-8300

Date of completion of this opinion
25 March 2019

Authorized officer
Blaine R. Copenheaver
PCT Helpdesk: 571-272-4300
PCT OSP: 571-272-7774

Form PCT/ISA/237 (cover sheet) (January 2015)

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US2019/016635

Box No. 1 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 43bis.1(a)).
3. ☐ With regard to any nucleotide and/or amino acid sequence disclosed in the international application, this opinion has been established on the basis of a sequence listing:
 - a. ☐ forming part of the international application as filed:
☐ in the form of an Annex C/ST.25 text file.
☐ on paper or in the form of an image file.
 - b. ☐ furnished together with the international application under PCT Rule 13ter.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 13ter.1(a)).
☐ on paper or in the form of an image file (Rule 13ter.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/US2019/016635

Box No. V	Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement			
1. Statement				
Novelty (N)	Claims	5-14, 16-18	YES	
	Claims	1-4, 15, 19, 20	NO	
Inventive step (IS)	Claims	6, 13, 17	YES	
	Claims	1-5, 7-12, 14-16, 18-20	NO	
Industrial applicability (IA)	Claims	1-20	YES	
	Claims	None	NO	
2. Citations and explanations:				
<p>Claims 1-4, 15, 19, and 20 lack novelty under PCT Article 33(2) as being anticipated by US Well Services LLC (hereinafter USWell022).</p> <p>Regarding Claim 1, USWell022 discloses a system for completing a well (a hydraulic fracturing operation can be carried out according to the following process... The fracturing fluid can be pumped into the wellbore at a high enough pressure that the fracturing fluid cracks the formation, para 0042), the system comprising: a generator (generators 222A, 222B, para 0045; also see Fig. 5); a plurality of electric load components, each electric load component powered by the generator (at least one first generator in electrical communication with a first switchgear for providing power to primary components of a hydraulic fracturing operation; claim 1; Each group A, B of generators 222A, 222B is connected in turn to separate and distinct groups of transformers 223A, 223B and pumps 210A, 210B [load components], para 0045; also see Fig. 5); and a load shedding control panel that monitors the generator and, if the generator loses functionality, is capable of deactivating one or more of the plurality of electric load components to reduce the electric load (The turbine generators 122 can be connected to the electric motors 114 [of the pumps/loads] via power distribution panels, para 0036; The load shed system of the embodiment of FIG. 5 can monitor when power draw will overload the system (i.e., when demand is higher than supply), and it will send a signal to open a breaker 233A, 233B to cut certain pumps 210A, 210B, thereby reducing power before the entire bank is overloaded para 0047; if one of the turbines loses power, ... [in prior art] the ability to shed load, such as by shutting down power to non-critical parts of the system, is limited. The power draw from all of the units overloads the turbines, para 0006; if the at least one first generator loses the ability to generate electricity, the at least one second generator can continue to generate electricity, para 0007).</p> <p>Regarding Claim 2, USWell022 discloses the system of claim 1, further comprising: a switch gear positioned between the generator and the plurality of electric load components to distribute power between the generator and the plurality of electric load components (The power from the generators 222A of group A goes to switchgear 235A. From switchgear 235A, the power goes to the transformers 223A, and to the auxiliary trailer 225A, which can have a transformer, as well as a VFD and softstarts for the blender and hydration units. Power can then go to one or more of the following: the primary blender 234A, the primary hydration unit 232A, the primary data van 227A, and/or the primary sand equipment 229A. Power from the transformers 223A also goes to pumps 210A, para 0050; also see Fig. 5).</p> <p>Regarding Claim 3, USWell022 discloses the system of claim 1, wherein the generator is a natural gas turbine generator, a natural gas generator, or a diesel generator (the electric generators 22 can be powered by natural gas.. para 0027).</p> <p>Regarding Claim 4, USWell022 discloses the system of claim 1, wherein the electric load components are selected from the group consisting of electric hydraulic fracturing pumps, a blender, sand equipment, a hydration unit, and a data van (Each group A, B of generators 222A, 222B is connected in turn to separate and distinct groups of transformers 223A, 223B and pumps 210A, 210B, as well as separate and distinct auxiliary trailers 225A, 225B, each including its own ancillary equipment, such as, for example, data vans 227A, 227B, sand equipment 229A, 229B, blenders 234A, 234B, and hydration units 232A, 232B, para 0045; also see Fig. 5).</p> <p>Regarding Claim 15, USWell022 discloses a method of completing a well (a hydraulic fracturing operation can be carried out according to the following process... The fracturing fluid can be pumped into the wellbore at a high enough pressure that the fracturing fluid cracks the formation, para 0042), the method comprising the steps of: a) powering a plurality of hydraulic fracturing equipment components with a generator (at least one first generator in electrical communication with a first switchgear for providing power to primary components of a hydraulic fracturing operation; claim 1; Each group A, B of generators 222A, 222B is connected in turn to separate and distinct groups of transformers 223A, 223B and pumps 210A, 210B [load components], para 0045; also see Fig. 5); b) monitoring the generator to determine when the generator loses functionality; c) when the generator loses functionality, selectively deactivating one or more of the plurality of hydraulic fracturing equipment components to decrease the load (The turbine generators 122 can be connected to the electric motors 114 [of the pumps/loads] via power distribution panels, para 0036; The load shed system of the embodiment of FIG. 5 can monitor when power draw will overload the system (i.e., when demand is higher than supply), and it will send a signal to open a breaker 233A, 233B to cut certain pumps 210A, 210B, thereby reducing power before the entire bank is overloaded para 0047; if one of the turbines loses power, ... [in prior art] the ability to shed load, such as by shutting down power to non-critical parts of the system, is limited. The power draw from all of the units overloads the turbines, para 0006; if the at least one first generator loses the ability to generate electricity, the at least one second generator can continue to generate electricity, para 0007).</p> <p>Regarding Claim 19, USWell022 discloses the method of claim 15, further comprising: distributing power between the generator and the plurality of hydraulic fracturing equipment components with a switchgear (at least one first generator in electrical communication with a first switchgear for providing power to primary components of a hydraulic fracturing operation; claim 1; Each group A, B of generators 222A, 222B is connected in turn to separate and distinct groups of transformers 223A, 223B and pumps 210A, 210B [load components], para 0045; also see Fig. 5).</p>				

Form PCT/ISA/237 (Box No. V) (January 2015)

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US2019/016635

Supplemental Box

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

Continuation of:

Regarding Claim 20, USWell022 discloses the method of claim 15, wherein step c) is carried out by a load shedding control panel that monitors the generator to determine when the generator loses functionality (The turbine generators 122 can be connected to the electric motors 114 [of the pumps/loads] via power distribution panels, para 0036; The load shed system of the embodiment of FIG. 5 can monitor when power draw will overload the system (i.e., when demand is higher than supply), and it will send a signal to open a breaker 233A, 233B to cut certain pumps 210A, 210B, thereby reducing power before the entire bank is overloaded para 0047; if the at least one first generator loses the ability to generate electricity, the at least one second generator can continue to generate electricity, para 0007).

Claim 5 lacks an inventive step under PCT Article 33(3) as being obvious over US Well Services LLC (hereinafter USWell022) in view of Baldassarre et al. (hereinafter Baldassarre).

Regarding Claim 5, USWell022 fails to disclose the system of claim 4, wherein the load shedding panel prioritizes the order in which the plurality of electric load components will be deactivated. Baldassarre is in the field of energy management systems (para 0002) and teaches wherein the load shedding panel prioritizes the order in which the plurality of electric load components will be deactivated (loads are shed in the predetermined sequence established by a user and/or as defined by a user in real-time via a user interactive device until the total current is less than the predetermined peak total or until the system has detected a stable current situation, para 0058; the control system can store this information and statistically translate it to determine the priority of each sensed load, and subsequently create a priority list to be implemented by an auxiliary power source in the instance when the utility power source fails, para 0076). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify USWell022 with the teaching of Baldassarre for the purpose of shedding lower priority loads based on predetermined priority or real-time decisions made by the user so as to ensure that the vital loads remain connected and active while the auxiliary or generator power source remains below a threshold value (see Baldassarre, para 0130).

Claims 7-12, 14, 16, and 18 lack an inventive step under PCT Article 33(3) as being obvious over US Well Services LLC (hereinafter USWell022) in view of US Well Services LLC (hereinafter USWell593).

Regarding Claim 7, USWell022 fails to disclose the system of claim 1, wherein the generator is in selective electrical communication with a power grid.

USWell593 is in the field of hydraulic fracturing (para 0002) and teaches wherein the generator is in selective electrical communication with a power grid (FIG. 14 illustrates an example 1400 of a configuration for load sharing with a utility grid, according to an embodiment, para 0085; enable the switchgear units -B+- 1425-b and "C+- 1425-c to load share between the generator sets 1405-a, 1405-b, 1405-c, 1405-d and the utility grid. For example, if the utility grid is transmitting power at 69 kV, the transformer 1445 can step down the 69kV voltage to 13.8 kV for use by the microgrid. In this configuration, power can be either provided to the grid or supplemented from the utility grid during times of peak power demand, para 0086). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify USWell022 with the teaching of USWell593 for the purpose of allowing for power transfer to and from the grid as needed (see USWell593, para 0086).

Regarding Claim 8, USWell022 discloses a system for completing a well (a hydraulic fracturing operation can be carried out according to the following process... The fracturing fluid can be pumped into the wellbore at a high enough pressure that the fracturing fluid cracks the formation, para 0042), the system comprising: a generator (generators 222A, 222B, para 0045; also see Fig. 5); a plurality of hydraulic fracturing equipment components, each of the plurality of hydraulic fracturing equipment components powered by the generator (at least one first generator in electrical communication with a first switchgear for providing power to primary components of a hydraulic fracturing operation; claim 1; Each group A, B of generators 222A, 222B is connected in turn to separate and distinct groups of transformers 223A, 223B and pumps 210A, 210B, as well as separate and distinct auxiliary trailers 225A, 225B, each including its own ancillary equipment, such as, for example, data vans 227A, 227B, sand equipment 229A, 229B, blenders 234A, 234B, and hydration units 232A, 232B [hydraulic fracturing components], para 0045; also see Fig. 5); an electric equipment, the electric equipment powered by the generator; and a load shedding control panel that monitors the generator and, if the generator loses functionality, is capable of deactivating one or more of the plurality of hydraulic fracturing equipment components or the electric equipment to reduce the electric load (The turbine generators 122 can be connected to the electric motors 114 [of the pumps/loads] via power distribution panels, para 0036; The load shed system of the embodiment of FIG. 5 can monitor when power draw will overload the system (i.e., when demand is higher than supply), and it will send a signal to open a breaker 233A, 233B to cut certain pumps 210A, 210B, thereby reducing power before the entire bank is overloaded para 0047; if one of the turbines loses power,... [in prior art] the ability to shed load, such as by shutting down power to non-critical parts of the system, is limited. The power draw from all of the units overloads the turbines, para 0006; if the at least one first generator loses the ability to generate electricity, the at least one second generator can continue to generate electricity, para 0007).

USWell022 does not disclose wherein the electric equipment is an electric drilling rig. USWell593 discloses wherein the electric equipment is an electric drilling rig (The power generation equipment can be used to supply any oilfield equipment including... drilling rigs, para 0044). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify USWell022 with the teaching of USWell593 for the purpose of providing power for oilfield equipment that does not have access to a utility provided power grid or that has a dynamic power load or low power factor (see USWell593, para 008644).

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US2019/016635

Supplemental Box

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

Regarding Claim 9, modified USWell022 discloses the system of claim 8, further comprising: a switch gear positioned between the generator and the plurality of hydraulic fracturing equipment components, and between the generator and the electric equipment, to distribute power between the generator and the plurality of hydraulic fracturing equipment components, and between the generator and the electric equipment (at least one first generator in electrical communication with a first switchgear for providing power to primary components of a hydraulic fracturing operation); claim 1; Each group A, B of generators 222A, 222B is connected in turn to separate and distinct groups of transformers 223A, 223B and pumps 210A, 210B (load components), para 0045; also see Fig. 5). USWell022 does not disclose wherein the electric equipment is an electric drilling rig. USWell593 discloses wherein the electric equipment is an electric drilling rig (The power generation equipment can be used to supply any oilfield equipment including... drilling rigs, para 0044). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify USWell022 with the teaching of USWell593 for the purpose of providing power for oilfield equipment that does not have access to a utility provided power grid or that has a dynamic power load or low power factor (see USWell593, para 008644).

Regarding Claim 10, modified USWell022 discloses the system of claim 8, wherein the generator is a natural gas turbine generator, a natural gas generator, or a diesel generator (the electric generators 22 can be powered by natural gas., para 0027).

Regarding Claim 11, modified USWell022 discloses the system of claim 8, wherein the hydraulic fracturing equipment components are selected from the group consisting of electric hydraulic fracturing pumps, a blender, sand equipment, a hydration unit, and a data van (Each group A, B of generators 222A, 222B is connected in turn to separate and distinct groups of transformers 223A, 223B and pumps 210A, 210B, as well as separate and distinct auxiliary trailers 225A, 225B, each including its own ancillary equipment, such as, for example, data vans 227A, 227B, sand equipment 229A, 229B, blenders 234A, 234B, and hydration units 232A, 232B, para 0045; also see Fig. 5).

Regarding Claim 12, modified USWell022 fails to disclose the system of claim 11, wherein the load shedding panel prioritizes the order in which the plurality of hydraulic fracturing equipment components and the electric drilling rig will be deactivated. USWell593 teaches wherein the load shedding panel prioritizes the order in which the plurality of hydraulic fracturing equipment components and electric equipment will be deactivated (loads are shed in the predetermined sequence established by a user and/or as defined by a user in real-time via a user interactive device until the total current is less than the predetermined peak total or until the system has detected a stable current situation, para 0058; the control system can store this information and statistically translate it to determine the priority of each sensed load, and subsequently create a priority list to be implemented by an auxiliary power source in the instance when the utility power source fails, para 0076). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify USWell022 with the teaching of Baldassarre for the purpose of shedding lower priority loads based on predetermined priority or real-time decisions made by the user so as to ensure that the vital loads remain connected and active while the auxiliary or generator power source remains below a threshold value (see Baldassarre, para 0130).

Regarding Claim 14, modified USWell022 fails to disclose the system of claim 8, wherein the generator is in selective electrical communication with a power grid. USWell593 teaches wherein the generator is in selective electrical communication with a power grid (FIG. 14 illustrates an example 1400 of a configuration for load sharing with a utility grid, according to an embodiment, para 0085; enable the switchgear units -B+ 1425-b and -C+ 1425-c to load share between the generator sets 1405-a, 1405-b, 1405-c, 1405-d and the utility grid. For example, if the utility grid is transmitting power at 69 kV, the transformer 1445 can step down the 69kV voltage to 13.8 kV for use by the microgrid. In this configuration, power can be either provided to the grid or supplemented from the utility grid during times of peak power demand, para 0086). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify USWell022 with the teaching of USWell593 for the purpose of allowing for power transfer to and from the grid as needed (see USWell593, para 0086).

Regarding Claim 16, USWell022 fails to explicitly disclose the method of claim 15, further comprising: powering an electric drilling rig with the generator. USWell593 discloses wherein the electric equipment is an electric drilling rig (The power generation equipment can be used to supply any oilfield equipment including... drilling rigs, para 0044). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify USWell022 with the teaching of USWell593 for the purpose of providing power for oilfield equipment that does not have access to a utility provided power grid or that has a dynamic power load or low power factor (see USWell593, para 008644).

Regarding Claim 18, USWell022 fails to disclose the method of claim 15, further comprising: distributing power from the generator to a power grid. USWell593 teaches distributing power from the generator to a power grid (FIG. 14 illustrates an example 1400 of a configuration for load sharing with a utility grid, according to an embodiment, para 0085; enable the switchgear units -B+ 1425-b and -C+ 1425-c to load share between the generator sets 1405-a, 1405-b, 1405-c, 1405-d and the utility grid. For example, if the utility grid is transmitting power at 69 kV, the transformer 1445 can step down the 69kV voltage to 13.8 kV for use by the microgrid. In this configuration, power can be either provided to the grid or supplemented from the utility grid during times of peak power demand, para 0086). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify USWell022 with the teaching of USWell593 for the purpose of allowing for extra power generated to be fed to the grid (see USWell593, paras 0086 and 0088).

Claims 6, 13, and 17 meet the criteria set out in PCT Article 33(2)-(3), because the prior art does not teach or fairly suggest:

Regarding claim 6, the prior art of record, individually or in combination, does not teach or fairly suggest the system of claim 5, wherein the load shedding panel is programmed to deactivate the blender after other electric load components are deactivated.

Regarding claim 13, the prior art of record, individually or in combination, does not teach or fairly suggest the system of claim 12, wherein the load shedding panel is programmed to deactivate the blender after other hydraulic fracturing equipment components are deactivated.

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US2019/016635

Supplemental Box

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

Continuation of:

Regarding claim 17, the prior art of record, individually or in combination, does not teach or fairly suggest the method of claim 15, wherein the plurality of hydraulic fracturing equipment includes at least one blender, the method further comprising: prioritizing the deactivation of the plurality of hydraulic fracturing equipment components so that the at least one blender is deactivated only after other hydraulic fracturing equipment is deactivated.

Claims 1-20 meet the criteria set out in PCT Article 33(4), and thus have industrial applicability because the subject matter claimed can be made or used in industry.

Search History:

Limited Classification Search

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

CPC Class/Subclass(es): H02J 3/14; E21B 43/26; F04D 13/06; H02J 3/12 (2019.02)

IPC (8) Class/Subclass(es): H02J 3/14; E21B 43/26; F04D 13/06; H02J 3/12 (2019.01)

U.S. Class/Subclass(es): 700/295; 166/305.1; 166/308.1; 700/293

See Global Search Results.

Global Patent Literature Text Search

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

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

#	Search query	Results
1	((BRANDON 2D HINDERLITER)/IN/OIN/INH/INV)	24
2	((JARED 2D OEHRING)/IN/OIN/INH/INV)	34
3	((WELL W SERVICES)/PA/OPA)	214
4	(1 OR 2) AND 3	35
5	1 OR 2 OR 3	214
6	5 AND (LOAD W SHED+)/TX	5
7	5 AND (LOAD W SHED+)/TX AND RIG/TX	2
8	(HYDRAULIC AND FRACTUR+ AND (LOAD W SHED+) AND (DRILLING W RIG))/TX	7
9	5 AND ((LOAD W SHED+) AND (CONTROL W PANEL))/TX	1
10	5 AND (PRIORITIZ+)/TX	0
11	(HYDRAULIC AND FRACTUR+ AND BLENDER AND (LOAD W SHED+))/TX	6
12	(CA2964593)/XPN	1
13	(LOAD W SHED+)/TI/AB	1126
14	(700295)/PCL	1333
15	(700293)/PCL	390
16	(166308100)/PCL	1261
17	(166305100)/PCL	1957
18	14 OR 15 OR 16 OR 17	4711

19	18 AND (HYDRAULIC AND FRACTURING)/TX	1567
20	18 AND (HYDRAULIC AND FRACTURING AND SHED+)/TX	10
21	(E21B-043/26)/CPC	5467
22	(E21B-043/26)/IPC	9814
23	(F04D-013/06)/IPC	12913
24	(F04D-013/06)/CPC	5242
25	(H02J-003/14)/CPC	4245
26	(H02J-003/14)/IPC	5368
27	(H02J-003/12)/IPC	3841
28	(H02J-003/12)/CPC	1026
29	21 OR 22 OR 23 OR 24 OR 25 OR 26 OR 27 OR 28	34106
30	29 AND (LOAD W SHED+)/TX	963
31	29 AND (HYDRAULIC AND FRACTUR+ AND (LOAD W SHED+)/TX	7
32	29 AND (HYDRAULIC AND DRILL+ AND (LOAD W SHED+)/TX	4

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

#	Search query	Results
1	hydraulic fracturing generator control	100+
2	hydraulic fracturing generator control load shedding	100+
3	MICROGRID ELECTRICAL LOAD MANAGEMENT for hydraulic fracturing	100+
4	hydraulic fracturing generator load shedding prioritize	100+
5	drilling generator load shedding prioritize	100+
6	generator load control prioritize	100+
7	generator load control prioritize blender drilling	100+
8	hydraulic fracturing blender turned off last	100+
9	generator powered earth equipment blender turned off last	100+

Computer Accessed Text Databases Searched

The Patent Analyst searched the following computer accessed text databases:

Google Scholar: <https://scholar.google.com/>

#	Search query	Results
1	hydraulic fracturing generator control	100+
2	hydraulic fracturing generator control load shedding	100+

3	MICROGRID ELECTRICAL LOAD MANAGEMENT for hydraulic fracturing	100+
4	drilling generator load shedding prioritize	100+
5	generator load control prioritize	100+
6	generator load control prioritize blender drilling	100+
7	hydraulic fracturing blender turned off last	100+
8	generator powered earth equipment blender turned off last	100+

Date search was completed: 25 March 2019

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Electronic Acknowledgement Receipt

EFS ID:	39743348
Application Number:	16597014
International Application Number:	
Confirmation Number:	4687
Title of Invention:	MODULAR SWITCHGEAR SYSTEM AND POWER DISTRIBUTION FOR ELECTRIC OILFIELD EQUIPMENT
First Named Inventor/Applicant Name:	Jared Oehring
Customer Number:	132858
Filer:	Taylor P. Evans/Stephanie McDonough
Filer Authorized By:	Taylor P. Evans
Attorney Docket Number:	047158.100048
Receipt Date:	17-JUN-2020
Filing Date:	09-OCT-2019
Time Stamp:	11:50:22
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
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