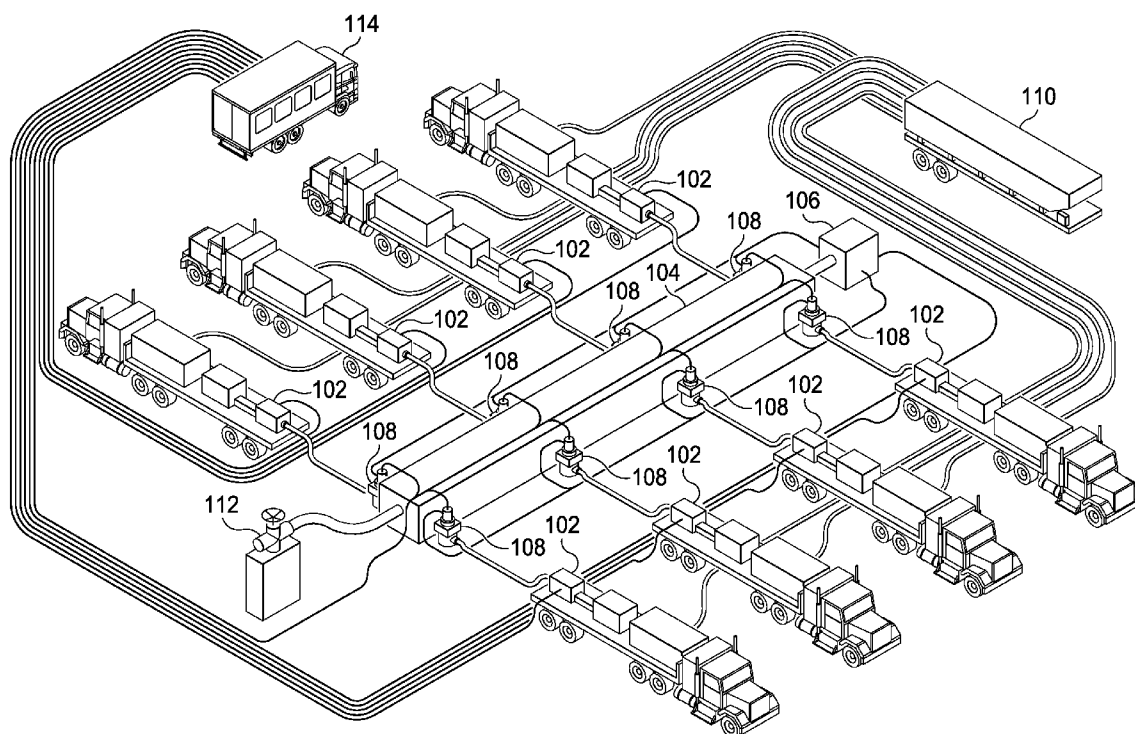




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(19) **United States**(12) **Patent Application Publication**
Randle et al.(10) **Pub. No.: US 2014/0290768 A1**(43) **Pub. Date: Oct. 2, 2014**(54) **FRAC PUMP ISOLATION SAFETY SYSTEM**(71) Applicant: **FTS INTERNATIONAL SERVICES, LLC**, Fort Worth, TX (US)(72) Inventors: **Coy Randle**, Fort Worth, TX (US);
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Don Wade, Fort Worth, TX (US)(21) Appl. No.: **13/851,707**(22) Filed: **Mar. 27, 2013****Publication Classification**(51) **Int. Cl.**
E21B 43/26 (2006.01)(52) **U.S. Cl.**CPC **E21B 43/26** (2013.01)USPC **137/565.16; 137/565.11**(57) **ABSTRACT**

The improved system allows an operator overseeing a well stimulation hydraulic fracturing operation to bring frac pumps online and offline as necessary. A control panel allows the operator to remain at a safe distance from high-pressure equipment, including the frac pumps and respective remotely actuated isolation valves, yet allows monitoring and operation of same. The operating condition of the frac pumps and the isolation valves is monitored by an automated processing device, which prevents operation of same during certain pump and valve conditions. A wireless operator interface is also provided.



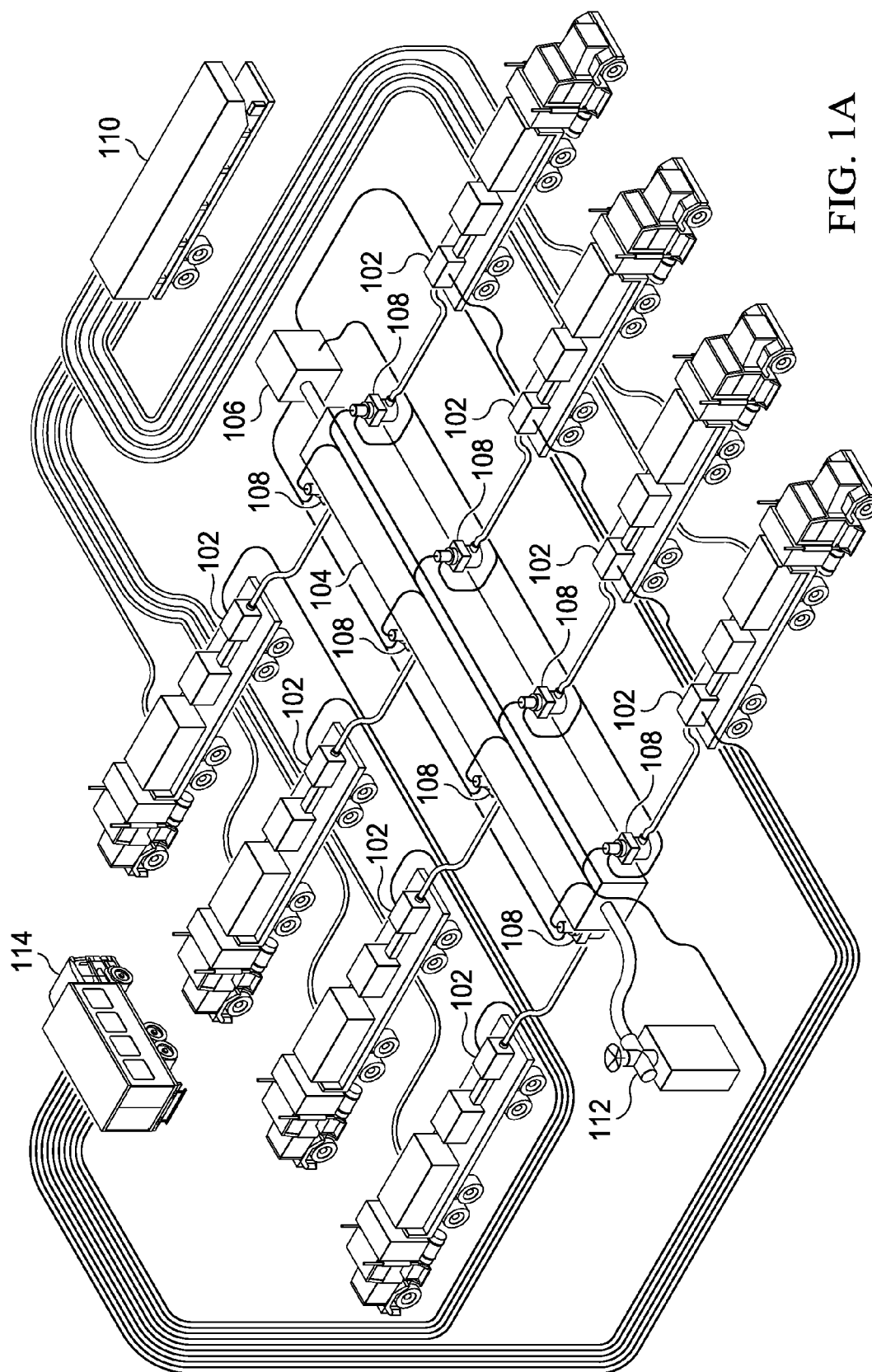
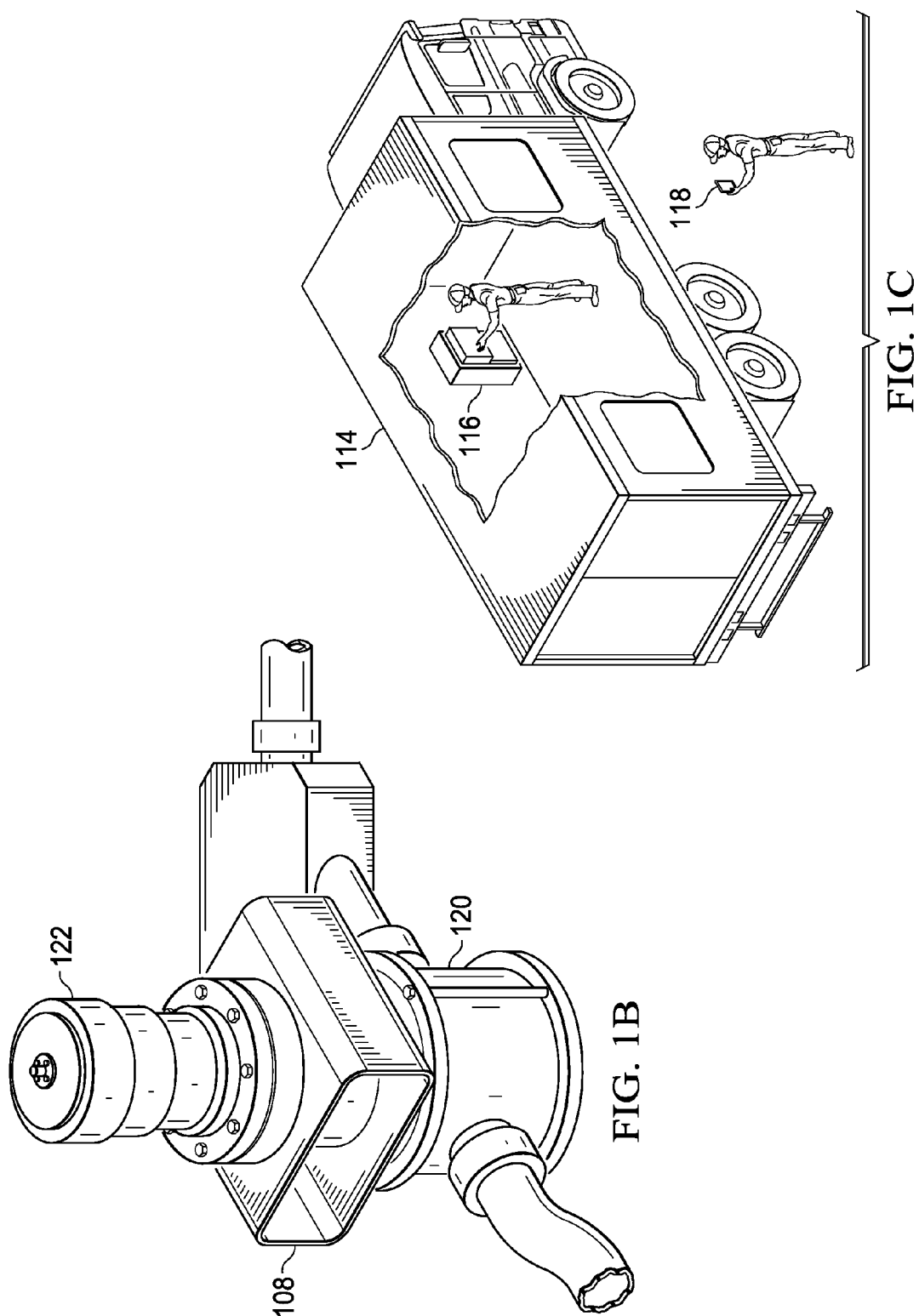


FIG. 1A



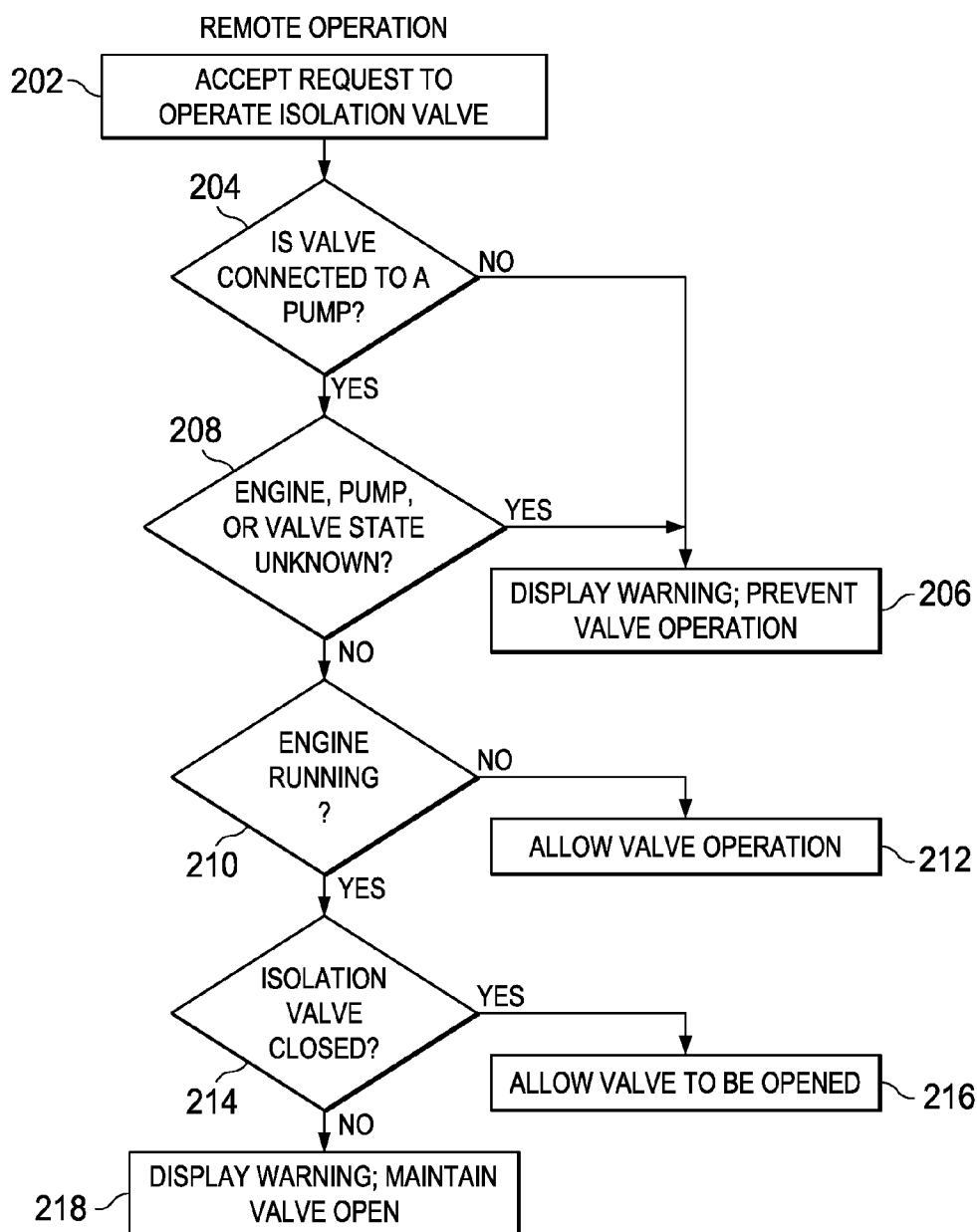


FIG. 2

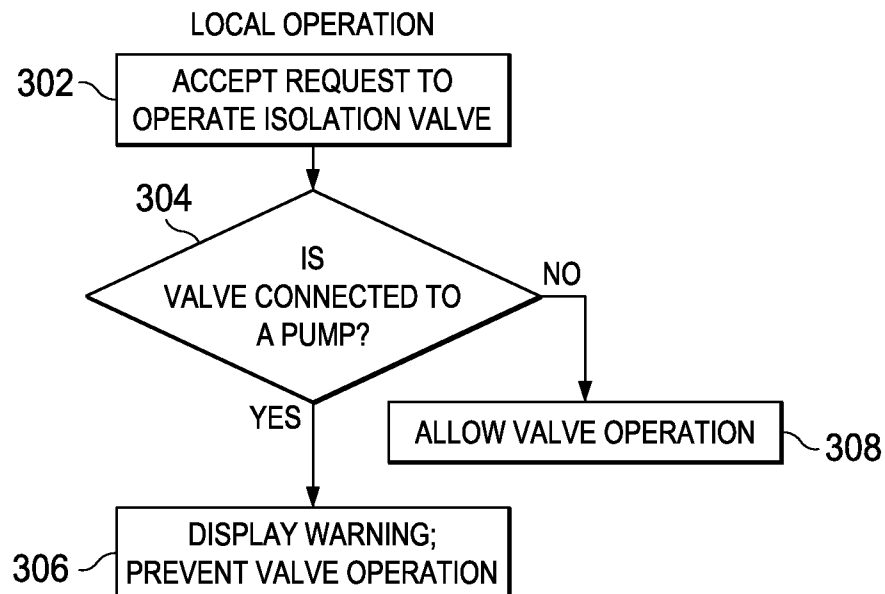


FIG. 3

FRAC PUMP ISOLATION SAFETY SYSTEM**CROSS-REFERENCE TO RELATED APPLICATIONS**

[0001] Not Applicable

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not Applicable

THE NAMES OF THE PARTIES TO A JOINT RESEARCH AGREEMENT

[0003] Not Applicable

INCORPORATION-BY-REFERENCE OF MATERIAL SUBMITTED ON A COMPACT DISC

[0004] Not Applicable

BACKGROUND OF THE INVENTION

[0005] 1. Field of the Invention

[0006] The present invention relates to a system for safe remote monitoring and operation of high-pressure and high-volume industrial fluid delivery system and, more specifically, to a system for remote monitoring and control of hydraulic fracturing equipment in a well stimulation operation.

[0007] 2. Description of Related Art including information disclosed under 37 CFR 1.97 and 1.98

[0008] Horizontal drilling and well stimulation processes have revolutionized the oil and gas industry with regard to the optimization of hydrocarbon extraction. Shale areas once thought unreachable are now within range of the horizontal drilling technology, with most shale gas wells having an average depth from the surface of between 7,500 and 13,000 feet with a horizontal run in the pay zone of 2,000 to 3,000 feet on average, if not better. Further, wells in shale areas that were once thought to be dry or of limited productivity are now capable of efficient (and profitable) production due to the use of advanced well stimulation processes, specifically hydraulic fracturing of the well bore in the specific hydrocarbon zones.

[0009] Every shale zone is composed differently, requiring somewhat different drilling and well stimulation techniques to make the well economically viable. Because of the attendant high costs of horizontal drilling, it is necessary that such a well produce as much hydrocarbon as possible as quickly as possible to allow the well operator to recover these substantial upfront costs. As such, hydraulic fracturing is used quite extensively to open up the pores and create fissures in the surrounding shale to allow trapped hydrocarbons to flow freely.

[0010] Rock pressures beneath the earth's surface are quite extreme, especially given the depths to which the well holes must be drilled to reach the pay zones. As a rule of thumb, the pressure exerted by the surrounding rock at a depth of 10,000 feet measures approximately 10,000 PSI, but can be as high as 15,000 PSI or greater depending on the shale characteristics. When a well hole is drilled to this depth and continued horizontally, this enormous pressure is felt on the walls of the lateral run. Consequently, the ability to fracture the surrounding shale formation requires the ability to exceed this surrounding pressure.

[0011] Hydraulic fracturing pumps, or "frac pumps" as they are known in the industry, are relatively massive positive displacement pumps capable of countering this enormous pressure at these extreme depths. Fracturing fluid ("frac fluid"), often containing proppants and/or slickwater, is pumped downhole by the frac pump, relying on the relative incompressibility of the frac fluid to transmit the frac pump pressure at the surface to an adequate pressure in the pay zone to cause the fractures and fissures to form. Thus, a frac pump is typically called upon to continuously pump frac fluid at a maximum pressure of around 15,000 PSI with a maximum flow rate of over 1,132 GPM downhole, depending on the rpm and plunger size, which requires an input power of upwards of 2,500 BHP to achieve this kind of performance from the pump.

[0012] However, pressure is not the only requirement. Because of the extreme distance that the frac fluid must travel, in addition to the large number of perforations in the lateral run through which the frac fluid must flow, a very high volumetric flow rate must also be achieved and maintained. If not maintained for an optimum amount of time, which is determined primarily by the shale conditions of the well, any fissures that form might close once the frac fluid stops flowing. If these stimulation operations are halted before sufficient amounts of proppant are introduced into the fissures, the fissures can close and negate any progress made to that point. Thus, for redundancy to ensure sufficient continuous pressures and volumes of frac fluid, it becomes necessary to utilize multiple frac pumps during such a well stimulation operation.

[0013] A typical hydraulic fracturing operation requires numerous high-pressure pumps and support equipment. A blender unit supplies massive amounts of frac fluid to the intakes of multiple high-pressure frac pumps during operation. The discharge of each of the frac pumps is connected to a manifold where the frac-fluid flows are combined. The manifold is connected to a wellhead, typically using a wellhead isolation device, directing the frac fluids into the wellbore.

[0014] Because the frac fluid is abrasive and often corrosive, maintenance of frac pumps must occur regularly. Also, because of the great strains on the frac pumps, breakdowns can occur, hence the need for redundancy. To allow for maintenance or repair, it is necessary to isolate the particular frac pump while the others continue to pump. However, extra precaution must be taken when isolating a frac pump—given the extreme operating pressures involved.

[0015] Manual isolation valves are commonly utilized between the frac pumps and the manifold. These isolation valves require an operator to physically locate and operate the desired valve to take a frac pump offline for repairs or maintenance. With the valves typically mounted in close proximity to the manifold, the operator must therefore physically approach the manifold to locate the appropriate isolation valve to close. However, with all of the other pumps running, the extreme environment due to the cacophony of noise and the mechanical vibrations of the equipment can make it exceedingly difficult for the operator to determine which valve to operate, or whether the respective frac pump is in a safe condition. If the wrong valve is closed on an operating frac pump, an essentially instantaneous overpressure and explosion of the valve hardware, lines, and/or fluid head of the pump can occur, possibly leading to equipment destruction, operation and production time losses, operator injury, and

attendant costs. The present invention addresses these shortcomings as well as others as will become apparent upon a thorough reading of the disclosure provided herein.

BRIEF SUMMARY OF THE INVENTION

[0016] Described herein is an industrial high-pressure fluid delivery system having a plurality of fluid pumps in fluid communication with a manifold to provide high fluid pressures and high fluid volumes, the system comprising: an isolation valve in a fluid circuit between each of a plurality of fluid pumps and a fluid manifold, the isolation valve capable of substantially isolating the fluid pump discharge from the manifold, the isolation valve adapted to allow for remote actuation; and a remote operator control panel, the control panel in signal communication with each isolation valve and its respective pump, the control panel adapted to monitor at least one valve condition and at least one respective pump condition, the isolation valve operable in response to a signal from the operator control panel. Supplementary elements forming additional embodiments include wired and/or wireless operator interfaces, alternate means of isolation valve actuation, and various system condition monitoring inputs.

[0017] Also described herein is a hydraulic fracturing pump isolation safety system, the system comprising: a plurality of remotely actuated isolation valves, each isolation valve in fluid communication with the fluid head of a hydraulic fracturing pump, the plurality of isolation valves in further fluid communication with a manifold through which fracturing fluid is provided to a well head; and a control panel located remotely from the plurality of isolation valves and the hydraulic fracturing pumps, the control panel in signal communication with the plurality of isolation valves and the hydraulic fracturing pumps, the control panel comprising an operator interface for monitoring by an operator of at least one valve condition and at least one respective pump condition, wherein the control panel is adapted to allow the operator to remotely monitor and control each valve and/or pump in response to the monitored conditions. Supplementary elements forming additional embodiments include wired and/or wireless operator interfaces, alternate means of isolation valve actuation, and various system condition monitoring inputs.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S)

[0018] The present invention will be more fully understood by reference to the following detailed description of the preferred embodiments of the present invention when read in conjunction with the accompanying drawings, wherein:

[0019] FIG. 1A depicts a first embodiment of the invention as it applies to a hydraulic fracturing operation during well stimulation, emphasizing the large amount of basic equipment necessary for the fracturing operation;

[0020] FIG. 1B depicts a hydraulically actuated isolation valve as used in the present embodiment;

[0021] FIG. 1C depicts a first operator controlling the system via the remotely located control panel, with a second operator monitoring system operation via wireless device;

[0022] FIG. 2 is a simplified flow diagram showcasing the basic functional operating steps followed by an embodiment with regard to remote operation of an isolation valve; and

[0023] FIG. 3 is a simplified flow diagram showcasing the basic functional operating steps followed by an embodiment with regard to local operation of an isolation valve.

[0024] The above figures are provided for the purpose of illustration and description only, and are not intended to define the limits of the disclosed invention. Use of the same reference number in multiple figures is intended to designate the same or similar parts. Furthermore, when the terms “top,” “bottom,” “first,” “second,” “upper,” “lower,” “height,” “width,” “length,” “end,” “side,” “horizontal,” “vertical,” and similar terms are used herein, it should be understood that these terms have reference only to the structure shown in the drawing and are utilized only to facilitate describing the particular embodiment. The extension of the figures with respect to number, position, relationship, and dimensions of the parts to form the preferred embodiment will be explained or will be within the skill of the art after the following teachings of the present invention have been read and understood.

DETAILED DESCRIPTION OF THE INVENTION

[0025] FIG. 1A depicts a first embodiment of the invention as it applies to a hydraulic fracturing operation during well stimulation, emphasizing the large amount of basic equipment necessary for the fracturing operation. As shown, a plurality of hydraulic fracturing (“frac”) pumps (102) is connected, each in parallel, to a primary fluid manifold (104) to provide frac fluids to a wellhead (112) for well stimulation as previously described. Hydraulically actuated isolation valves (108) provide a means for isolating a frac pump (102) from the manifold (104) to allow for repair or maintenance of the frac pump while avoiding work stoppage. A hydraulic control pump and reservoir (106) provide hydraulic pressure for remote isolation valve (108) actuation. The frac fluids are supplied to each pump (102) from a frac fluid blender reservoir trailer (110). Remote monitoring and control of the equipment occurs from a remote location, for example, a treater truck (114) as depicted.

[0026] FIG. 1B depicts a hydraulically actuated isolation valve as used in the present embodiment. In this embodiment a hydraulically actuated plug valve is utilized as the isolation valve (108). A plug valve uses rotational motion of a machined plug feature to stop or start fluid flow. In the open position, a bored passage in the plug lines up with the inlet and outlet ports of the valve body to allow flow. However, when the plug feature is rotated from the open position (usually 90 degrees), the bored passage no longer aligns with the ports and the solid part of the plug blocks the ports and stops fluid flow (with, perhaps, the exception of minor leakage around the plug due to the valve seat and packing tolerances). A well-known industrial hydraulic actuation means (122) mounted on the valve utilizes external hydraulic controller pressure to effect rotation of the valve into the open or the closed position as desired. It is also within the scope of the invention to utilize remote mechanical/electrical solenoid actuation, pneumatic actuation, or some combination of hydraulic, mechanical/electrical, and pneumatic actuation.

[0027] The isolation valve (108) also utilizes a valve position determining means to provide a signal to the operator indicating the condition of the valve (i.e., whether the valve is open or closed). For example, the present embodiment utilizes isolation valves having a physical limit switch (120) that detects the rotational position of the plug and provides a signal representing the valve’s current condition.

[0028] Moreover, although plug valves are described in the present embodiment, one of ordinary skill will understand and appreciate that other types of isolation valves may be utilized and are within the scope of the claims. For example, alternatives to plug valves include gate, ball, and disc gate valves capable of handling the operating pressures of the system.

[0029] Turning again to FIG. 1A, the frac pumps (102) each, likewise, include a pump condition determining means that generates a signal that reflects the condition or operational status of the pump. For example, in the present embodiment, a limit switch is utilized to provide a signal indication representing whether or not the frac pump (102) transmission is engaged. The frac pumps utilize a large diesel engine or electric motor that powers a drive gear to operate the frac pump (102). If the pump transmission is disengaged, then the frac pump (102) pistons will not reciprocate under power and, therefore, the pump is considered offline. Other conditions that may be monitored include the current flow through the motor windings, fluid end pressure, temperature, sound, and/or vibration, which can also give an indication of the overall health and operation of the frac pump.

[0030] Another source of input to the control system is a valve to pump connection determining means, which provides an indication that a valve is in fluid communication with a frac pump. This can be provided by visual indication and subsequent input by an operator of the connectedness, or may be automated. For example, the high-pressure fluid lines connecting the frac pump and isolation valve are typically constructed entirely of metal or include sufficient metal such that the line is capable of electrical current flow. A conductivity sensor with one lead placed on the pump and the other lead placed on the valve will provide an indication of current flow (or electrical resistance less than infinity) between the two devices. Thus, this may serve as a controller input for automation purposes. Other indicators may include the use of reflected electromagnetic waves (sound or light), or even a separate conductive cable that must be detached when the fluid line is detached.

[0031] FIG. 1C depicts a first operator controlling and/or monitoring the system from a treater truck (114) via the remotely located wired control panel (116), with a second operator controlling and/or monitoring system operation via wireless device (118). The remote operator control panel (116) collects the various aforementioned signals of interest for consideration by an equipment operator. The remote operator control panel (116) allows the operator to interface with and control the operation of the well stimulation system. The control panel in the present embodiment provides a display screen that is updated with status information regarding the monitored portions of the system and accepts operator input to affect the condition of the frac pumps (102), isolation valves (108), and the like. The control panel in the present embodiment is constructed utilizing commercially available controller programming software to construct the graphical user interface, but other embodiments are envisioned that utilize a proprietary interface or some combination thereof.

[0032] The remote operator control panel (116) operates in combination with an industrial programmable logic controller ("PLC") as an automated processing device for collection and handling of the various equipment condition and control signals. The PLC is essentially a stored program computer with large current handling relays that provides hard real time monitoring and control of the system. For example, the PLC

accepts as inputs the valve condition and the pump condition, and presents the monitored conditions to the operator control panel for display on the operator graphical interface. Specifically, the system provides indication of the transmission engagement condition of each of the pumps, as well as the open or closed condition of each of the isolation valves. Other conditions may be monitored and displayed as desired, including line pressures, other valve conditions, frac pump motor running conditions, fluid and hardware temperatures, etc. One of ordinary skill will appreciate that the controller software may be programmed to present this condition information in any desired format. In addition, the PLC functionality may be envisioned as a simple automated computing device (for example, a laptop, notebook, desktop computer, industrial single board computer, or the like) running proprietary software, or even a programmable logic relay (PLR) device capable of accepting the equipment condition signals for processing and generating control signals in response to operator action or pre-programmed logic.

[0033] The control panel (116) in the present embodiment is located at a position sufficiently remote from the frac pumps (102), isolation valves (108), and manifold (104) to prevent potential operator injury should an overpressure event occur. Because they are electric, the valve and pump condition signals may be routed over wired cables of sufficient length to allow the operator control panel (116) to be located within a safety enclosure, for example, in a vehicle such as a treater truck (114) or even a reinforced building.

[0034] The control panel (116) may also utilize industrial wireless communications for all or a portion of the equipment condition and control signals, as well as the operator graphical interface. For example, a portable tablet (118), smartphone, or portable computer communicating over a wireless network may be carried by an operator to afford additional flexibility in the monitor and control of fracturing operation equipment. The present embodiment utilizes packetized Wi-Fi communications with the handheld remote. However, wireless communication may occur over any cellular or packetized communications means, for example, 3G, 4G LTE, Bluetooth, Zigbee, or the like, or some combination of same.

[0035] During normal operation, a desired number of pumps are attached and running and the respective isolation valves are open. Depending on the requirements of a particular pumping operation, up to the maximum number of pumps may be connected to a manifold. For example, on a manifold that allows a maximum of twelve pumps to be connected it is not uncommon to have fewer than twelve pumps connected to the manifold at one time. Thus, there may be one or more isolation valves attached to the manifold without an attached pump.

[0036] If a particular attached pump requires shutdown for maintenance or repair, an offline backup pump may be brought online by first engaging the backup pump transmission (with the electric motor de-energized), opening the respective isolation valve, and energizing the pump's motor. The frac pump to be secured may then be de-energized (transmission engaged) and the respective isolation valve closed when the pump's head pressure has decreased to a safe pressure. The transmission may then be disengaged to signal the system that the isolation valve should remain closed. System safety interlocks prevent conditions that could cause an overpressure event to occur.

[0037] FIG. 2 is a simplified flow diagram showcasing the basic functional operating steps followed by an embodiment

with regard to remote operation of an isolation valve. The present embodiment utilizes two modes of operation: local (maintenance) and remote (normal operation). Because of the potential hazards involved during operation, the system includes safety interlocks that prevent local (maintenance) operation of the manifold and isolation valves unless each of the isolation valves are disconnected from their respective frac pumps. Thus, certain operational conditions must be tested before operation is allowed.

[0038] Remote operation is the primary method for controlling the high pressure pumping system during operation. As shown, upon accepting an operator's request to operate an isolation valve (202) the system considers a number of operating conditions. The first test involves whether the valve for which operation is requested is connected to a pump (204). If the valve is not connected to a pump (204), the system displays a warning on the operating panel and valve operation is prevented (206). If the valve is connected to a pump (204), the system checks to ensure that the connected engine, pump, and valves are in a known state (208). With regard to the valves, it is important for the system to ascertain the exact state—whether fully opened or fully closed—before operation is allowed. A valve in an intermediate position may be an indication of a stuck or otherwise faulty valve or actuator, or even a faulty indicator circuit. In such a situation the system will again display a warning to the operator and prevent valve operation (206) until the exact conditions can be determined. Likewise, if an engine or pump state is unknown (208) the system will display a warning to the operator and prevent valve operation (206). If the connected engine is not running (210) the valve operation is allowed (212) (i.e., an open valve may be closed and a closed valve may be opened). If the engine is running (210) and the connected isolation valve is closed, then the system will allow the valve to be opened (216). This condition allows for a pump to be brought online. However, if the isolation valve was open and the remote request was to close the valve, the system displays a warning to the operator and maintains the valve open (218). This prevents the operator from inadvertently closing an isolation valve during active pumping. Engine operation may be determined by the transmission state (i.e., forward gear engaged or disengaged) as well engine RPM, current draw (for electrical motors), and the like.

[0039] FIG. 3 is a simplified flow diagram showcasing the basic functional operating steps followed by an embodiment with regard to local operation of an isolation valve. As stated previously, for local operation to occur it is necessary that the system be in maintenance mode with all frac pumps disconnected from their respective isolation valves. As shown, upon accepting an operator's request to operate an isolation valve (302) the system checks each isolation valve to determine if any valve is connected to a pump (304). If no valves are connected to a pump, the valve operation is allowed (308). However, if even a single valve is connected to a pump then the system, in response to a local valve operation request, displays a warning to the operator and valve operation is prevented (306). This forces remote operation of the isolation valves and pumps to ensure an increased level of operator safety.

[0040] The safety interlock steps of the present embodiment may be modified in accordance with the desired level of safety or risk tolerance. One of ordinary skill in the art to which the invention pertains will appreciate that greater or lesser levels of redundancy may be utilized. For example, in

another embodiment the system prompts the operator at least once to confirm the desired valve operation request before opening or closing the valve in those conditions in which valve operation is allowed.

[0041] Although the embodiments described herein have involved primarily systems for performing well stimulation using hydraulic fracturing, the invention is also applicable to other industrial applications that involve the use of pumps for delivery of high fluid pressures and volumes to a single discharge manifold. For example, the disclosed safety system may be utilized in the high-pressure/volume processing, preparation, and delivery of fluids in the food, chemical, and energy industries, and the like. The present invention teaches safety features that benefit operators in any such industrial fluid delivery situations.

[0042] The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive. Accordingly, the scope of the invention is established by the appended claims rather than by the foregoing description. All changes that come within the meaning and range of equivalency of the claims are, therefore, intended to be embraced therein. Further, the recitation of method steps does not denote a particular sequence for execution of the steps. Such method steps may therefore be performed in a sequence other than that recited unless the particular claim expressly states otherwise.

We claim:

1. A high-pressure fluid delivery system having a plurality of fluid pumps in fluid communication with a manifold to provide high fluid pressures and high fluid volumes, the system comprising:

an isolation valve in a fluid circuit between a fluid discharge of each of a plurality of fluid pumps and a fluid manifold, the isolation valve capable of substantially isolating the fluid pump discharge from the manifold, the isolation valve adapted to allow for remote actuation; and

a remote operator control panel, the control panel in signal communication with each isolation valve and its respective pump, the control panel adapted to monitor at least one valve condition and at least one respective pump condition, the isolation valve operable in response to a signal from the operator control panel.

2. The system of claim 1, the control panel further comprising:

a graphical operator interface adapted to allow an operator to remotely monitor the at least one valve condition or the at least one pump condition during operations.

3. The system of claim 1, the control panel further comprising:

a graphical operator interface adapted to allow an operator to remotely monitor the at least one valve condition or the at least one pump condition during operations, and to effect actuation of each isolation valve and/or operation of each pump.

4. The system of claim 1 further comprising:

a graphical operator interface in wireless communication with the control panel, the interface adapted to allow an operator to remotely monitor the at least one valve condition and/or the at least respective one pump condition during operations.

5. The system of claim 1 further comprising:
a graphical operator interface in wireless communication with the control panel, the interface adapted to allow an operator to remotely monitor the at least one valve condition and/or the at least one respective pump condition during operations, and to effect actuation of each isolation valve and/or operation of each hydraulic fracturing pump.
6. The system of claim 1 further comprising:
a hydraulic or pneumatic valve actuation system, the actuation system in fluid communication with the isolation valves for isolation valve actuation, the actuation system in further signal communication with the control panel to effect the isolation valve actuation.
7. The system of claim 1 further comprising:
an electromechanical valve actuation system, the actuation system in mechanical communication with the isolation valves for isolation valve actuation, the actuation system in further signal communication with the control panel to effect the isolation valve actuation.
8. The system of claim 1, wherein the at least one pump condition is an indication of the operational status of the pump, the system further comprising:
an automated processing and control device adapted to perform the program steps for:
accepting a request by operator to close the isolation valve;
if the respective pump is not operating, closing the isolation valve; and
if the respective pump is operating, maintaining the valve open.
9. The system of claim 1, wherein the at least one valve condition is an indication of the open or closed state of the valve, the system further comprising:
an automated processing and control device adapted to perform the program steps for:
accepting a request by operator to engage the transmission on a hydraulic fracturing pump;
if the respective isolation valve is open, starting the pump; and
if the respective isolation valve is not open, warning the operator of the valve condition.
10. The system of claim 1, wherein the at least one valve condition is an indication of the open or closed state of the valve, the system further comprising:
an automated processing and control device adapted to perform the program steps for:
accepting a request by operator to engage the transmission on a hydraulic fracturing pump;
if the respective isolation valve is open, starting the pump; and
if the respective isolation valve is not open, automatically opening the isolation valve before starting the pump.
11. The system of claim 1, wherein the at least one valve condition is an indication of the open or closed state of the valve and the at least one pump condition is an indication of the physical integrity of the pump, the system further comprising:
an automated processing and control device adapted to perform the program steps for:
monitoring the physical integrity of the pump to determine an adverse change in the pump operational characteristics necessitating isolation;
if the pump transmission is not disengaged, disengaging the pump transmission; and
closing the isolation valve.
12. A hydraulic fracturing pump isolation safety system, the system comprising:
a plurality of remotely actuated isolation valves, each isolation valve in fluid communication with the fluid head of a hydraulic fracturing pump, the plurality of isolation valves in further fluid communication with a manifold through which fracturing fluid is provided to a well head; and
a control panel located remotely from the plurality of isolation valves and the hydraulic fracturing pumps, the control panel in signal communication with the plurality of plug valves and the hydraulic fracturing pumps, the control panel comprising an operator interface for monitoring by an operator of at least one valve condition and at least one respective pump condition,
wherein the control panel is adapted to allow the operator to remotely monitor and control each valve and/or pump in response to the monitored conditions.
13. The system of claim 12, the system further comprising:
an automated processing device adapted to automatically monitor the pump condition and to prevent the ability to change the operating condition of the respective isolation valve in response to this monitored pump condition.
14. The system of claim 12, the system further comprising:
an automated processing device adapted to automatically monitor the isolation valve condition and to prevent the ability to change the operating condition of the respective hydraulic fracturing pump in response to this monitored valve condition.
15. The system of claim 12, the system further comprising:
an automated processing device adapted to automatically monitor the first condition of a pump and to automatically operate the respective isolation valve in response to this monitored pump condition.
16. The system of claim 12, the control panel further comprising:
a graphical operator interface adapted to allow an operator to remotely monitor the at least one valve condition and/or the at least one pump condition during well stimulation operations.
17. The system of claim 12, the control panel further comprising:
a graphical operator interface adapted to allow an operator to remotely monitor the at least one valve condition and/or the at least one pump condition during well stimulation operations, and to effect operation of each isolation valve and/or operation of each hydraulic fracturing pump.
18. The system of claim 12, the system further comprising:
a graphical operator interface in wireless communication with the control panel, the interface adapted to allow an operator to remotely monitor the at least one valve condition and/or the at least one pump condition during well stimulation operations.
19. The system of claim 12, the system further comprising:
a graphical operator interface in wireless communication with the control panel, the interface adapted to allow an operator to remotely monitor the at least one valve condition and/or the at least one pump condition during well

stimulation operations, and to effect operation of each isolation valve and/or operation of each hydraulic fracturing pump.

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