US 20100133004A1

(19) United States

(12) Patent Application Publication

Burleson et al.

(10) Pub. No.: US 2010/0133004 A1

(43) Pub. Date: Jun. 3, 2010

(54) SYSTEM AND METHOD FOR VERIFYING PERFORATING GUN STATUS PRIOR TO PERFORATING A WELLBORE

(75) Inventors: **John D. Burleson**, Denton, TX (US); **John H. Hales**, Frisco, TX (US); **Kevin D. Fink**, Frisco, TX (US)

Correspondence Address:
LAWRENCE R. YOUST
Lawrence Youst PLLC
2900 McKinnon, Suite 2208
DALLAS, TX 75201 (US)

(73) Assignee: **HALLIBURTON ENERGY SERVICES, INC.**, Carrollton, TX (US)

(21) Appl. No.: **12/327,019**

(22) Filed: **Dec. 3, 2008**

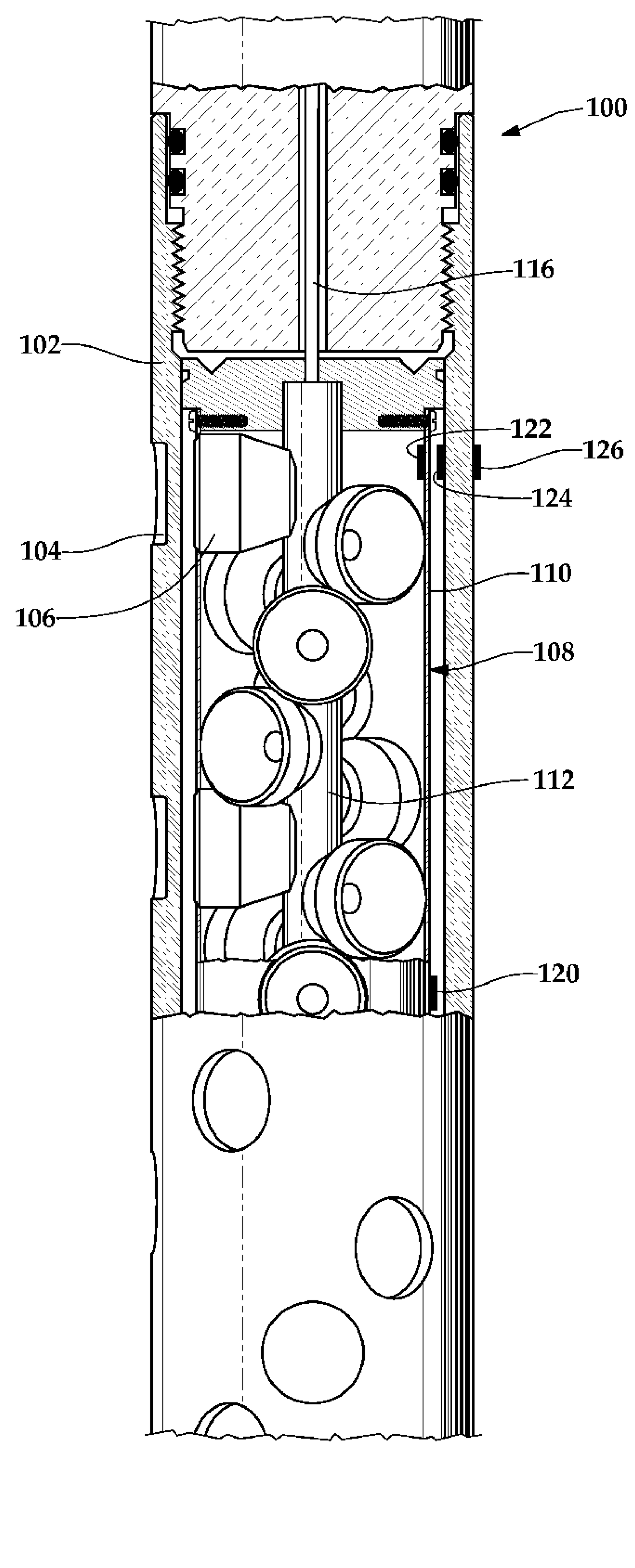
Publication Classification

(51) **Int. Cl.**
E21B 43/116 (2006.01)
E21B 47/12 (2006.01)
E21B 47/16 (2006.01)
E21B 47/14 (2006.01)

(52) **U.S. Cl.** **175/2**; 367/82; 340/854.4; 73/152.54

(57) **ABSTRACT**

A system for verifying perforating gun status prior to perforating a wellbore. The system includes a perforating gun (**38**) having a leak sensor disposed therein that is positionable at a target location within the wellbore on a tubing string (**30**). A communication system (**42**, **44**, **46**, **48**, **50**) is integrated with the tubing string (**30**). The communication system (**42**, **44**, **46**, **48**, **50**) is operable to communicate with the leak sensor. A surface controller (**40**) is operable to send a first telemetry signal via the communication system (**42**, **44**, **46**, **48**, **50**) to interrogate the leak sensor regarding a leak status of the perforating gun (**38**), receive a second telemetry signal from the leak sensor via the communication system (**42**, **44**, **46**, **48**, **50**) including the leak status of the perforating gun (**38**) and determine whether to operate the perforating gun (**38**) based upon the leak status information.



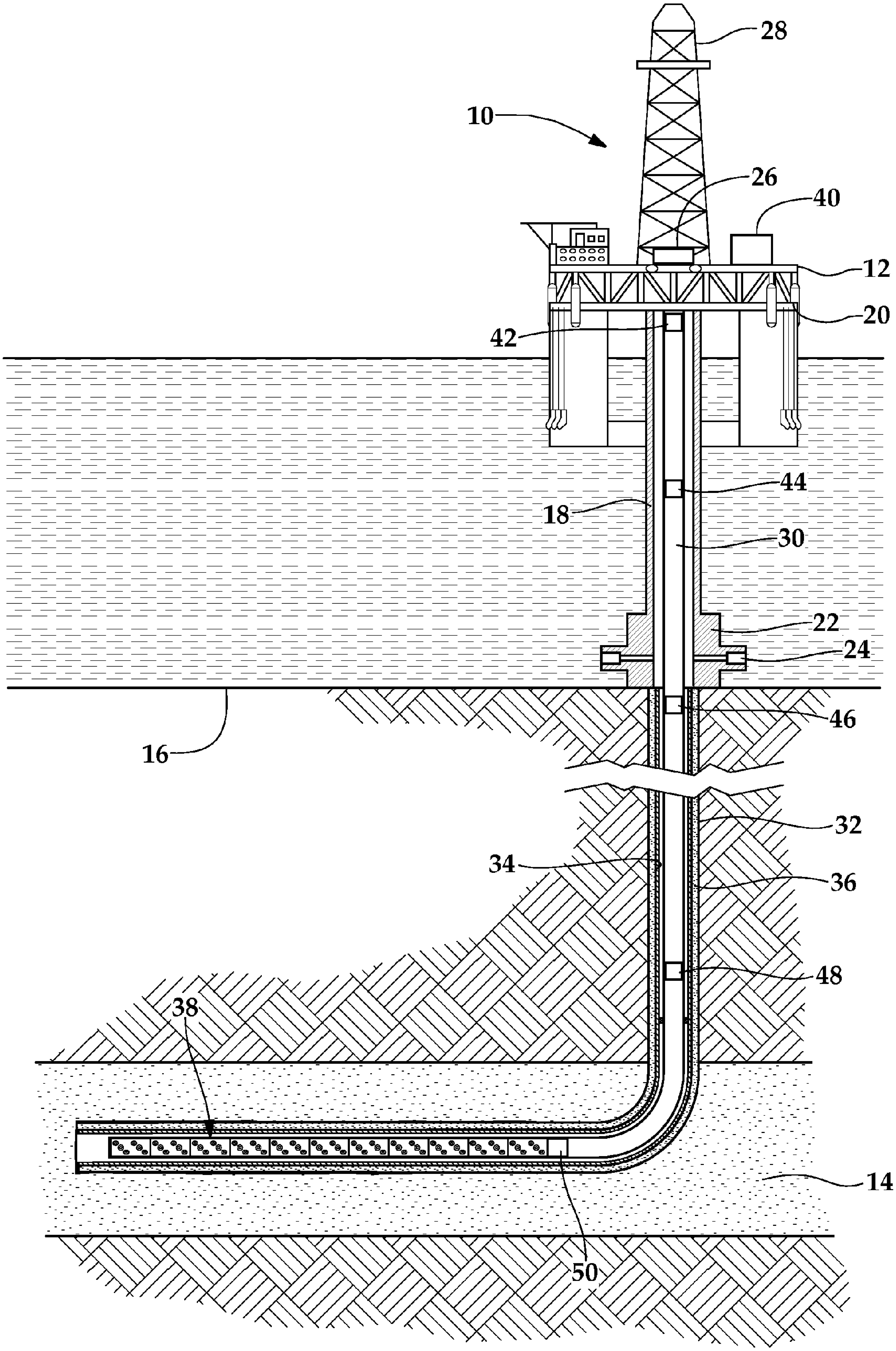


Fig.1

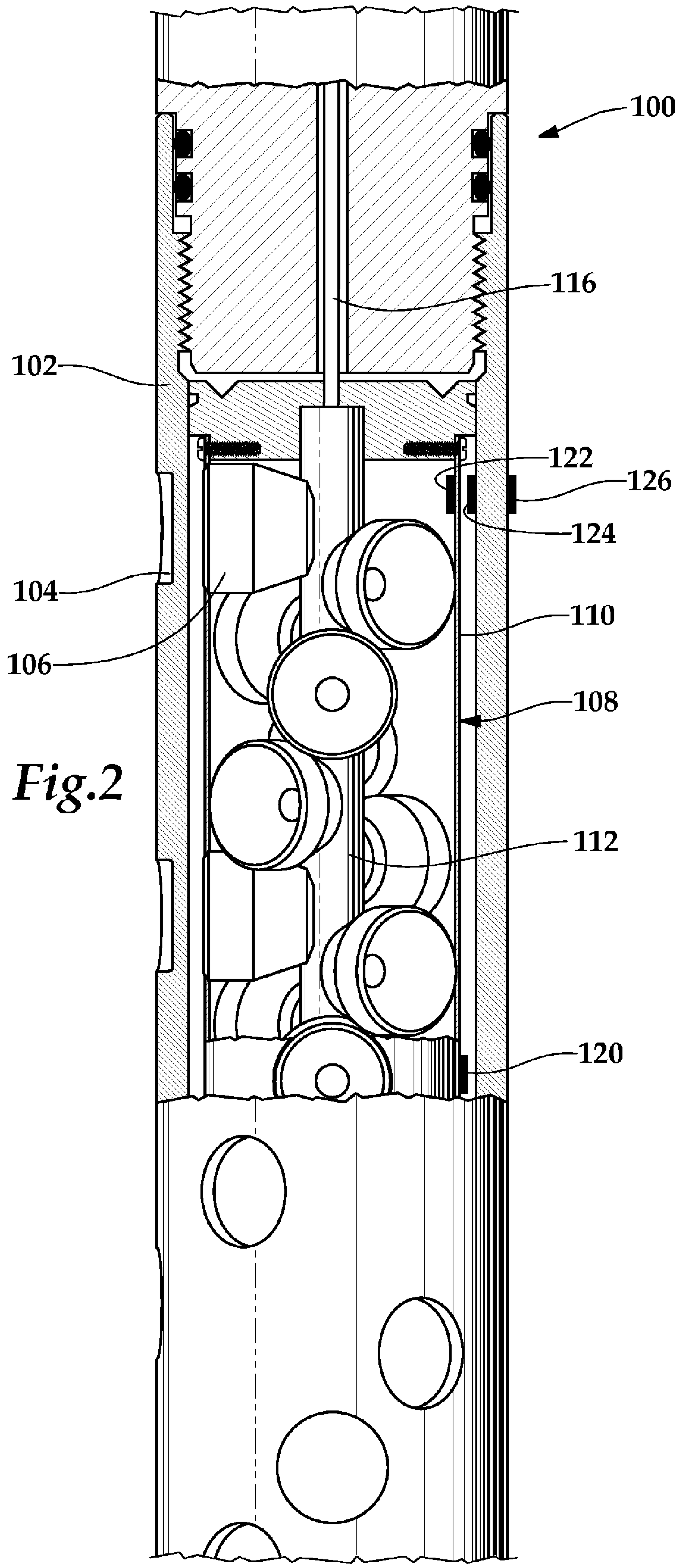


Fig.2

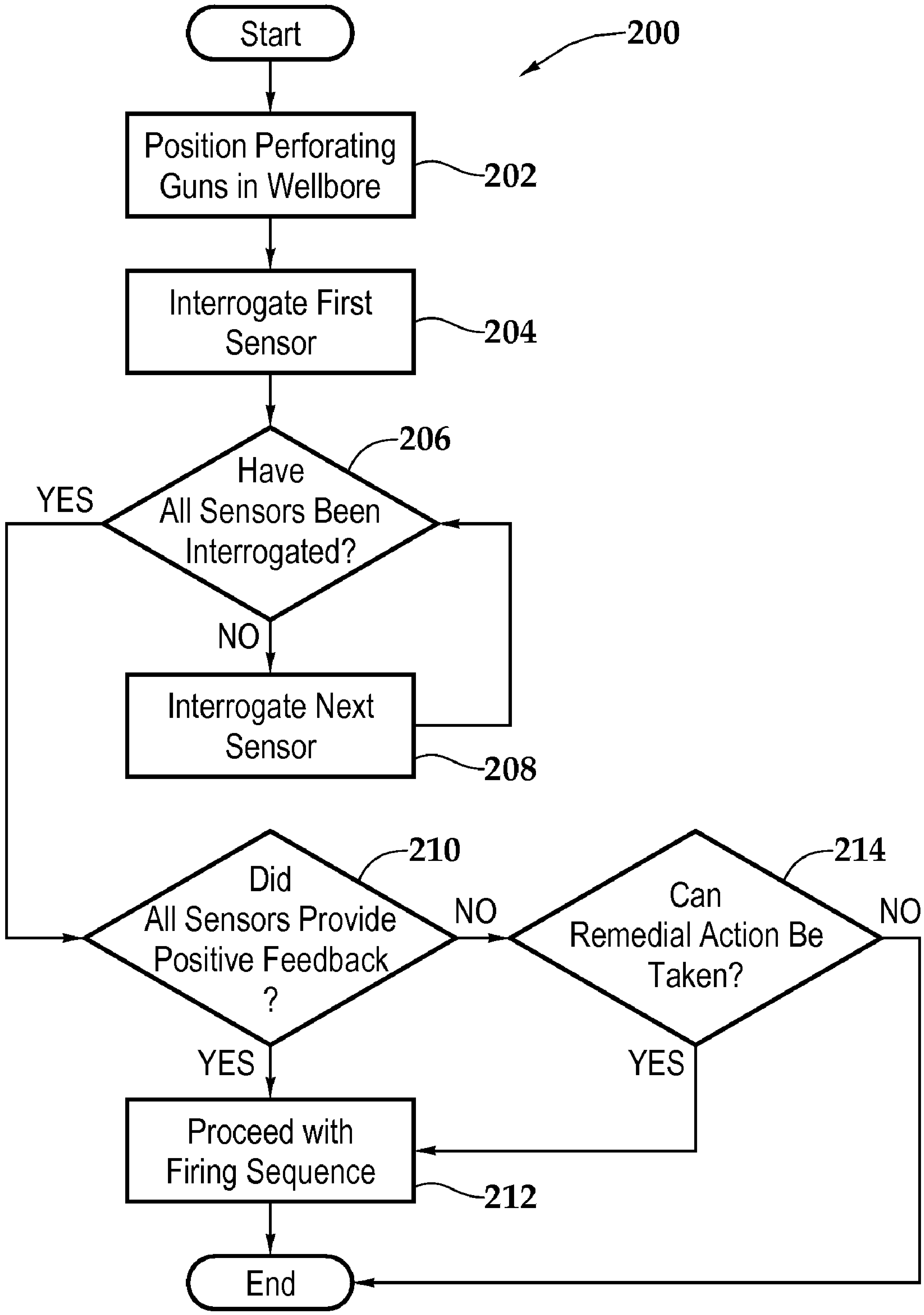

200
Start
Position Perforating Guns in Wellbore
202
Interrogate First Sensor
204
206
Have All Sensors Been Interrogated?
YES
NO
Interrogate Next Sensor
208
210
Did All Sensors Provide Positive Feedback ?
NO
214
Can Remedial Action Be Taken?
NO
YES
YES
Proceed with Firing Sequence
212
End

Fig.3

SYSTEM AND METHOD FOR VERIFYING PERFORATING GUN STATUS PRIOR TO PERFORATING A WELLBORE

TECHNICAL FIELD OF THE INVENTION

[0001] This invention relates, in general, to opening communication paths through a casing disposed in a wellbore and, in particular, to systems and methods for verifying the status of perforating guns prior to perforating the wellbore.

BACKGROUND OF THE INVENTION

[0002] Without limiting the scope of the present invention, its background will be described in relation to perforating a wellbore, as an example.

[0003] After drilling the various sections of a subterranean wellbore that traverses a formation, individual lengths of relatively large diameter metal tubulars are typically secured together to form a casing string that is positioned within the wellbore. This casing string increases the integrity of the wellbore and provides a path for producing fluids from the producing intervals to the surface. Conventionally, the casing string is cemented within the wellbore. To produce fluids into the casing string, hydraulic openings or perforations must be made through the casing string, the cement and a distance into the formation.

[0004] Typically, these perforations are created by detonating a series of shaped charges that are disposed within the casing string and are positioned adjacent to the formation. Specifically, one or more charge carriers or perforating guns are loaded with shaped charges that are connected with a detonator via a detonating cord. The charge carriers are then connected within a tool string that is lowered into the cased wellbore at the end of a tubing string or other conveyance. Once the charge carriers are properly positioned in the wellbore such that the shaped charges are adjacent to the formation to be perforated, the shaped charges may be fired. If more than one downhole zone is to be perforated, a select fire perforating gun assembly may be used such that once the first zone is perforated, subsequent zones may be perforated by repositioning and firing the previously unfired perforating guns without tripping out of the well.

[0005] Typically, once the perforating guns are assembled, the charge carriers protect the shaped charges disposed therein against wellbore fluids. It has been found, however, that perforating guns sometimes develop a leak, for example during the run in process, and become partially or completely filled with wellbore fluid. Once such fluid infiltration has occurred, if such a perforating gun is fired, there is a high likelihood that the perforating gun may split. Not only does such an occurrence result in a failed perforation operation, the explosive event may damage other wellbore equipment and may result in the split perforating gun becoming lodged in the wellbore. As such, an expensive recovery effort to retrieve the damaged equipment may be required and the entire completion may have to be abandoned resulting in the need to drill a sidetrack well.

[0006] A need has therefore arisen for an apparatus and method for perforating a cased wellbore that create effective perforation tunnels. A need has also arisen for such an apparatus and method that provide for determining whether a perforating gun has experienced a leak prior to firing the perforating gun.

SUMMARY OF THE INVENTION

[0007] The present invention disclosed herein provides systems and methods for bidirectional communication between a surface system and a downhole system that enables a determination of whether a perforating gun has experienced a leak prior to firing the perforating gun. The systems and methods of the present invention enable such a determination by telemetering encoded signals from the surface system to one or more downhole systems requesting leak status and other environmental information and by telemetering encoded signals from the downhole systems to the surface system including the leak status or other requested environmental information.

[0008] In one aspect, the present invention is directed to a method for verifying perforating gun status prior to perforating the wellbore. The method includes running a perforating gun having a leak sensor disposed therein to a target location within the wellbore on a tubing string, integrating a communication system with the tubing string, the communication system operable to communicate with the leak sensor, sending a first telemetry signal via the communication system to interrogate the leak sensor regarding a leak status of the perforating gun, returning a second telemetry signal from the leak sensor via the communication system including the leak status of the perforating gun and determining whether to operate the perforating gun based upon the leak status information.

[0009] In one embodiment, the leak sensor may be a moisture sensor. In this embodiment, the method may include determining whether to operate the perforating gun based upon moisture status information. In another embodiment, the leak sensor may be a pressure sensor. In this embodiment, the method may include determining whether to operate the perforating gun based upon pressure status information. In a further embodiment, the communication system may be an acoustic communication system that is integrated with the tubing string. In this embodiment, the method may include sending an acoustic signal encoded with the leak status request to the leak sensor and returning an acoustic signal encoded with the leak status information from the leak sensor.

[0010] In another aspect, the present invention is directed to a method for verifying perforating gun system status prior to perforating a wellbore. This method includes running the perforating gun system to a target location within the wellbore on a tubing string, the perforating gun system including a plurality of perforating guns each having a leak sensor disposed therein, integrating a communication system with the tubing string, the communication system operable to communicate with the leak sensors, sending first telemetry signals via the communication system to interrogate the leak sensors regarding a leak status of each of the perforating guns, returning second telemetry signals from the leak sensors via the communication system including the leak status of each of the perforating guns and determining whether to operate the perforating gun system based upon the leak status information.

[0011] In a further aspect, the present invention is directed to a system for verifying perforating gun status prior to perforating a wellbore. The system includes a perforating gun having a leak sensor disposed therein. The perforating gun may be deployed on a tubing string and positioned at a target location within the wellbore. A communication system is integrated with the tubing string. The communication system is operable to communicate with the leak sensor. A surface controller is operable to send a first telemetry signal via the communication system to interrogate the leak sensor regarding a leak status of the perforating gun, receive a second telemetry signal from the leak sensor via the communication system including the leak status of the perforating gun and determine whether to operate the perforating gun based upon the leak status information.

[0012] In yet another aspect, the present invention is directed to a method for verifying an environmental condition relative to a perforating gun disposed in a wellbore. The method includes running the perforating gun having at least one environmental sensor associated therewith to a target location within the wellbore on a tubing string, integrating a communication system with the tubing string, the communication system operable to communicate with the environmental sensor, sending a first telemetry signal via the communication system to interrogate the environmental sensor regarding an environmental condition relative to the perforating gun and returning a second telemetry signal from the environmental sensor via the communication system including the environmental condition relative to the perforating gun.

[0013] In one embodiment, the environmental sensor may include one or more of a moisture sensor, a pressure sensor, a high speed pressure sensor, a temperature sensor, an accelerometer, a shock load sensor, a liner displacement sensor, a depth sensor and a fluid sensor. These environmental sensors may be disposed interior of the perforating gun, exterior of the perforating gun or in the vicinity of the perforating gun. In another embodiment, the communication system may be an acoustic communication system that enables sending of an acoustic signal encoded with the environmental condition request and returning an acoustic signal encoded with the environmental condition information.

[0014] In an additional aspect, the present invention is directed to a system for verifying an environmental condition relative to a perforating gun disposed in a wellbore. At least one environmental sensor is associated with the perforating gun which is positioned at a target location within the wellbore on a tubing string. A communication system is integrated with the tubing string. The communication system is operable to communicate with the environmental sensor. A surface controller is operable to send a first telemetry signal via the communication system to interrogate the environmental sensor regarding an environmental condition relative to the perforating gun and receive a second telemetry signal from the environmental sensor via the communication system including the environmental condition relative to the perforating gun.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] For a more complete understanding of the present invention, including its features and advantages, reference is now made to the detailed description of the invention, taken in conjunction with the accompanying drawings in which like numerals identify like parts and in which:

[0016] FIG. **1** is a schematic illustration of an offshore oil and gas platform operating a system for verifying the status of perforating guns prior to perforating a wellbore that embodies principles of the present invention;

[0017] FIG. **2** is a partial cut away view of a perforating gun for use in a system for verifying the status of perforating guns prior to perforating a wellbore that embodies principles of the present invention; and

[0018] FIG. **3** is a flow chart illustrating a method for verifying the status of perforating guns prior to perforating a wellbore that embodies principles of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0019] While the making and using of various embodiments of the present invention are discussed in detail below, it should be appreciated that the present invention provides many applicable inventive concepts which can be embodied in a wide variety of specific contexts. The specific embodiments discussed herein are merely illustrative of specific ways to make and use the invention, and do not delimit the scope of the invention.

[0020] Referring initially to FIG. **1**, a system for verifying the status of perforating guns prior to perforating a wellbore is operating from an offshore oil and gas platform that is schematically illustrated and generally designated **10**. A semi-submersible platform **12** is centered over a submerged oil and gas formation **14** located below sea floor **16**. A subsea conduit **18** extends from deck **20** of platform **12** to wellhead installation **22** including subsea blow-out preventers **24**. Platform **12** has a hoisting apparatus **26** and a derrick **28** for raising and lowering pipe strings such as work sting **30**.

[0021] A wellbore **32** extends through the various earth strata including formation **14**. A casing **34** is cemented within wellbore **32** by cement **36**. Work string **30** includes various tools such as a plurality of perforating guns **38** disposed in a generally horizontal portion of wellbore **32** and a communication system including communication nodes **42**, **44**, **46**, **48**, **50**. In the illustrated embodiment, a surface communication node or controller **40** provides a user interface including, for example, input and output devices such as one or more video screens or monitors, including touch screens, one or more keyboards or keypads, one or more pointing or navigation devices, as well as any other user interface devices that are currently known to those skilled in the art or are developed. The user interface may take the form of a computer including a notebook computer. In addition, surface controller **40** may include a logic module having various controllers, processors, memory components, operating systems, instructions, communication protocols and the like for implementing the systems and methods for verifying the status of perforating guns of the present invention. Surface controller **40** is coupled to a bidirectional communication link that provides for communication between surface controller **40** and a node **42** that is positioned in the well as part of or attached to work string **30**.

[0022] The bidirectional communication link includes at least one communication path from surface controller **40** to node **42** and at least one communication path from node **42** to surface controller **40**. In certain embodiments, bidirectional communication may be achieved via a half duplex channel which allows only one communication path to be open in any time period. Preferably, bidirectional communication is achieved via a full duplex channel which allows simultaneous communication over multiple communication paths. This can be achieved, for example, by providing independent hardwire connections or over a shared physical media through frequency division duplexing, time division duplexing, echo cancellation or similar technique. In either case, the communication link may include one or more electrical conductors, optical conductors or other physical conductors.

[0023] Each of communication nodes **42**, **44**, **46**, **48**, **50** includes a transmitter, a receiver and a logic module that includes, for example, various fixed logic circuits, controllers, processors, memory components, operating systems, instructions, communication protocols and the like for implementing the systems and methods for verifying the status of perforating guns of the present invention. In addition, each communication node **42**, **44**, **46**, **48**, **50** also includes a power supply such as a battery pack which may include a plurality of batteries, such as nickel cadmium, lithium, alkaline or other suitable power source, which are configured to provide proper operating voltage and current.

[0024] In one embodiment, communication nodes **42**, **44**, **46**, **48**, **50** are operable to transmit and receive acoustic signals that are propagated over work string **30**. In this case, the transmitters and receivers of communication nodes **42**, **44**, **46**, **48**, **50** preferably include one or more transducers in the form of stacks of piezoelectric ceramic crystals. It should be noted that a single transducer may operated as both the transmitter and the receiver of a given communication node. Any number of communication nodes may be operated in the system of the present invention with the number determined by the length of work string **30**, the noise in the wellbore, the type of communication media used and the like. As illustrated, communication nodes **44**, **46**, **48** serve as repeater that are positioned to receive the acoustic signals transmitted along work string **30** at a point where the acoustic signals are of a magnitude sufficient for adequate reception. Once the acoustic signals reach a given node, the signals are converted to an electrical current which represents the information being transmitted and is fed to the logic module for processing. The current is then sent to the transducer to generate acoustic signals that are transmitted to the next node. In this manner, communication from node **40** to node **50** as well as from node **50** to node **40** is achieved.

[0025] When it is desired to perforate casing **34**, work string **30** is lowered through casing **34** until the perforating guns **38** are properly positioned relative to formation **14**. To verify the condition of perforating guns **38** prior to the perforating operation, an interrogation command may be sent from surface controller **40** to sensors disposed in perforating guns **38**. For example, as discussed in greater detail below, each perforating gun **38** may include one or more sensors such as moisture sensors, pressure sensors or other leak sensors. Preferably, each of these sensors is individually addressable and communicates with communication node **50** via a wired connection but a short range wireless connection such as an electromagnetic communication link could alternatively be used.

[0026] Accordingly, when surface controller **40** sends interrogation commands to determine the leak status of perforating guns **38** to one or more of the sensors, the commands are received by communication node **42** and retransmitted as encoded acoustic signals along work string **30** which are received by communication node **44**. Communication node **44** acts as a repeater to receive, process and retransmit the commands via acoustic signals along work string **30** which are received by communication node **46**. Likewise, communication node **46** forwards the commands to communication node **48** via acoustic signals along work string **30** and communication node **48** forwards the commands to communication node **50** via acoustic signals along work string **30**. Communication node **50** then sends the commands to interrogate each of the sensors in perforating guns **38**. The sensors obtain the desired data regarding the leak status of each perforating gun **38** and provide this information to communication node **50**. Communication node **50** converts this information to acoustic signals that are sent to communication node **48** along work string **30**. Communication nodes **48**, **46**, **44** act as repeaters, each receiving, processing and retransmitting the information in the form of acoustic signals along work string **30**. Communication node **42** receives the acoustic signals send from communication node **44** and processes the information such that it can be forwarded to surface controller **40** for analysis.

[0027] If the sensors report that no leaks have been identified within perforating guns **38**, then the communication system may be used in a similar manner to enable, arm and fire perforating guns **38** using, for example, one or more electronic or hydraulic firing heads. Thereafter, the shaped charges within perforating guns **38** are sequentially fired, either in an uphole to downhole or a downhole to uphole direction. Upon detonation, the liners of the shaped charges form jets that create a spaced series of perforations extending outwardly through casing **34**, cement **36** and into formation **14**, thereby allow fluid communication between formation **14** and wellbore **32**.

[0028] In the illustrated embodiment, wellbore **32** has an initial, generally vertical portion and a lower, generally deviated portion which is illustrated as being horizontal. It should be noted, however, by those skilled in the art that the system for verifying the status of perforating guns of the present invention is equally well-suited for use in other well configurations including, but not limited to, inclined wells, wells with restrictions, non-deviated wells and the like. In addition, even though FIG. **1** has been described with reference to an offshore environment, it should be understood by one skilled in the art that the principles described herein are equally well-suited for an onshore environment.

[0029] As should be understood by those skilled in the art, any of the functions described with reference to a logic module herein can be implemented using software, hardware, including fixed logic circuitry, manual processing or a combination of these implementations. As such, the term "logic module" as used herein generally represents software, hardware or a combination of software and hardware. For example, in the case of a software implementation, the term "logic module" represents program code and/or declarative content, e.g., markup language content, that performs specified tasks when executed on a processing device or devices such as one or more processors or CPUs. The program code can be stored in one or more computer readable memory devices. More generally, the functionality of the logic modules may be implemented as distinct units in separate physical grouping or can correspond to a conceptual allocation of different tasks performed by a single software program and/or hardware unit. The logic modules can be located at a single site such as implemented by a single processing device, or can be distributed over plural locations such as a notebook computer or personal digital assistant in combination with other physical devices that communication with one another via wired or wireless connections.

[0030] Referring next to FIG. **2**, therein is depicted a perforating gun for use in the system for verifying the status of perforating guns of the present invention that is generally designated **100**. Perforating gun **100** includes a carrier **102**

having a plurality of recesses, such as recess **104**, defined therein. Radially aligned with each of the recesses is a respective one of the plurality of shaped charges, such as shaped charge **106**.

[0031] The shaped charges are retained within carrier **102** by a support member **108** which includes an outer charge holder sleeve **110** and an inner charge holder sleeve **112**. In this configuration, outer tube **110** supports the discharge ends of the shaped charges, while inner tube **112** supports the initiation ends of the shaped charges. Disposed within inner tube **112** is a detonating cord **116**. In the illustrated embodiment, the initiation ends of the shaped charges extend across the central longitudinal axis of perforating gun **100** allowing detonating cord **116** to connect to the high explosive within the shaped charges through an aperture defined at the apex of the housings of the shaped charges. In this configuration, carrier **102** is sealed to protect the shaped charges disposed therein against wellbore fluids.

[0032] Each of the shaped charges, such as shaped charge **106**, is longitudinally and radially aligned with a recess, such as recess **104**, in carrier **102** when perforating apparatus **100** is fully assembled. In the illustrated embodiment, the shaped charges are arranged in a spiral pattern such that each shaped charge is disposed on its own level or height and is to be individually detonated so that only one shaped charge is fired at a time. It should be noted, however, by those skilled in the art that alternate arrangements of shaped charges may be used, including cluster type designs wherein more than one shaped charge is at the same level and is detonated at the same time, without departing from the principles of the present invention.

[0033] As discussed above, perforating guns for use in the system for verifying the status of perforating guns of the present invention, such as perforating gun **100**, include one or more sensors used to obtain and provide information relative to environmental factors that surround perforating gun **100**. In the illustrated embodiment, perforating gun **100** includes a plurality of sensors such as sensor **120** positioned on the exterior of support member **108**, sensor **122** positioned on the interior of support member **108**, sensor **124** positioned on the interior of carrier **102** and sensor **126** positioned on the exterior of carrier **102**. As discussed above, sensors **120**, **122**, **124**, **126** are preferably coupled to communication node **50** via a wired connection but other communication means are also possible and considered within the scope of the present invention.

[0034] Sensors **120**, **122**, **124**, **126** may be of the same type or different types and may be moisture sensors, humidity sensors, pressure sensors including high speed pressure sensors or fast gauge sensors, temperature sensors, accelerometers, shock load sensors, liner displacement sensors, depth sensors, fluid sensors, CO_2 sensors, H_2S sensors, CO sensors, thermal decomposition sensors, casing collar locators, gamma detectors or any other types of sensors that are operable to provide information relating to the perforating gun environment. Sensors **120**, **122**, **124**, **126** and similar sensors associated with the perforating gun system may be used for monitoring a variety of environmental conditions relative to the gun string such as the depth and orientation of the guns in the wellbore; the condition of the guns prior to firing including leak status, pressure, thermal decomposition and moisture; whether the guns fired properly including gun pressures, accelerations and shock loads; the near wellbore reservoir parameters including temperatures, hydrostatic pressures, peak pressures and transient pressures as well as other environmental conditions that are known to those skilled in the art.

[0035] The operation of one embodiment of the present invention will now be described as process **200** with reference to FIG. **3**. Once the perforating guns **38** are positioned at the target location in the wellbore (step **202**) and prior to detonating the shaped charges, the system of the present invention is operable to perform a variety of gun condition verifications such as those described above and including perforating gun depth and orientation verification and perforating guns condition verification. This verification is accomplished using the surface controller in conjunction with the communication nodes positioned along the work string to interrogate the sensors associated with the perforating guns for the desired information. As an example, an interrogation command requesting the leak status of one of the perforating guns is sent to one of the downhole sensors via the communication nodes and the work string and that downhole sensor responds with the requested information also via the communication nodes and the work string (step **204**). Next, the surface controller determines whether all the sensors have been interrogated (decision **206**). If all of the sensors have not been interrogated, an interrogation command requesting the leak status of another of the perforating guns is sent to another of the downhole sensors and that downhole sensor responds with the requested information (step **208**). This process continues until all of the sensors have been interrogated (decision **206**).

[0036] Once all of the sensors have been interrogated, the surface controller determines whether all of the perforating guns are dry (decision **210**). If all of the perforating guns are dry, the surface controller may proceed with the remainder of the firing sequence including sending the appropriate enable, arm and fire commands via the communication nodes to a suitable firing head (step **212**). If all of the perforating guns are not dry, the surface controller determines whether remedial action can be taken to allow the perforating event to occur (decision **214**). Such remedial action may include repeating the verification process to determine if the out of range condition persists, identifying which guns have an out of range condition and removing those guns from the firing sequence or the like. If in performing such remedial action the surface controller determines that the perforating event should occur, then the surface controller may proceed with the remainder of the firing sequence (step **212**). If in performing such remedial action it is determined that the perforating event may not occur, then the process ends.

[0037] During the perforating event, the sensors associated with the perforating guns may continue gather and transmit information. Specifically, sensors such as the above described accelerometers, pressure sensors, high speed pressure sensors, temperature sensors and the like are used to obtain a variety of perforating gun and near wellbore reservoir data. For example, the high speed pressure sensors are operably to obtain pressure data in the millisecond range such that the pressure surge and associated pressure cycles created by the perforating event can be measured. Likewise, the accelerometers are operable to record shock data associated with the perforating event. Use of this and other data provide for a determination of the intensity level of the detonation associated with the perforating guns. During, immediately after or at a later time, this information is communicated from the sensors to the surface controller over the communication system. This information may be used to determine the quality of the perforating event such as whether the initiator was detonated, whether any of the shaped charges within the perforating gun were detonated, whether all of the shaped charges within the perforating gun were detonated or whether only some of the shaped charges within the perforating gun were detonated. This information will allow the operator in substantially real time to determine, for example, if a zone should be reperforated.

[0038] Likewise, following the perforating event, the sensors associated with the perforating guns may continue gather and transmit information. Specifically, sensors such as the above described pressure sensors, temperature sensors, fluid sensors and the like are used to obtain a variety of near wellbore reservoir data. This data may be useful in designing the next phase of the completion such as whether to perform an acid job or a facture stimulation.

[0039] While this invention has been described with a reference to illustrative embodiments, this description is not intended to be construed in a limiting sense. Various modifications and combinations of the illustrative embodiments as well as other embodiments of the invention, will be apparent to persons skilled in the art upon reference to the description. It is, therefore, intended that the appended claims encompass any such modifications or embodiments.

What is claimed is:

1. A method for verifying perforating gun status prior to perforating a wellbore comprising:

running a perforating gun having a leak sensor disposed therein to a target location within the wellbore on a tubing string;

integrating a communication system with the tubing string, the communication system operable to communicate with the leak sensor;

sending a first telemetry signal via the communication system to interrogate the leak sensor regarding a leak status of the perforating gun;

returning a second telemetry signal from the leak sensor via the communication system including the leak status of the perforating gun; and

determining whether to operate the perforating gun based upon the leak status information.

2. The method as recited in claim **1** wherein running the perforating gun having a leak sensor disposed therein further comprises running the perforating gun having a moisture sensor disposed therein.

3. The method as recited in claim **1** wherein running the perforating gun having a leak sensor disposed therein further comprises running the perforating gun having a pressure sensor disposed therein.

4. The method as recited in claim **1** wherein integrating a communication system with the tubing string further comprises integrating an acoustic communication system with the tubing string.

5. The method as recited in claim **1** wherein sending a first telemetry signal via the communication system to interrogate the leak sensor regarding a leak status of the perforating gun further comprises sending an acoustic signal encoded with the leak status request.

6. The method as recited in claim **1** wherein returning a second telemetry signal from the leak sensor via the communication system including the leak status of the perforating gun further comprises returning an acoustic signal encoded with the leak status information.

7. The method as recited in claim **1** wherein determining whether to operate the perforating gun based upon the leak status information further comprises determining whether to operate the perforating gun based upon moisture status information.

8. The method as recited in claim **1** wherein determining whether to operate the perforating gun based upon the leak status information further comprises determining whether to operate the perforating gun based upon pressure status information.

9. A method for verifying perforating gun system status prior to perforating a wellbore comprising:

running the perforating gun system to a target location within the wellbore on a tubing string, the perforating gun system including a plurality of perforating guns each having a leak sensor disposed therein;

integrating a communication system with the tubing string, the communication system operable to communicate with the leak sensors;

sending first telemetry signals via the communication system to interrogate the leak sensors regarding a leak status of each of the perforating guns;

returning second telemetry signals from the leak sensors via the communication system including the leak status of each of the perforating guns; and

determining whether to operate the perforating gun system based upon the leak status information.

10. The method as recited in claim **9** further comprises selecting the leak sensors from moisture sensors and pressure sensors.

11. The method as recited in claim **9** wherein integrating a communication system with the tubing string further comprises integrating an acoustic communication system with the tubing string.

12. A system for verifying perforating gun status prior to perforating a wellbore comprising:

a perforating gun having a leak sensor disposed therein positioned at a target location within the wellbore on a tubing string;

a communication system integrated with the tubing string, the communication system operable to communicate with the leak sensor; and

a surface controller operable to send a first telemetry signal via the communication system to interrogate the leak sensor regarding a leak status of the perforating gun, receive a second telemetry signal from the leak sensor via the communication system including the leak status of the perforating gun and determine whether to operate the perforating gun based upon the leak status information.

13. The system as recited in claim **12** wherein the leak sensor further comprises a moisture sensor.

14. The system as recited in claim **12** wherein the leak sensor further comprises a pressure sensor.

15. The system as recited in claim **12** wherein the communication system further comprises an acoustic communication system.

16. A method for verifying an environmental condition relative to a perforating gun disposed in a wellbore comprising:

running the perforating gun having at least one environmental sensor associated therewith to a target location within the wellbore on a tubing string;

integrating a communication system with the tubing string, the communication system operable to communicate with the environmental sensor;

sending a first telemetry signal via the communication system to interrogate the environmental sensor regarding an environmental condition relative to the perforating gun; and

returning a second telemetry signal from the environmental sensor via the communication system including the environmental condition relative to the perforating gun.

17. The method as recited in claim **16** wherein running the perforating gun having at least one environmental sensor associated therewith to a target location within the wellbore on a tubing string further comprises selecting the at least one environmental sensor from at least one of a moisture sensor, a pressure sensor, a temperature sensor, an accelerometer, a shock load sensor, a liner displacement sensor, a depth sensor and a fluid sensor.

18. The method as recited in claim **16** wherein running the perforating gun having at least one environmental sensor associated therewith to a target location within the wellbore on a tubing string further comprises disposing the at least one environmental sensor interior of the perforating gun.

19. The method as recited in claim **16** wherein running the perforating gun having at least one environmental sensor associated therewith to a target location within the wellbore on a tubing string further comprises disposing the at least one environmental sensor exterior of the perforating gun.

20. The method as recited in claim **16** wherein integrating a communication system with the tubing string further comprises integrating an acoustic communication system with the tubing string.

21. The method as recited in claim **16** wherein sending a first telemetry signal via the communication system to interrogate the environmental sensor regarding an environmental condition relative to the perforating gun further comprises sending an acoustic signal encoded with the environmental condition request.

22. The method as recited in claim **16** wherein returning a second telemetry signal from the environmental sensor via the communication system including the environmental condition relative to the perforating gun further comprises returning an acoustic signal encoded with the environmental condition information.

23. The method as recited in claim **16** further comprising determining whether to operate the perforating gun based upon the environmental condition.

24. A system for verifying an environmental condition relative to a perforating gun disposed in a wellbore comprising:

at least one environmental sensor associated with the perforating gun positioned at a target location within the wellbore on a tubing string;

a communication system integrated with the tubing string, the communication system operable to communicate with the environmental sensor; and

a surface controller operable to send a first telemetry signal via the communication system to interrogate the environmental sensor regarding an environmental condition relative to the perforating gun and receive a second telemetry signal from the environmental sensor via the communication system including the environmental condition relative to the perforating gun.

25. The system as recited in claim **24** wherein the communication system further comprises an acoustic communication system.

* * * * *