

(51) International Patent Classification:
G01V 1/22 (2006.01)(21) International Application Number:
PCT/US2014/025877(22) International Filing Date:
13 March 2014 (13.03.2014)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/783,856 14 March 2013 (14.03.2013) US
61/783,613 14 March 2013 (14.03.2013) US
61/784,024 14 March 2013 (14.03.2013) US

(71) Applicant: INOVA LTD. [US/US]; 12200 Parc Crest Drive, Stafford, TX 77477 (US).

(72) Inventors: PHILLIPS, Thomas, F.; 7150 Oakwood Creek Road, Edmond, OK 73034 (US). HLADIK, Timothy, D.; 22 Hidden Vale Court NW, Calgary, Alberta, T3A 5B5 (CA). RADCLIFFE, Keith, S.; 12215 Brook Meadows Lane, Meadows Place, TX 77477 (US). SAMOYLOV, Igor; 1025 Dulles Avenue, Apt. No. : 734, Stafford, TX 77477 (US). MAECHLER, Bernard; 8618 Green Ash Drive, Sugar Land, TX 77477 (US). MAGUIRE, Gerald, H.; 1947 49th Avenue S.W., Calgary, Alberta, T2T 2V3 (CA).

(74) Agent: KUMAR, Chandran, D.; Mossman, Kumar & Tyler, P.O.Box 421239, Houston, TX 77242 (US).

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

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

[Continued on next page]

(54) Title: CONFIGURABLE SOURCE ENCODERS FOR SEISMIC SYSTEMS

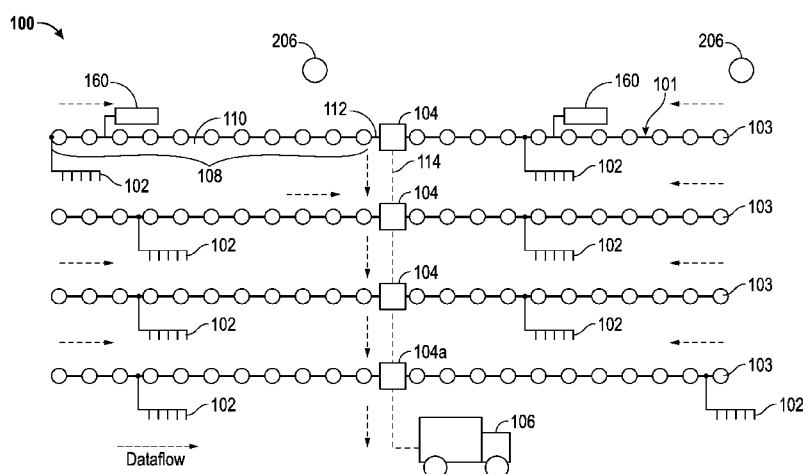


FIG. 1

(57) Abstract: A system for acquiring seismic information may include a seismic spread in signal communication with a central controller having a central recording system, a source encoder in signal communication with the seismic spread, and a source decoder in wireless signal communication with the source encoder. The source decoder and the encoder are each selectively responsive to a control signal and can be selectively configured to transmit the control signal.



-
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

TITLE: CONFIGURABLE SOURCE ENCODERS FOR SEISMIC SYSTEMS

INVENTOR(S): PHILLIPS, III., Thomas F.; HLADIK, Timothy D.;
RADCLIFFE, Keith S.; SAMOYLOV, Igor;
MAECHLER, Bernard; and MAGUIRE, Gerald H.

BACKGROUND OF THE DISCLOSURE

Field of the Disclosure

[0001] This disclosure relates generally to systems and methods for conducting seismic data acquisition activities.

Background of the Art

[0002] Seismic surveys are conducted to map subsurface structures to identify and develop oil and gas reservoirs. Seismic surveys are typically performed to estimate the location and quantities of oil and gas fields prior to developing (drilling wells) the fields and also to determine the changes in the reservoir over time subsequent to the drilling of wells. On land, seismic surveys are conducted by deploying an array of seismic sensors (also referred to as seismic receivers) over selected geographical regions. The seismic sensors (geophones or accelerometers) are placed or coupled to the ground in the form of a grid. An energy source is used at selected predetermined locations (also referred to as source points) in the geographical area to generate or induce acoustic waves or signals (also referred to as acoustic energy) into the subsurface. The acoustic waves generated into the subsurface reflect back to the surface from subsurface formation discontinuities, such as those formed by oil and gas reservoirs. The reflections are sensed or detected at the surface by the seismic sensors and recorded. The sensing, processing and recording of the seismic waves is referred to as seismic data acquisition. Two-dimensional and/or three-dimensional maps of the subsurface structures (also referred to as the “seismic image”) are generated from the recorded seismic data. These maps are then used to make

- 2 -

decisions about drilling locations, reservoir size, pay zone depth and estimates of the production of hydrocarbons.

[0003] The present disclosure provides methods and devices for facilitating seismic activity.

SUMMARY OF THE DISCLOSURE

[0004] In aspects, the present disclosure provides a system for acquiring seismic information. The system may include a central controller, a seismic spread in signal communication with the central controller, one or more source encoders in signal communication with the seismic spread, and one or more source decoders in wireless signal communication with the source encoders. The source decoder(s) and the source encoder(s) are each selectively responsive to control signals. Further, the source decoder(s) and the source encoder(s) are selectively configured to transmit control signals.

[0005] In aspects, the present disclosure provides a method for acquiring seismic information. The method may include: positioning a central controller and a seismic spread in a geographical area of interest; forming a communication link between the seismic spread and the central controller; forming a communication link between at least one source encoder and the seismic spread; forming a wireless communication link between the at least one source encoder and at least one source decoder; controlling the at least one source decoder using a control signal sent from the at least one source encoder; configuring the at least one source decoder to send a second control signal after sending the control signal; configuring the at least one source encoder to be responsive to the second control signal after sending the control signal; and controlling the at least one source encoder using the second control signal sent from the at least one source decoder.

[0006] In aspects, the present disclosure provides a system for acquiring seismic information. The system may include a central controller and a seismic spread in signal communication with the central controller. The seismic spread may include a plurality of

- 3 -

seismic devices configured for wireless signal communication; at least one source encoder in signal communication with at least one of the plurality of seismic devices; and at least one source decoder in signal communication with the at least one source encoder. The at least one source decoder is responsive to a signal transmitted by the at least one remote encoder.

[0007] In aspects, the present disclosure provides a method for acquiring seismic information. The method may include positioning a central controller and a seismic spread in a geographical area of interest, the seismic spread being in signal communication with the central controller, the seismic spread including: a plurality of seismic devices configured for wireless signal communication; at least one source encoder in signal communication with at least one of the plurality of seismic devices; and at least one source decoder in signal communication with the at least one source encoder, wherein the at least one source decoder is responsive to a signal transmitted by the at least one source encoder; and controlling the at least one remote encoder from the central controller, wherein the central controller instructs the at least one source encoder to transmit the signal to the source decoder.

[0008] In aspects, the present disclosure provides a system for acquiring seismic information. The system may include a central recording system (CRS) and a seismic spread. The seismic spread may include at least one cable in signal communication with the CRS, a plurality of seismic devices disposed along the at least one cable; at least one source encoder in signal communication with the at least one cable; and at least one source decoder in signal communication with the at least one source encoder. The at least one source decoder is responsive to a signal transmitted by the at least one remote encoder.

[0009] In aspects, the present disclosure provides a method for acquiring seismic information. The method may include the steps of positioning a central recording system (CRS) and a seismic spread in a geographical area of interest, the seismic spread including at least one cable in signal communication with the CRS, and a plurality of

- 4 -

seismic devices disposed along the at least one cable; forming a communication link between the seismic spread and the central controller; forming a communication link between at least one source encoder and the seismic spread; forming a wireless communication link between the at least one source encoder and at least one decoder; and controlling the at least one remote encoder from the central controller, wherein the central controller instructs the at least one source encoder to transmit the signal to the source decoder.

[0010] Examples of certain features of the systems, methods and apparatus disclosed herein have been summarized rather broadly in order that detailed description thereof that follows may be better understood, and in order that the contributions to the art may be appreciated. There are, of course, additional features of the disclosure that will be described hereinafter and will form the subject of the disclosure. The summary provided herein is not intended to limit the scope.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The novel features of this disclosure, as well as the disclosure itself, will be best understood from the attached drawings, taken along with the following description, in which similar reference characters generally refer to similar elements, and in which:

FIG. 1 shows a cable seismic data acquisition system made in accordance with one embodiment of the present disclosure;

FIG. 2 is a representation of a wireless seismic data acquisition system made in accordance with one embodiment of the present disclosure;

FIG. 3 shows a source encoder arrangement in accordance with one embodiment of the present disclosure; and

FIG. 4 shows a configurable encoder according to one embodiment of the present disclosure.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0012] The present disclosure relates to devices and methods for controlling activities relating to seismic data acquisition. The present disclosure may be implemented in embodiments of different forms. The drawings shown and the descriptions provided herein correspond to certain specific embodiments of the present disclosure for the purposes of explanation of the concepts contained in the disclosure with the understanding that the present disclosure is to be considered an exemplification of the principles of the disclosure, and is not intended to limit the scope of the disclosure to the illustrated drawings and the description herein.

[0013] **Figs. 1 and 2** depict illustrative, but not exclusive, seismic data acquisition systems that may implement the methods of the present disclosure. The basic components of these systems are discussed in greater detail below. Thereafter, the methods for enabling communication for these systems are described.

[0014] **FIG. 1** depicts a conventional cable seismic data acquisition system **100** that may implement certain methods of the present disclosure. The system **100** uses a seismic spread **101** that includes seismic devices such as seismic sensor units **102** and battery boosters. Each string of sensors is typically coupled via cabling to a data acquisition device **103**, and several of the data acquisition devices and associated string of sensors are coupled via cabling **110** to form a line **108**, which is then coupled via cabling **112** to a line tap or (crossline unit) **104**. Several crossline units **104** and associated lines are usually coupled together by cabling, such as shown by the dotted line **114**. The sensors **102** are usually spaced between **10-50** meters. Each of the crossline units **104** typically performs some signal processing and then stores the processed signals as seismic information. The crossline units **104** are each typically coupled, either in parallel or in series, with one of the units **104a** serving as an interface between a central controller, which may be a central recording system (CRS) **106**, and all crossline units **104**. This system may use wired communication media, e.g., RS232, Ethernet, RS485, USB, etc. During seismic operations, the CRS **106** includes data processing devices and communication device for transmitting control signals to the seismic spread **101** and

- 6 -

receiving seismic information from the seismic spread **101**, this seismic information may be recorded. For example, the sensors **102** may send signals representative of measured seismic energy to the CRS **106** and the CRS **106** may record this seismic information in real-time or near real time. This system is considered a cable system because a majority of the transmissions are made using physical conductors (e.g., wire). As used herein, a “control signal” is a command to a machine to perform, not perform, or stop performing one or more tasks. The “control signal” is in a form that can be received and understood by such a machine.

[0015] In an active mode, the system **100** uses one or more seismic energy sources **206** to generate seismic energy of known characteristics, such as magnitude, frequency etc., at known locations in the seismic spread to impart seismic energy into the subterranean formation. Illustrative energy sources include impulsive sources such as explosive sources. Illustrative impulsive sources include, but are not limited to dynamite and compressed gas source. Another illustrative energy source is a vibrator truck. Vibrator trucks support a heavy base plate that is connected to an inertia mass. The inertia mass contains a linear actuator that reciprocates the base plate along a vertical or horizontal axis in reaction to the momentum of the inertia mass. The reciprocating base plate injects a vibratory wave train into the earth. A programmable controller controls the force and frequency of the signal generated by the inertia mass. Still another energy source is an accelerated weight-drop truck. A weight-drop truck is a vehicle mounted ground impact which can be used to provide the seismic source. A heavy weight is raised by a hoist at the back of the truck and dropped, possibly about three meters, to impact (or “thump”) the ground. It should be understood, however, that any device that generates usable seismic energy may be an energy source.

[0016] Referring to **FIG. 2**, a representation of a wireless seismic data acquisition system **200** that may implement the methods of the present disclosure. The system **200** includes a central controller, which may be a control unit (CU) **202**, in data communication with each of a number of wireless field station units (FSU) or sensor

- 7 -

stations **208** forming a seismic spread **201** for seismic data acquisition. The wireless communication between the central controller **202** with the FSUs may be direct bi-directional wireless communication or via an intermediate unit such as a repeater unit (RU)(not shown). Each sensor station **208** includes one or more sensors **212** for sensing seismic energy. The sensors **212** may be any suitable seismic sensors, including geophones, and one or more component accelerometers. The sensor stations **208** may include processors, memory, communication devices, and other electronics for acquiring and locally recording seismic data and communicating with the CU **202**. The system may be considered wireless in that a majority of the signals are transmitted using wireless communication techniques.

[0017] Direct communication as used herein refers to individualized data flow as depicted in **FIG. 2** by dashed arrows. A wireless communication system can be a VHF, UHF, WiFi, or other wireless radio communication system. The data flow can be bi-directional to allow one or more of: transmission of command and control instructions from the central controller **202** to each wireless sensor station **208**; exchange of quality control and other data between the central controller **202** and each wireless sensor station **208**; and transmission of status signals, operating conditions and/or selected pre-processed seismic information from each wireless sensor station **208** to the central controller **202**. The communication might be in the form of radio signals transmitted from and received by the sensor stations **208** and central controller **202** via suitable antennas **203** and **204** respectively. As discussed above, the system **200** uses one or more seismic energy sources **206** to generate seismic energy of known characteristics, such as magnitude, frequency etc., at known locations in the seismic spread to impart seismic energy into the subterranean formation.

[0018] The central controller **202**, the central station computer (CSC) **260** and a central server **280** exert control over the constituent components of the system **200** and direct activities of the operators and devices during the operation of the system **200**. The server **280** can be programmed to manage data and activities over the span of the seismic

- 8 -

surveying activities, which can include daily shooting sequences, updating the shots acquired, tracking shooting assets, storing seismic data, pre-processing seismic data and broadcasting corrections. CSC 260 may be integral with the CU 202. The central controller 202 also may act as a central radio unit. For large fields, radio antennas and repeater transceivers may also be deployed at selected field locations as described below.

[0019] Referring to **Figs. 1** and **2**, in some situations, the systems **100**, **200** may be deployed into a geographical area where reliable long distance radio communications are not possible between the central units and the sources (*e.g.*, greater than two kilometers separates these devices). For these situations, the systems may include one or more source encoder systems **160** that use the seismic grid **101** or **201** to enable communications between the CRS **106** or CSC **260** and the sources **206**.

[0020] Referring now to **FIG. 3**, there is shown one non-limiting embodiment of a source encoder system **160** that may be used with the cable-based system **100** of **FIG. 1**. In this arrangement, the CRS **106** (**FIG. 1**) can communicate with a source **206** using the source encoder system **160** and communication architecture of the seismic spread **101**. Specifically, the source encoder system **160** may be connected via a physical data conductor, such as a cable **162**, to the cabling **112**. The cable **162** may be relatively short, *e.g.*, ten meters. Also, in some embodiments a wireless connection may be used in lieu of the cable **162**. That is, the source encoder system **160** may be used with the wireless system **200** of **FIG. 2**. In this arrangement, the CSC **260** (**FIG. 2**) can communicate with a source **206** using the source encoder system **160** and communication architecture of the seismic spread **201**. The connection to the cabling may be at a “take out” **164** along the cabling **11**.

[0021] In one arrangement, the source encoder system **160** provides a wireless communication link between the seismic spread **101** and the source **206**. The source encoder system **160** may include a source encoder **166** and a remote source decoder **168**. As used herein, the term encoder refers to a device that is configured to “encode” and transmit signals such as control signals. The term “decoder” refers to a device that is

- 9 -

configured to “decode” a signal transmitted from an encoder. The source encoder **166** may include a processor **170** having a communication interface for communicating with the CSR **106** (**FIG. 1**). In wireless arrangements, the source encoder **166** may include a processor **170** having a communication interface for communicating with the CSC **260** (**FIG. 2**). The source encoder **166** may also include a wireless communication device **172** that can transmit and receive information encoded radio signals. The source decoder **168** may include a processor **176** and a wireless communication device **178** that can transmit and receive information encoded radio signals. The processor **176** may include a communication interface for communicating with the wireless communication device **172** and the source encoder **166**. The processor **176** may also be configured to operate a source **206** (**FIG. 1**). Additionally, in some embodiments the source decoder **174** may include a position sensor **180** such as a global positioning device.

[0022] Referring to **Figs. 1, 2, and 3**, in one mode of operation, personnel may wish to bring one or more sources to a ready-to-fire state. To do so, the CRS **106** of the system **100** may transmit a suitable control signal into the communication architecture of the seismic spread **101**. In wireless arrangements, the CSC **260** of the system **200** may transmit a suitable control signal into the communication architecture of the seismic spread **201**. The source encoders **166** receive the control signals and transmit an appropriate radio signal to the source decoders **168**. Upon receipt of the control signal, the source decoder **168** takes a responsive action, e.g., bring the source **206** to a ready condition, fire the source **206**, etc. The responsive action may also include transmitting to the source decoders **166** a status report, an operational condition (e.g., ready-to-fire), error conditions, etc.

[0023] Generally, it is desirable that the location of each of the source decoders **168** be uniquely identifiable. In one arrangement, a “source point flag number” may be associated with the location of each source decoder **168**. The source point flag number may be derived or based on a preplanned seismic plan. This may be a value have alphabetical and / or numerical symbols. In one arrangement, the source decoder **168**

- 10 -

may transmit a source point flag number to the source encoder **166** when requested or automatically. The source encoder **166** may transmit the source point flag number to the CRS **106** (**FIG. 1**) via the seismic spread **101** (**FIG. 1**). Alternatively or additionally, the position sensor **180** may determine the location coordinates of the source decoder **166**. This location information may be solicited by the CRS **106** or sent automatically. In either case, the source decoder **168** can transmit the location determined by the position sensor **180** to the source encoder **166**. The source encoder **166** re-transmits the source decoder location to the CRS **106** (**FIG. 1**) via the seismic spread **101** (**FIG. 1**). In one arrangement, the location information is sent only if the quality and accuracy of the position data of the source decoder **168** is not sufficient.

[0024] In wireless arrangements, the source encoder **166** may transmit the source point flag number to the CSC **260** (**FIG. 2**) via the seismic spread **201** (**FIG. 2**). Alternatively or additionally, the position sensor **180** may determine the location coordinates of the source decoder **166**. This location information may be solicited by the CSC **260** or sent automatically. In either case, the source decoder **168** can transmit the location determined by the position sensor **180** to the source encoder **166**. The source encoder **166** re-transmits the source decoder location to the CSC **260** (**FIG. 2**) via the seismic spread **201** (**FIG. 2**).

[0025] It should be appreciated that embodiments of the present disclosure enable the CRS **106** to communicate with source decoders **166** using a combination of wired cables in the seismic spread **101** and the radio signals exchanged by the source encoders **166** and source decoders **168**. Therefore, even if direct radio communications may not be possible between the CRS **106** and the sources **206**, the CRS **106** can use the seismic spread **101** to operate the seismic sensors **102**, receiving seismic information from the seismic sensors **102**, communicate with the source decoders **168**, and control the sources **206**. During these operations, the source encoders **166** may be energized using the power supply associated with the seismic spread **101**.

[0026] The **FIG. 3** system **300** may also be used with the wireless system **200** of **FIG.**

- 11 -

2. Referring to **Figs. 2** and **3**, the source encoder system **160** may be connected via a physical data conductor, such as a cable **162**, to a sensor station **208**. The cable **162** may be relatively short, e.g., ten meters. Also, in some embodiments a wireless connection may be used in lieu of the cable **162**. This connection enables the CSC **260** to communicate with source decoders **166** using the wireless communication system of the seismic spread **201** (**FIG. 2**) and the radio signals exchanged by the source encoders **166** and source decoders **168**. Therefore, even if direct radio communications may not be possible between the CSC **260** and the sources **206**, the CSC **260** can use the seismic spread **201** to operate the seismic sensors **208**, receiving seismic information from the seismic sensors **208**, communicate with the source decoders **168**, and control the sources **206**. In embodiments where the CSC **260** does not receive seismic data from the sensor stations **208** as it is being detected, this information is stored locally at the sensor stations **208** (**FIG. 2**).

[0027] Referring now to **FIG. 4**, there is shown another embodiment of a source encoder system **300**. The source encoder system **300** may be connected via a physical data conductor or wireless to a seismic spread **101** (**FIG. 1**) or seismic spread **201** (**FIG. 2**) as described previously. In one arrangement, the source encoder system **300** may include an in-field configurable source encoder **320** and an in-field configurable source decoder **340**. The term “configurable” refers to the functionality that the encoder can be reconfigured to work as a decoder and the decoder can be reconfigured to work as an encoder. The devices may be configured manually or via suitable electronic commands.

[0028] The source encoder **320** may include a processor **322** having a communication interface for communicating with the CSR **106** (**FIG. 2**) or CU **260** (**FIG. 2**). The source encoder **322** may also include a wireless communication device **324** that can transmit and receive information encoded radio signals. The processor **322** may also be configured to operate a source **326**, which may be a source **206** (**FIG. 1**). Additionally, in some embodiments the source encoder **322** may include a position sensor **180** such as a global positioning device.

- 12 -

[0029] The source decoder **340** may include a processor **342** having a communication interface for communicating with the CSR **106** (**FIG. 2**) or CU **260** (**FIG. 2**). The source decoder **342** may also include a wireless communication device **344** that can transmit and receive information encoded radio signals. The source decoder **340** may include a wireless communication device **344** that can transmit and receive information encoded radio signals. Additionally, in some embodiments the source decoder **340** may include a position sensor **180** such as a global positioning device. The processor **342** may also be configured to operate a source **346**, which may be a source **206** (**FIG. 1**).

[0030] The source encoder **320** and the source decoder **340** are configurable in that either device can transmit control signals to the other device. Specifically, the source encoder **320** can control the source decoder **340** in order to operate the source **346**. After both devices have been reconfigured, the source encoder **340** can control the source decoder **320** in order to operate the source **326**.

[0031] In one mode of operation, personnel may wish to bring the source **346** to a ready to fire state. To do so, the CRS **106** (**FIG. 1**) of the system **100** (**FIG. 1**) may transmit a suitable control signal into the seismic spread **101** (**FIG. 1**). The source encoder **320** receives the control signals and transmits an appropriate radio signal to the source decoder **340**. Upon receipt of the control signal, the source decoder **340** takes a responsive action, e.g., bring the source **346** (**FIG. 1**). Afterwards, personnel may wish to bring the source **326** to a ready to fire state. To do so, personnel may physically reconfigure the source encoder **320** to operate as a decoder and reconfigure the source decoder **340** to operate as an encoder. Thereafter, the CRS **106** (**FIG. 1**) of the system **100** (**FIG. 1**) may transmit a suitable control signal into the seismic spread **101** (**FIG. 1**). The now-source encoder **340** receives the control signals and transmits an appropriate radio signal to the now-source decoder **320**. Upon receipt of the control signal, the now source decoder **320** takes a responsive action, e.g., bring the source **326** (**FIG. 1**).

[0032] The term “seismic devices” means any device that is used in a seismic spread, including, but not limited to sensors, sensor stations, receivers, transmitters, power

- 13 -

supplies, control units, etc. As used above, a seismic spread is a network of equipment configured to detect seismic energy. As used above, a central controller is a device used to control the seismic spread. The disclosure herein is provided in reference to particular embodiments and processes to illustrate the concepts and methods. Such particular embodiments and processes are not intended to limit the scope of the disclosure or the claims. All such modifications within the scope of the claims and disclaimers are intended to be part of this disclosure.

THE CLAIMS

What is claimed is:

1. A system for acquiring seismic information, comprising:
 - a central controller;
 - a seismic spread in signal communication with the central controller;
 - at least one source encoder in signal communication with the seismic spread; and
 - at least one source decoder in wireless signal communication with the at least one source encoder,wherein the at least one source decoder and the at least one source encoder are each selectively responsive to a control signal, and wherein the at least one source decoder and the at least one source encoder are selectively configured to transmit the control signal.
2. The system of claim 1, wherein:
 - the seismic spread includes a plurality of seismic devices configured for wireless signal communication; and
 - the at least one source encoder is in signal communication with at least one of the plurality of seismic devices.
3. The system of claim 2, wherein the seismic spread includes at least one of: (i) a line tap, (ii) a battery booster, (iii) a seismic receiver, and (iv) a take out.
4. The system of claim 3, wherein the seismic spread further comprises a communication interface using one of: (i) a wired signal carrier, and (ii) wireless signals.
5. The system of claim 4, wherein the at least one source encoder is in signal communication with at least one of the plurality of seismic devices, wherein the central

- 15 -

controller is configured to communicate commands and data messages and signals with the at least one source encoder using the communication interface.

6. The system of claim 1, wherein:
 - the central controller has a central recording system (CRS); and
 - the seismic spread includes at least one cable in signal communication with the CRS and a plurality of seismic devices being disposed along the at least one cable, wherein the at least one source encoder in signal communication with the at least one cable.
7. The system of claim 1, wherein the at least one source encoder and the at least one source decoder communicate using radio signals.
8. The system of claim 1, further comprising:
 - a position sensor associated with the source encoder, wherein the central controller estimates a location of the source encoder using the position sensor;
 - wherein the at least one source decoder transmits a location determined by the position sensor to the at least one source encoder;
 - wherein the at least one source encoder transmits the at least one source decoder location to the central controller via the seismic spread;
 - wherein the seismic spread energizes the source encoder;
 - wherein the at least one source encoder includes a plurality of source encoders distributed along at least one cable; and
 - wherein the at least one source decoder includes a plurality of source decoders.
9. The system of claim 1, wherein the at least one source encoder and the at least one source decoder communicate using one of: (i) a signal carrying cable connecting the at least one source encoder and the at least one source decoder

- 16 -

communication; and (ii) wireless signal transmissions.

10. The system of claim 1, wherein the at least one source decoder transmits its operational state to the at least one source encoder, and wherein the at least one source encoder transmits the at least one source decoder operational state to the central controller via the seismic spread.
11. The system of claim 1, wherein the at least one source decoder transmits a Source Point Flag Number to the at least one source encoder, and wherein the at least one source encoder transmits the Source Point Flag Number to the central encoder via the seismic spread.
12. A method for acquiring seismic information, comprising:
 - positioning a central controller and a seismic spread in a geographical area of interest;
 - forming a communication link between the seismic spread and the central controller;
 - forming a communication link between at least one source encoder and the seismic spread;
 - forming a wireless communication link between the at least one source encoder and at least one decoder; and
 - controlling the at least one source encoder from the central controller, wherein the central controller instructs the at least one source encoder to transmit the signal to the source decoder.
13. The method of claim 12, further comprising:
 - controlling the at least one source decoder using a control signal sent from the at least one source encoder;
 - configuring the at least one source decoder to send a second control signal

- 17 -

after sending the control signal;

configuring the at least one source encoder to be responsive to the second control signal after sending the control signal; and

controlling the at least one source encoder using a control signal sent from the at least one source decoder.

14. The method of claim 12, wherein:

the seismic spread has a plurality of seismic devices configured for wireless communication; and

the at least one source encoder is in signal communication with at least one of the plurality of seismic devices.

15. The method of claim 12, wherein:

the central controller has a central recording system (CRS); and

the seismic spread includes at least one cable in signal communication with the CRS, and a plurality of seismic devices disposed along the at least one cable.

1/3

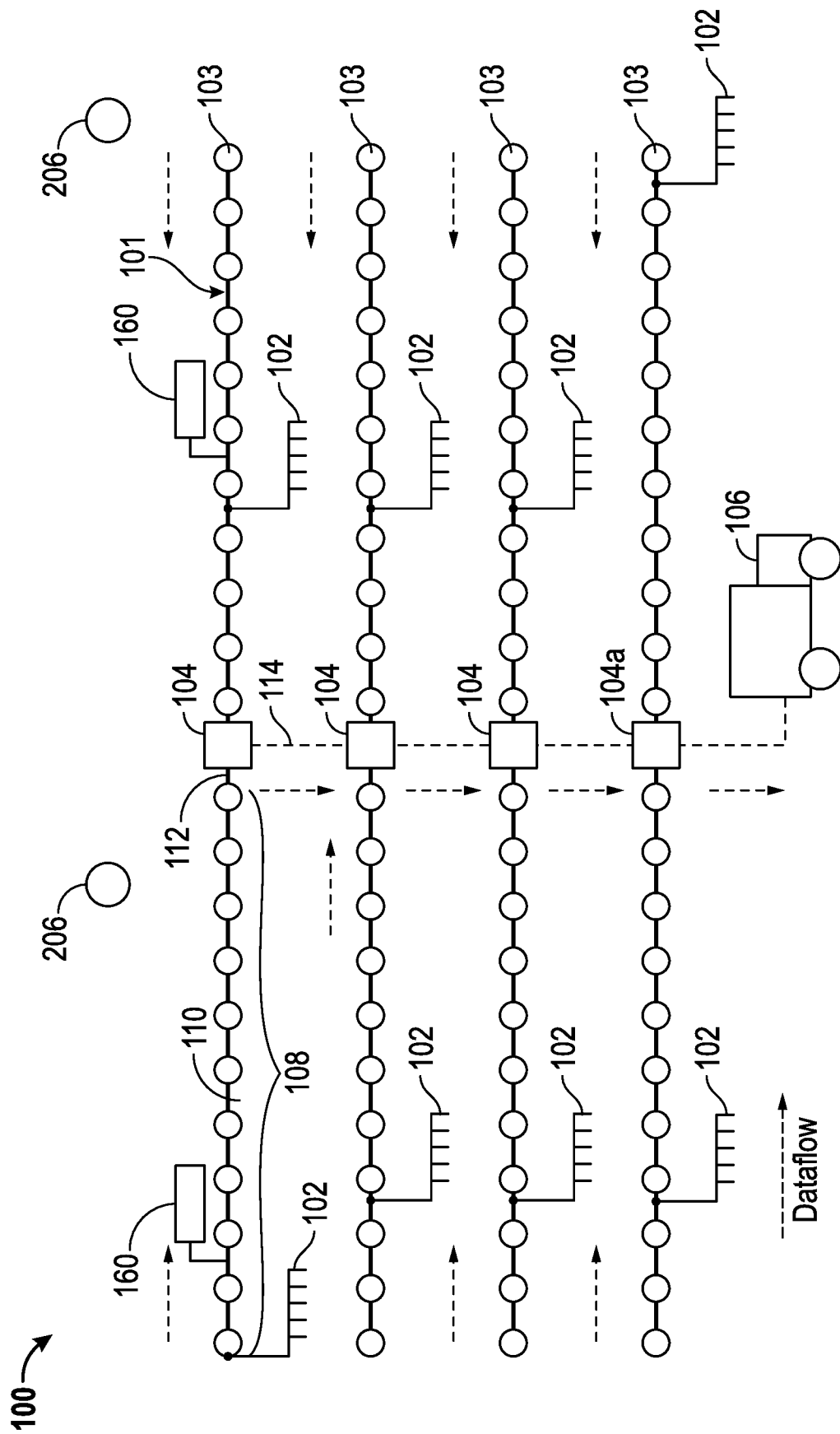


FIG. 1

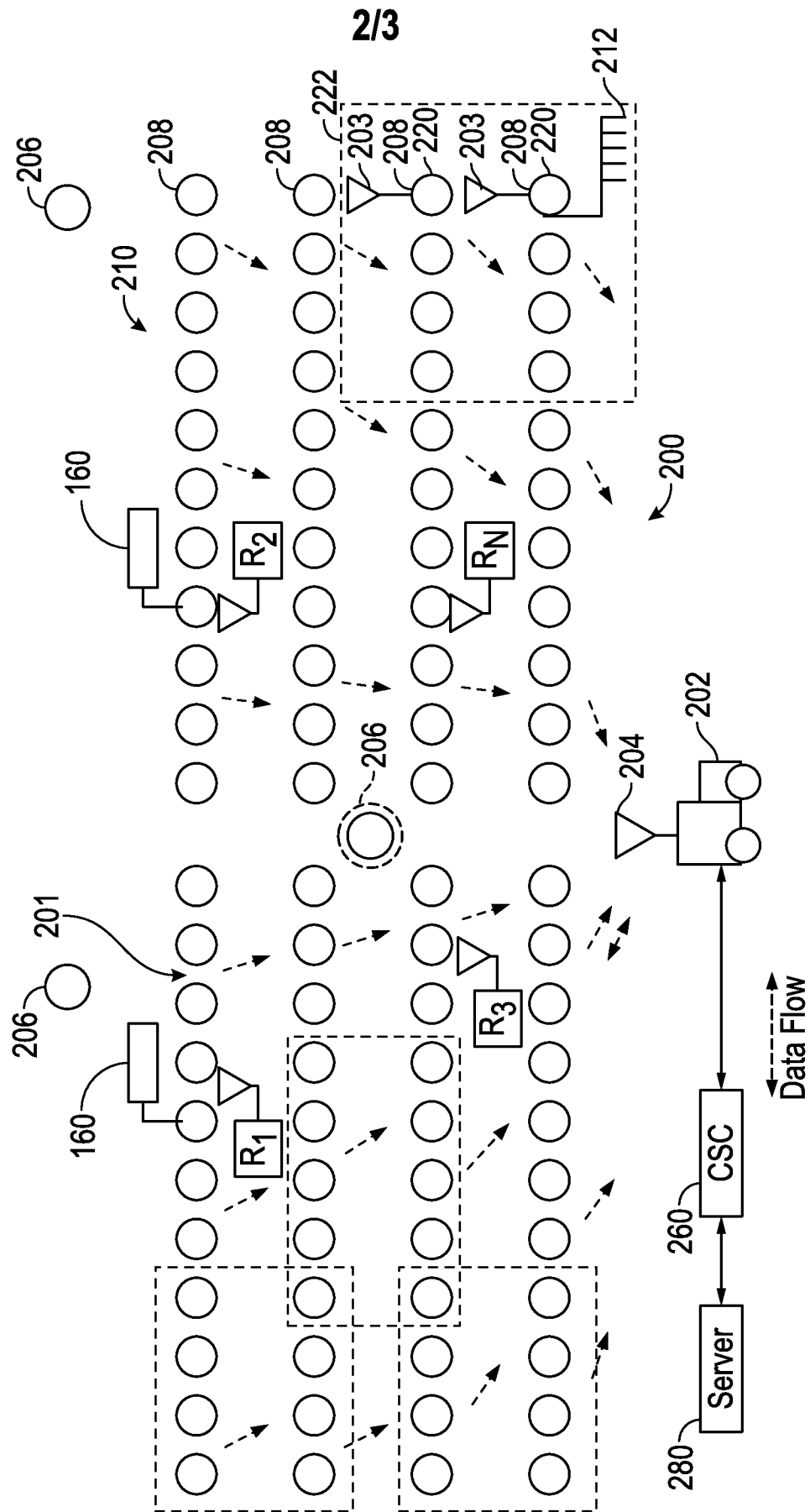


FIG. 2

3/3

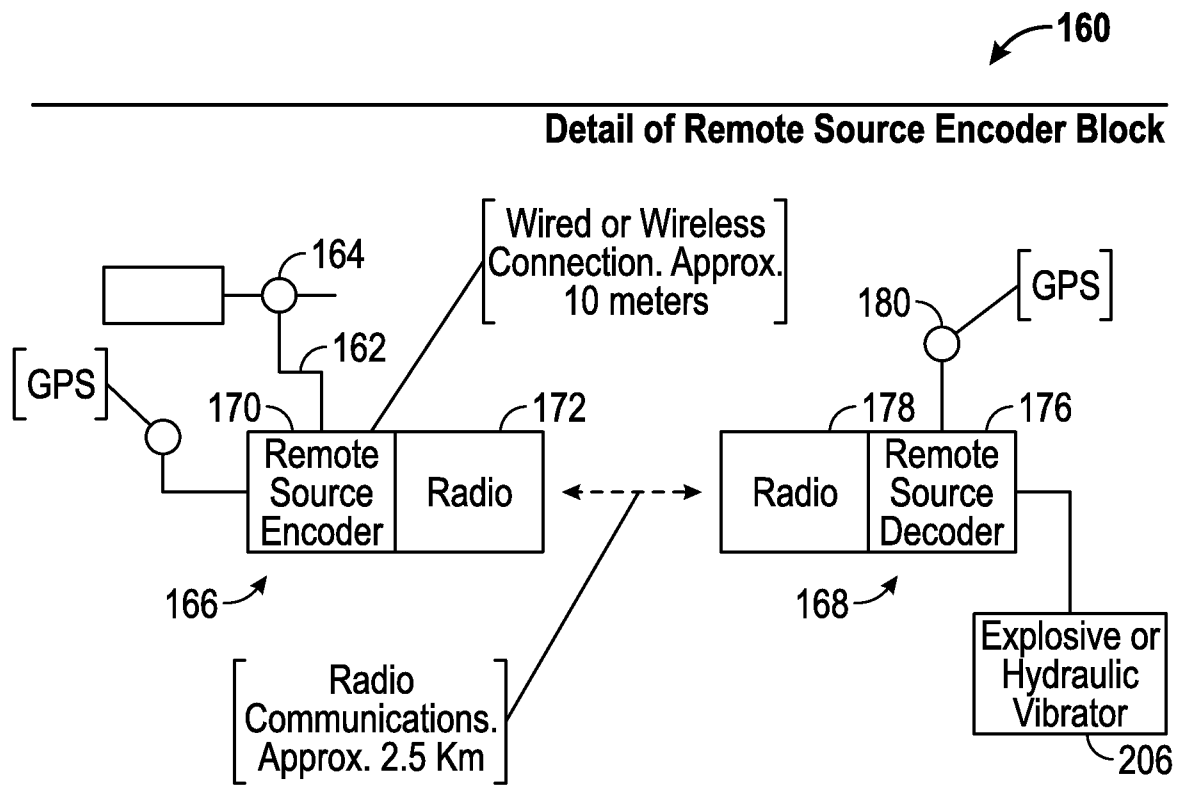


FIG. 3

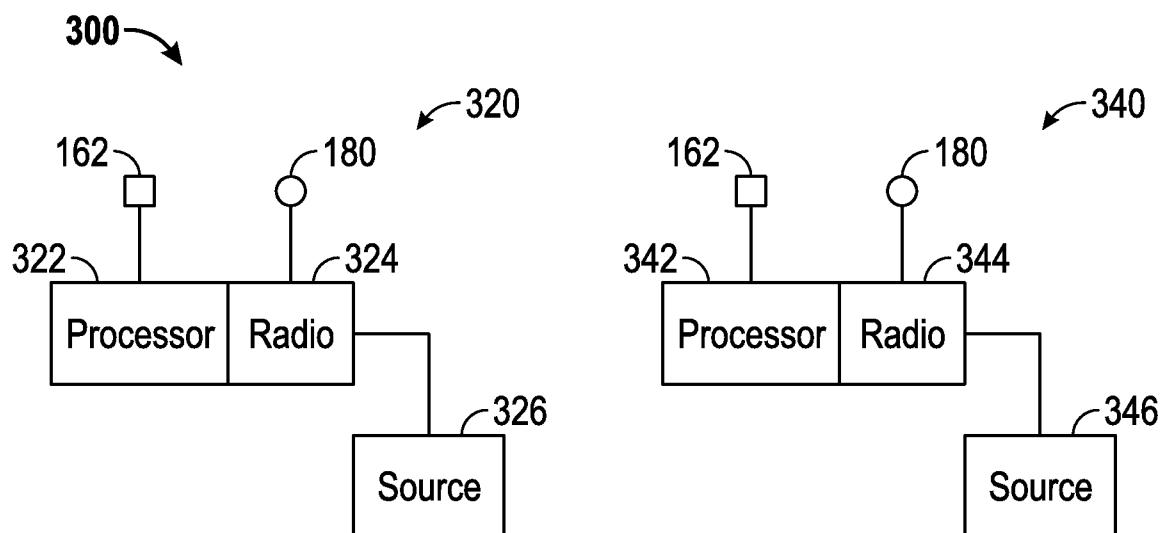


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 14/25877

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - G01V 1/22 (2014.01)

USPC - 367/76

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8)-G01V 1/22 (2014.01)Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
IPC(8)- G01V 1/00 (2014.01); USPC-367/14,21,60,77,78;702/14,16;250/301Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PatBase, Google Patents/Scholar-terms: acquire collect telemetry seismic information data source encoder central controller CRS source decoder control signal seismic spread grid array devices receivers line tap battery booster take out

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- A	US 2008/0021658 A1 (Pavel et al.) 24 Jan 2008 (24.01.2008), para [0048]-[0059]; figs. 1-6.	1-10,12-15 ----- 11
A	US 2008/0019215 A1 (Robertsson et al.) 24 Jan 2008 (24.01.2008), para [0036]-[0039], [0055]-[0057]; figs. 1-14.	1-15
A	US 2005/0276162 A1 (Brinkmann et al.) 15 Dec 2005 (15.12.2005), para [0035]-[0042]; fig. 1	1-15
A	US 2011/0251846 A1 (Liu et al.) 13 Oct 2011 (13.10.2011), entire document.	1-15
A	US 2004/0105533 A1 (Iseli) 03 June 2004 (03.06.2004), entire document.	1-15

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

* Special categories of cited documents:

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

"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

18 June 2014 (18.06.2014)

Date of mailing of the international search report

01 AUG 2014

Name and mailing address of the ISA/US

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

Facsimile No. 571-273-3201

Authorized officer:

Lee W. Young

PCT Helpdesk: 571-272-4300

PCT OSP: 571-272-7774