



- (51) **International Patent Classification:**
E21B 47/005 (2012.01) *E21B 47/09* (2012.01)
E21B 47/003 (2012.01)
- (21) **International Application Number:**
PCT/US2013/068108
- (22) **International Filing Date:**
1 November 2013 (01.11.2013)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
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- (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,

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(54) **Title:** HIGH PERFORMANCE WIRE MARKING FOR DOWNHOLE CABLES

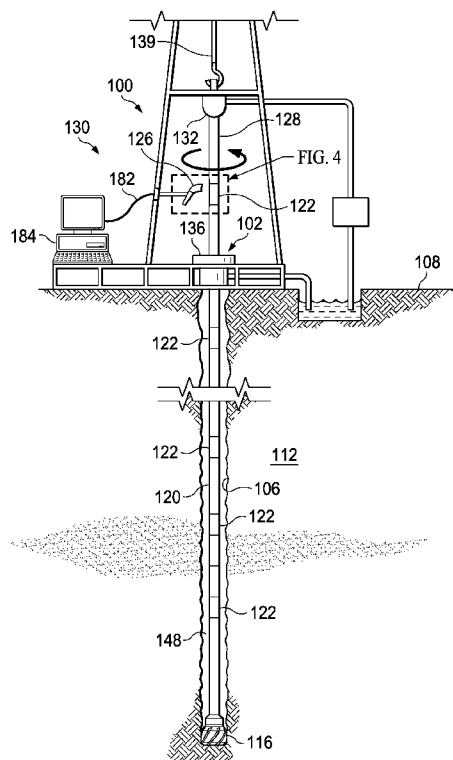


FIG. 1

(57) **Abstract:** Cables, systems, and methods are disclosed that provide for the monitoring of a cable being deployed to a borehole. Such systems may include a cable having one or more markings at regular intervals. Each marking includes marking data that may be alphanumeric characters, bar codes, ring codes, or a quick-response code. The system also includes a controller that is operable to receive, store, and transmit marking data, and a reader that is operable to read the markings and to transmit marking data to the controller. The marking data may be associated with cable data that is stored in a database to convey information about the cable, such as the origin, mechanical properties, and usage history of the cable.



MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, **Published:**
SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, — *with international search report (Art. 21(3))*
GW, KM, ML, MR, NE, SN, TD, TG).

HIGH PERFORMANCE WIRE MARKING FOR DOWNHOLE CABLES

1. Field of the Invention

[0001] The present disclosure relates generally to system and methods for marking
5 cables to be deployed within a borehole, and more particularly to systems and methods that
involve the use of a cable having markings indicative of marking data that can be read by a
reader and transmitted to a controller to convey information about the cable.

2. Description of Related Art

[0002] Wells are drilled at various depths to access and produce oil, gas, minerals, and
10 other naturally-occurring deposits from subterranean geological formations. The drilling of a
well is typically accomplished with a drill bit that is rotated within the well to advance the well
by removing topsoil, sand, clay, limestone, calcites, dolomites, or other materials. The drill bit
is typically attached to a drill string that may be rotated to drive the drill bit and within which
drilling fluid, referred to as “drilling mud” or “mud”, may be delivered downhole. The drilling
15 mud is used to cool and lubricate the drill bit and downhole equipment and, as such, is
circulated through the drill string and back to the surface in an annulus formed by the space
between the drill string and wall of the well bore.

[0003] In addition to a drill string, other conveyances may also be used to deploy tools
and equipment in a well. Such other conveyances may include wireline and slickline cables used
20 to lower tools into wells for well intervention, logging efforts, and pipe recovery. Generally,
slickline deployments involve the use of non-electric cables used to install or remove tools from
a well, while wireline deployments typically involve the use of electric cables that are operable
to transmit power and data to and from tools in a well.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] FIG. 1 is a schematic, front view of a well that includes a system for reading marking data from a drill string and transmitting the marking data to a controller;

[0005] FIG. 2 is a schematic, front view of a subsea well that includes the system for reading marking data from a drill string and transmitting the marking data to a controller;

[0006] FIG. 3 is a schematic, front view of wireline tool being deployed in a well that includes the system for reading marking data from a cable and transmitting the read marking data to a controller; and

[0007] FIG. 4 is a detail view showing a marking and a reader operable to read the marking and transmit marking data to a controller.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0008] In the following detailed description of the illustrative embodiments, reference is made to the accompanying drawings that form a part hereof. These embodiments are described in sufficient detail to enable those skilled in the art to practice the invention. It is understood that other embodiments may be utilized and that logical structural, mechanical, electrical, and chemical changes may be made without departing from the spirit or scope of the invention. To avoid detail not necessary to enable those skilled in the art to practice the embodiments described herein, the description may omit certain information known to those skilled in the art. The following detailed description is, therefore, not to be taken in a limiting sense, and the scope of the illustrative embodiments is defined only by the appended claims.

[0009] In the case of wireline and slickline cable deployments as described above, a well operator may employ a system for monitoring a cable being deployed into a borehole. Such a system may include a cable, which may be a braided steel cable or any similar cable type, and which may include cabling to transmit and receive electricity and data to and from downhole tools. In an embodiment, the system includes one or more markings at regular intervals, and such markings may include marking data that is associated with cable data. In an embodiment, the system also includes a controller to receive, store, and transmit marking data, and a reader that is operable to read the markings on the cables and to transmit marking data to the controller. While the markings and marking data are typically described herein with regard to slickline and wireline systems, the concepts may also be employed in a drilling system that includes a drill bit deployed from a drill string to indicate similar types of information about a drill string or segments of drill pipe that make up the drill string.

[0010] Referring now to the figures, FIG. 1 shows a drilling system, which may be referred to as a wellbore cable deployment system 100 that includes a marking data subsystem 130 for reading a marking 122 that is applied to a segment of drill pipe included in a drill string 120. The marking data subsystem 130 includes a reader 126 that is communicatively coupled to a controller 184 by a coupling 182. While the coupling 182 is shown as a wired coupling, it is noted that the coupling 182 may be any suitable communicative coupling. For example, the coupling 182 may be a wireless coupling formed by a wireless transceiver that is connected to the reader in communication with a second wireless transceiver that is connected to the controller 184 via any suitable wireless communications protocol. In addition, while the reader 126 is shown as being mounted to a linkage of a rig, the reader 126 may instead be a hand-operated reader or a reader that is mounted at any other point in the drilling system along the path of the drill string 120.

[0011] The marking data subsystem 130 is used in a well 102 having a borehole 106 that extends from a surface 108 of the well 102 to or through a subterranean formation 112. The well 102 is illustrated onshore in FIG. 1 with the markings 122 being applied to multiple segments of the drill string 120. In an embodiment, a marking 122 is applied to each segment of drill pipe in the drill string 120. In another embodiment, the marking data subsystem 130 may be deployed in a sub-sea well 119 accessed by a fixed or floating platform 121, as shown in FIG. 2. FIGS. 1 and 2 each illustrate possible implementations of the marking data subsystem 130, and while the following description of the marking data subsystem 130 and associated controls focusses primarily on the use of the marking data subsystem 130 with the onshore well 102 of FIG. 1, the marking data subsystem 130 may be used instead in the well configuration illustrated in FIG. 2, as well as in other well configurations where it is desirable to read and transmit marking data. Similar components in FIGS. 1 and 2 are identified with similar reference numerals.

[0012] In FIG. 1, the well 102 is formed by a drilling process in which a drill bit 116 is turned by the drill string 120 to remove material from the formation and form the borehole 106. The drill string 120 extends from the drill bit 116 at the bottom of the borehole 106 to the surface 108 of the well 102, where it is joined with a kelly 128. The drill string 120 may be made up of one or more connected tubes or pipes of varying or similar cross-section. A marking 122 may be applied to one or more of such connected tubes or pipes or to each segment of drill pipe. As referenced herein, the drill string 120 may refer to the collection of pipes or tubes as a single component, or alternatively to the individual pipes or tubes that comprise the string. The term drill string is not meant to be limiting in nature and may refer to any

component or components that are capable of transferring rotational energy from the surface of the well to the drill bit 116. The drill string 120 may include a central passage disposed longitudinally in the drill string 120 and capable of allowing fluid communication between the surface 108 of the well and downhole locations.

5 **[0013]** At or near the surface 108 of the well 102, the drill string 120 is coupled to the kelly 128. The kelly 128 may have a square, hexagonal or octagonal cross-section. The kelly 128 is connected at one end to the remainder of the drill string 120 and at an opposite end to a rotary swivel 132. The kelly passes through a rotary table 136 that is capable of rotating the kelly 128 and thus the remainder of the drill string 120 and drill bit 116. The rotary swivel 132
10 allows the kelly 128 to rotate without rotational motion being imparted to the rotary cable 139. A hook 138, the cable 139, a traveling block (not shown), and a hoist (not shown) are provided to lift or lower the drill bit 116, drill string 120, kelly 128 and rotary swivel 132. The drill string 120 may be raised or lowered as needed to add additional sections of tubing to the drill string 120 as the drill bit 116 advances, or to remove sections of tubing 126 from the drill string 120 if
15 removal of the drill string 120 and drill bit 116 from the well 102 are not desired. While the rotary table 136 and kelly 128 are described herein as providing the rotational force to turn the drill string 120, other systems may be used in their place. For example, a top drive assembly having a motor that turns the drill string 120 may be used to form the borehole 106.

[0014] A similar system is shown in FIG. 3, which illustrates a wireline assembly 200
20 that includes components that are analogous in some respects to the components referred to above with regard to FIGS. 1 and 2. Such analogous components may be referred to by the same reference numeral indexed by 100. More specifically, FIG. 3 shows a wireline tool 215 being deployed in a borehole 204 from a wireline cable 220 to gather measurements relating to the properties of a formation 212. At the surface 208, the cable 220 is deployed from a spool and
25 winch assembly 217, which allows the wireline tool 215 to be raised and lowered in the borehole 204 by a hydraulic or manual control system. Like the drill string 120 described with regard to FIGS. 1 and 2, the cable 220 includes one or more markings 222 at or near the surface of the cable 220.

[0015] While the cable 220 discussed with regard to FIG. 3 is a wireline cable, the
30 cable may instead be a slickline cable or any other similar cable deployed within a borehole 204. The cables may be composite cables, composite rods, or coated cables, such as open hole, cased hole, or slickline coated cables.

[0016] In an embodiment, the markings 222 are applied to the cable 220 at regular intervals or spacings. Such intervals may be preselected distances, which may be regular

distances, for example, 1m, 10m, 30m, or any shorter or longer suitable distance. In an embodiment, the intervals may be spaced according to an algorithm or frequency of marking on a spool. For example, the marking 222 may be applied at regular time intervals as the cable 220 is wound about the spool so that each interval corresponds to a rotation of the spool. Where the cable 220 is a coated cable, such as a polymer-coated cable, the marking 222 may be applied outside of the outermost coating layer of the cable 220. In another embodiment in which the outermost coating layer of the cable 220 is transparent, the marking 222 may be applied to the outermost nontransparent layer, which is subsequently covered and protected by the transparent layer in a way that does not affect readability.

[0017] The marking 222 may be applied to the cable 220 using any suitable method, such as ring marking, hot foil marking or cladding. Generally, ring marking involves spraying the marking 222 onto the cable as is passed through a pair of rotating wheels as the cable is extruded or coated. Hot foil marking, conversely, involves the use of a heated metal die that presses a pigmented hot foil tape against the layer of cable to be marked. Both ring marking and hot foil marking are suitable for high-speed marking of the cable, allowing for the markings 222 to be very close together if desired.

[0018] In an embodiment, the marking 222 may be a continuous marking that extends lengthwise along the cable 220, from end-to-end, allowing a user of the cable 220 to identify and read the marking from an end-on view or a side view of the cable 220. The marking 222 can be encoded with information based on the number of marks, the widths of the individual marks, and/or the spacing between each mark, similar to a barcode marking. Such a marking 222 may be viewed as a continuous barcode that is integrated into a material or layer of the cable 222. To fabricate such a cable, the materials that form the marking may be integrated into the cable material and coextruded as the cable or cable casing is formed by pulling a marking 222 into the cable 222 or its casing.

[0019] Each marking 222 may include marking data. As referenced herein, marking data means data encoded in or associated with a marking 222. Such data may be visual data that is printed on or embedded in the surface of the cable, including visual data that is encoded as a barcode, ring barcode, quick-response code, alphanumeric sequence, such as a serial number or other unique identifier, or any other suitable visually readable code. As referenced herein, a quick-response code, also referred to as a QR code, is a machine-readable code consisting of an array of black and white squares, that may be associated with stored data. Each marking 222 may be different dependent on the location of the marking 222 relative to an end of the cable 220 or a previous or subsequent marking 222.

[0020] The marking data may include a distance from the marking 222 to one or both ends of the cable 220, to a previous marking 222, to a subsequent marking 222, and any combination thereof. In an embodiment, additional data, which may be referred to as cable data, is associated with the marking data in a memory or a database. Such cable data may include specific information about the cable, such as its origin (cable type and manufacturer), age (date of manufacture), mechanical properties (including composition, modulus of deformation, and tensile strength), usage history, total length, the location of a marking relative to other markings, and other data of interest to a well operator. It is noted that any of the cable data may also be included as marking data by including the data in the marking instead of storing the data in a memory or database and correlating it with the marking data.

[0021] Like the wellbore cable deployment system 100 described with regard to FIGS. 1 and 2, the wireline assembly 200 includes a marking data subsystem 230. In turn, the marking data subsystem 230 includes a reader 226 that is communicatively coupled to a controller 284 by a coupling 282. While the coupling 282 is shown as a wired coupling, it is noted that the coupling 282 may be any suitable communicative coupling. For example, the coupling 282 may be a wireless coupling formed by a wireless transceiver connected to the reader 226 in communication with a second wireless transceiver that is connected to the controller 284.

[0022] The reader 226, which may be an automated reader, may be any suitable read device that is operable to read a marking or to otherwise receive visual input. In an embodiment, the reader 226 is an optical reader capable of capturing the visual information included in the marking 222 and transforming the visual information to digital information. For example, the reader 226 may be a pen-type stylus having a light source and a photodiode, which is operable to read visual signals detected by the reader 226. In another embodiment, the reader 226 may be a laser scanner that is similar in functionality to the aforementioned stylus, wherein the reader 226 reads marking data by shining a laser on the marking data and receiving the marking data with a sensor. For example, as shown in FIG. 4, a reader 326 includes a laser scanner that distributes a laser 330 over an area of a cable 320 that includes a marking 322. The marking 322 is a barcode or QR code that is read by the reader 326 from a reflection of the laser 330 by the marking 322, and transmitted to an operator.

[0023] Referring again to FIG. 3, in another embodiment, the reader 226 may be a CCD or CMOS sensor that is coupled to a computing system to receive and transmit marking data illuminated by ambient light or an artificial light source. In another embodiment, the reader 226 may be camera system that obtains an electronic image of the marking 222 and applies an optical character recognition algorithm to determine the content of the marking 222.

[0024] More generally, the reader 226 may include a processor, a sensor, a power source, a memory, and a transceiver. The memory may include instructions for the processor to cause the reader 226 to read the marking 222 and digitize the marking data through any suitable process, such as, for example, optical character recognition. In operation, as a marking 222 passes the reader 226, the reader 226 reads marking data from the marking 222, digitizes the marking data, and transmits the marking data to the controller 284.

[0025] The controller 284 may be a computer, computing system, personal computing device, or any other suitable controller, and may include a memory, a processor, a power source, and a transceiver. In an embodiment, the memory of the controller 284 may include a database that includes cable data that is associated with the marking data. For example, the database may include cable data consisting of a cable's type, age, place of origin, usage history, and mechanical properties, and such cable data may be associated with a serial number or other marking data included in the marking 222 in the database. In addition, the controller 284 and reader 226 may be configured to observe the time or distance between each marking 222 as the cable 220 is deployed in the borehole, and to compare the observed time or distance to an expected time or distance to compute the cable strain or load on the cable 220 based on known mechanical properties of the cable 220. Alternatively, where the cable strain and mechanical properties of the cable 220 are known, the observed time or distance may be used to compute the rate of deployment of the cable 220.

[0026] In addition, the marking data may be used by the controller 284 to provide precise depth information that indicates the length of cable 220 that has been deployed past the reader 222 and therefore the depth of the wireline tool 215. In addition, the marking data or cable data may be used to provide a precise remaining cable length after the cable 220 has been cut. Where the depth of the end of the cable 220 is known, marking data or cable data may be used to calculate cable tension and cable deformation. After the cable 220 has been used and retrieved from the borehole 204, the markings 222 may be read by a remote reader when there is no load on the cable 220 to determine permanent deformation of the cable 220, which may be stored or monitored as an indicator of cable wear. In such an embodiment, an operator may compare the measured cable wear to a predetermined amount of acceptable cable wear determined as a function of the permanent deformation of the cable 220, and if the measured cable wear exceeds the predetermined amount, then the operator may determine that the cable 220 should not be used.

[0027] The illustrative systems, methods, and devices described herein may also be described by the following examples:

Example 1. A wellbore cable deployment system for monitoring a cable being deployed to a borehole, the system comprising:

- a downhole cable having a continuous marking or a plurality of markings at regular intervals, such markings including marking data;
- 5 a controller operable to receive, store, and transmit marking data; and
- a reader operable to read the markings as the downhole cable is deployed and to transmit marking data to the controller.

Example 2. The system of example 1, wherein the cable comprises a polymer coating having an inner layer and an outer transparent layer, and wherein the inner layer of the polymer
10 coating comprises the marking.

Example 3. The system of example 1, wherein the marking comprises a member of the group consisting of: alphanumeric characters, bar codes, ring codes, and quick-response code.

Example 4. The system of example 1, wherein the marking comprises ring marking
15 or hot foil marking.

Example 5. The system of example 1, wherein the reader comprises a stylus having a light source and a photodiode and the markings comprise optical marks.

Example 6. The system of example 1, wherein the reader comprises a laser and a photodiode, and wherein the markings comprise optical marks.

20 Example 7. The system of example 1, wherein the reader comprises a charge-coupled device operable to read the markings using ambient light.

Example 8. The system of example 1, wherein the reader comprises a camera system having a processor, a sensor, and a memory, and wherein the memory comprises instructions for reading the markings using optical character recognition.

25 Example 9. The system of example 1, wherein the marking data comprises data selected from the group consisting of: the distance between markings, the marking count, a unique identification number, data indicating the material composition of the cable.

Example 10. The system of example 1, where the controller comprises a database storing cable data, and wherein the marking data is associated with cable data.

30 Example 11. The system of example 10, wherein the cable data comprises the usage history of the cable.

Example 12. A cable for deployment in a borehole, the cable comprising: a continuous marking, such marking including marking data that is associated with cable data.

Example 13. A cable for deployment in a borehole, the cable comprising: a plurality of

markings at regular intervals, such markings including marking data that is associated with cable data.

Example 14. The cable of examples 12 and 13, wherein each marking is a machine-readable marking that can be read by an automated reader.

5 Example 15. The cable of example 12, wherein the cable comprises a polymer coating, and wherein the polymer coating comprises each marking.

Example 16. The cable of example 13, wherein the markings comprise a member of the group consisting of: alphanumeric characters, bar codes, ring codes, and quick-response code.

10 Example 17. The cable of example 13, wherein the markings comprise ring marking or hot foil marking.

Example 18. The cable of example 13, wherein the cable data comprises data selected from the group consisting of: the distance between markings, the marking count, a unique identification number, data indicating the material composition of the cable.

15 Example 19. A method for gathering information about a cable deployed in a borehole, the method comprising:

reading at least one marking from a cable, such marking including marking data that is associated with cable data;

20 transmitting the marking data to a control system, the control system having a memory, a processor, and a transceiver;
receiving the marking data at the control system.

Example 20. The method of example 19, wherein reading at least one marking comprises using a pen-type stylus having a light source and a photodiode to detect the markings, the markings comprising optical marks.

25 Example 21. The method of example 19, wherein reading at least one marking comprises using a laser scanner having a laser light source and a photodiode to detect the markings, the markings comprising optical marks.

Example 22. The method of example 19, wherein reading at least one marking comprises using a charge-coupled device to read the markings in ambient light.

30 Example 23. The method of example 19, wherein reading at least one marking comprises using a camera system having a processor, a sensor, and a memory, wherein the memory comprises instructions for reading the markings using optical character recognition.

Example 24. The method of example 19, further comprising tracking a length of cable that has entered the well based on marking data from the read markings.

Example 25. The method of example 19, further comprising tracking a length of cable that has entered the well based on the number of read markings.

Example 26. The method of example 19, further comprising determining a cable tension based on marking data from the read markings.

5 Example 27. The method of example 19, further comprising determining cable deformation based on marking data from the read markings.

Example 28. The method of example 19, further comprising determining permanent cable deformation based on marking data from the read marking, comparing the permanent cable deformation to an acceptable amount of permanent cable deformation, and determining
10 whether the cable is suitable for continued use based on whether the data and permanent cable deformation exceeds the acceptable amount of permanent cable deformation.

[0028] It should be apparent from the foregoing that an invention having significant advantages has been provided. While the invention is shown in only a few of its forms, it is not limited to only these embodiments but is susceptible to various changes and modifications
15 without departing from the spirit thereof.

CLAIMS

We claim:

- Claim 1. A wellbore cable deployment system for monitoring a downhole cable being deployed to a borehole, the system comprising:
- 5 a downhole cable having at least one marking, such marking including marking data; a controller operable to receive, store, and transmit marking data; and a reader operable to read the markings from the downhole cable as the downhole cable is deployed in a wellbore, and to transmit marking data to the controller.
- 10 Claim 2. The system of claim 1, wherein the downhole cable comprises a polymer coating having an inner layer and an outer transparent layer, and wherein the inner layer of the polymer coating comprises the marking.
- Claim 3. The system of claim 1, wherein the marking comprises a member of the group consisting of: alphanumeric characters, bar codes, ring codes, and quick-response
- 15 code.
- Claim 4. The system of claim 1, wherein the reader comprises a stylus having a light source and a photodiode and the marking comprises an optical mark.
- Claim 5. The system of claim 1, wherein the reader comprises a laser and a photodiode, and wherein the marking comprises an optical mark.
- 20 Claim 6. The system of claim 1, wherein the reader comprises a charge-coupled device operable to read the marking using ambient light.
- Claim 7. The system of claim 1, wherein the reader comprises a camera system having a processor, a sensor, and a memory, and wherein the memory comprises instructions for reading the markings using optical character recognition.
- 25 Claim 8. The system of claim 1, wherein the marking data comprises data selected from the group consisting of: the distance between markings, the marking count, a unique identification number, data indicating the material composition of the cable.

Claim 9. The system of claim 1, where the controller comprises a database storing cable data, and wherein the marking data is associated with cable data.

Claim 10. The system of claim 1, wherein the cable data comprises the usage history of the downhole cable.

5 Claim 11. A downhole cable for deployment in a borehole, the downhole cable comprising: at least one marking, such marking including marking data that is associated with cable data.

10 Claim 12. The cable of claim 11, wherein the at least one marking comprises a machine-readable marking that can be read by an automated reader, and wherein the at least one marking is selected from the group consisting of a continuous marking arranged along a portion of the cable, and a plurality of markings spaced at regular intervals along the downhole cable.

15 Claim 13. The cable of claim 11, wherein the marking comprises a member of the group consisting of: alphanumeric characters, bar codes, ring codes, and quick-response code.

20 Claim 14. The cable of claim 11, wherein the cable data comprises data selected from the group consisting of: the distance between markings, the marking count, a unique identification number, data indicating the material composition of the downhole cable, and wherein the cable is selected from the group consisting of a wireline cable and a slickline cable.

25 Claim 15. A method for gathering information about a cable deployed in a borehole, the method comprising:
reading a marking from a downhole cable as the downhole cable is deployed to a wellbore, such marking including marking data that is associated with cable data;
transmitting the marking data to a control system, the control system having a memory, a processor, and a transceiver; and
receiving the marking data at the control system.

30 Claim 16. The method of claim 15, further comprising tracking a length of downhole cable that has entered the well based on marking data from the read markings.

Claim 17. The method of claim 15, further comprising tracking a length of downhole cable that has entered the well based on the number of markings read.

Claim 18. The method of claim 15, further comprising determining a cable tension based on marking data from the read markings.

5 Claim 19. The method of claim 15, further comprising determining cable deformation based on marking data from the read markings.

10 Claim 20. The method of claim 15, further comprising determining permanent cable deformation based on marking data from the marking, comparing the permanent cable deformation to an acceptable amount of permanent cable deformation, and determining whether the downhole cable is suitable for continued use based on whether the data and permanent cable deformation exceeds the acceptable amount of permanent cable deformation.

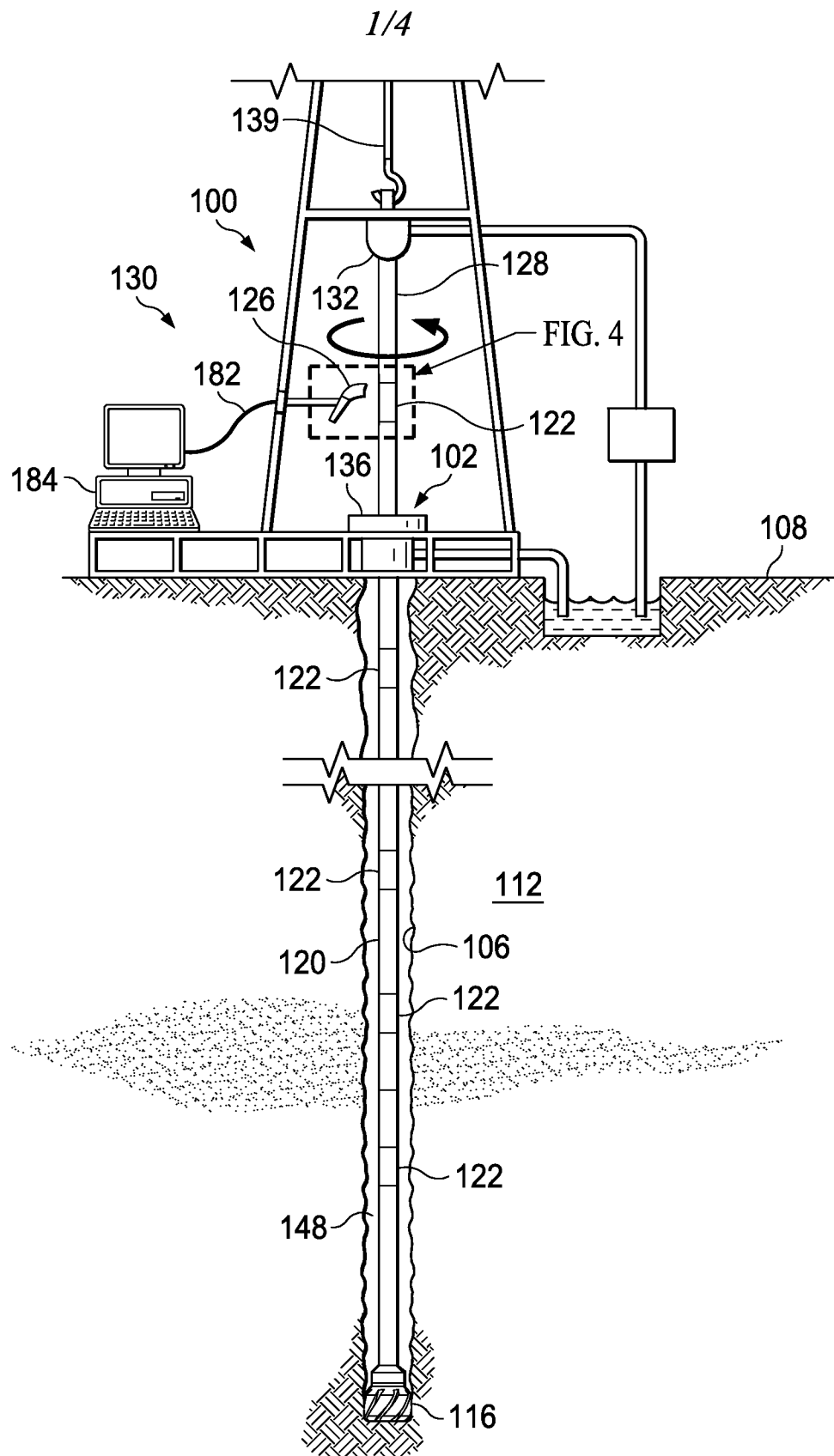
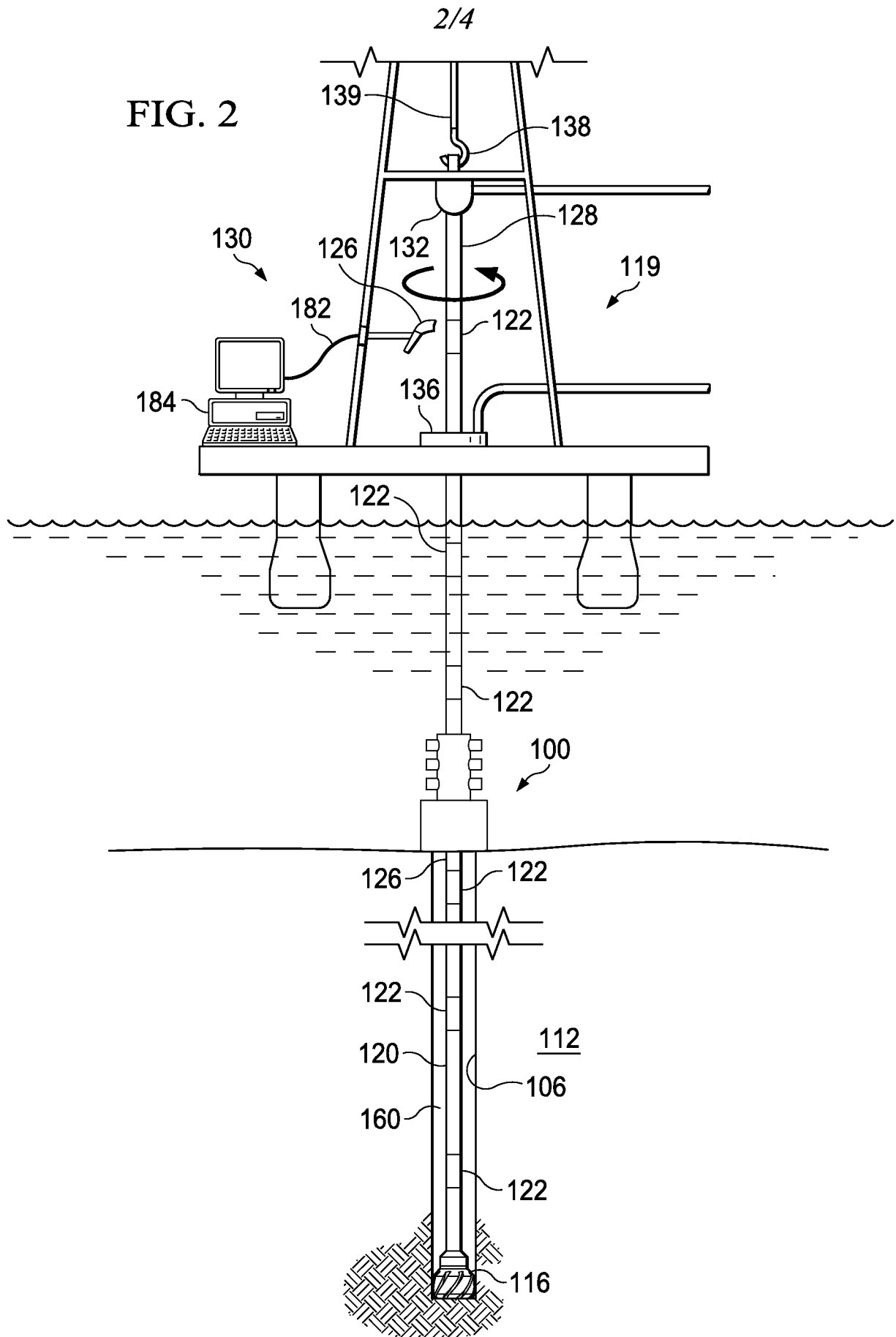


FIG. 1

FIG. 2



3/4

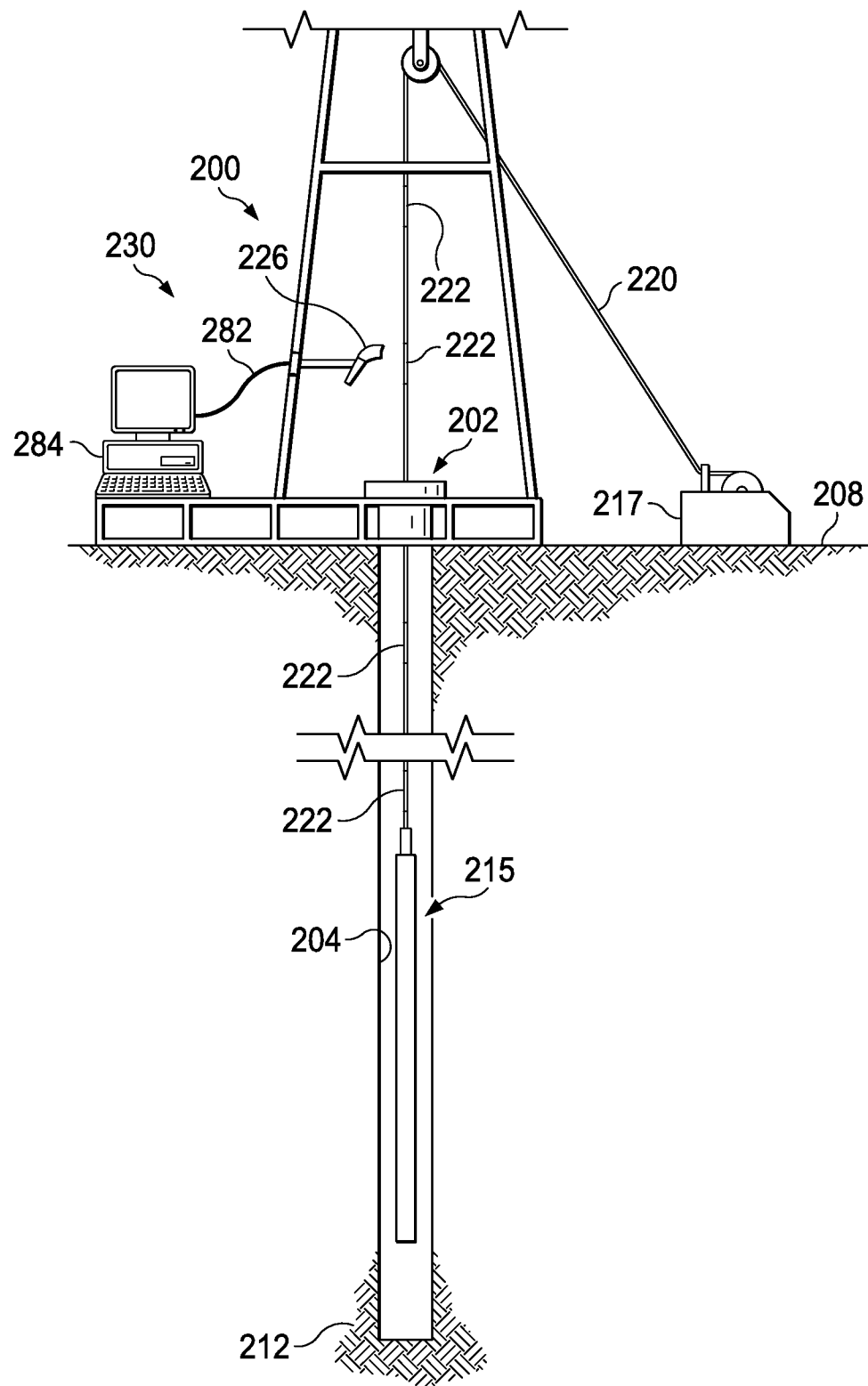


FIG. 3

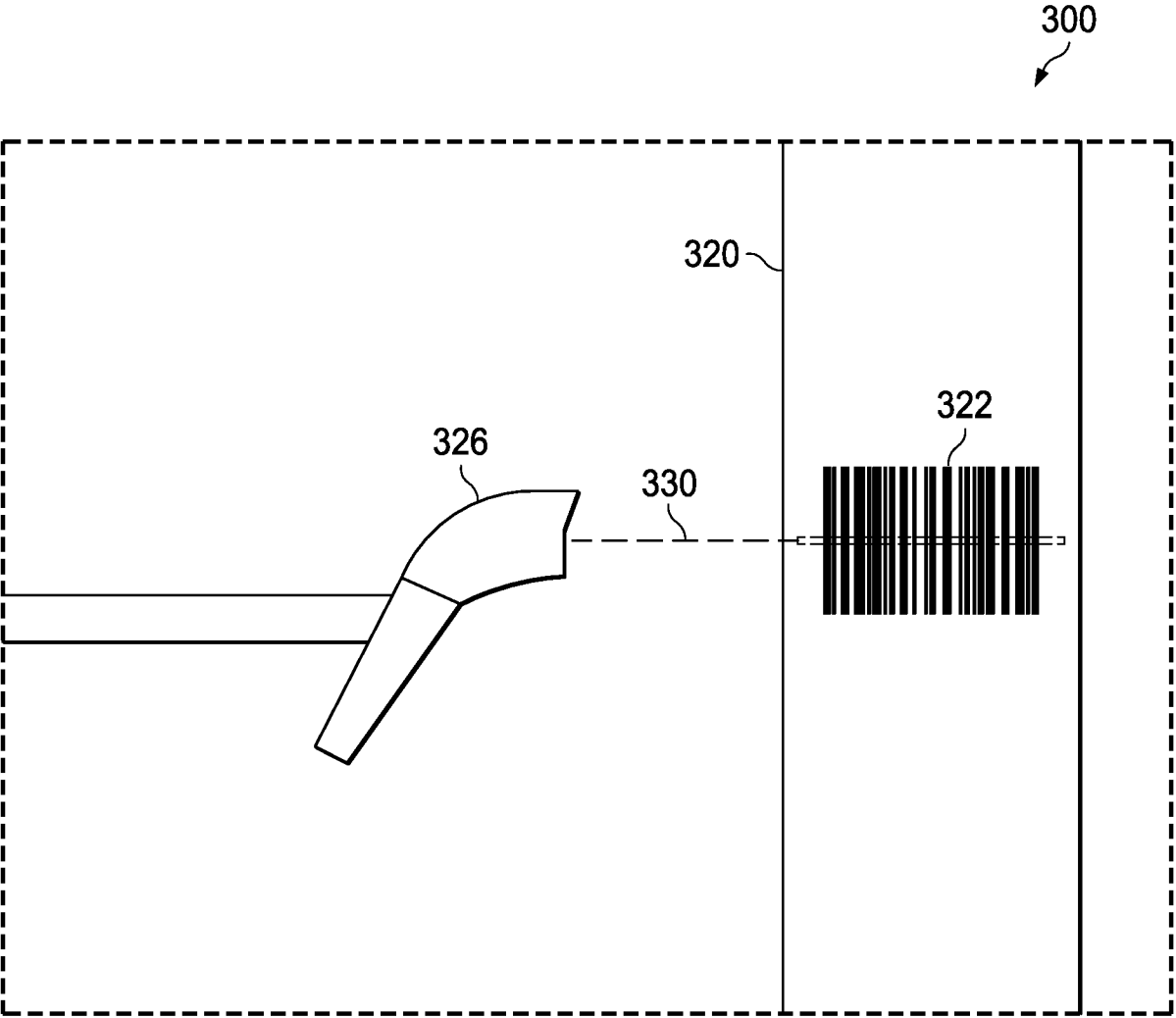


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/068108**A. CLASSIFICATION OF SUBJECT MATTER****E21B 47/005(2012.01)i, E21B 47/003(2012.01)i, E21B 47/09(2006.01)i**

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

B. FIELDS SEARCHEDMinimum documentation searched (classification system followed by classification symbols)
E21B 47/005; E21B 25/16; H04B 13/02; E21B 47/09; F21B 45/00; G01V 1/40; E21B 47/003Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility modelsElectronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & keywords: cable, marking, reader, controller, and marking data**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007-0131418 A1 (BARROW et al.) 14 June 2007 See abstract, paragraphs [0020],[0028]-[0032], and figures 1-2.	1-6,8-17
Y		7,18-20
Y	US 5107705 A (WRAIGHT et al.) 28 April 1992 See abstract, column 7, line 35 - column 9, line 2, and figures 1-4.	7
Y	US 2009-0288835 A1 (SBORDONE, ANDREA) 26 November 2009 See abstract, paragraphs [0028]-[0031],[0034], claims 16-23, and figures 1-3.	18-20
A	US 7107154 B2 (WARD, SIMON J.) 12 September 2006 See abstract, column 12, lines 8-32, and figure 6.	1-20
A	US 2011-0291854 A1 (MORLEY et al.) 01 December 2011 See abstract, paragraphs [0012]-[0013], and figure 1.	1-20

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

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Information on patent family members

International application No.

PCT/US2013/068108

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2007-0131418 A1	14/06/2007	CA 2633597 A1 EA 012202 B1 EA 200870040 A1 GB 0810741 D0 GB 2446551 A GB 2446551 B US 2008-0217007 A1 US 2009-0248307 A1 US 7458421 B2 WO 2007-068877 A1 WO 2007-068877 A8	21/06/2007 28/08/2009 27/02/2009 16/07/2008 13/08/2008 27/07/2011 11/09/2008 01/10/2009 02/12/2008 21/06/2007 24/07/2008
US 5107705 A	28/04/1992	EP 0449710 A2 EP 0449710 A3	02/10/1991 02/01/1992
US 2009-0288835 A1	26/11/2009	GB 201019407 D0 GB 2472937 A GB 2472937 B US 8439109 B2 WO 2009-141160 A2 WO 2009-141160 A3	29/12/2010 23/02/2011 07/09/2011 14/05/2013 26/11/2009 01/04/2010
US 7107154 B2	12/09/2006	AT 413513 T AU 2007-202004 A1 CA 2508182 A1 CA 2508182 C CA 2587982 A1 DE 602005010783 D1 EP 1600601 A2 EP 1600601 A3 EP 1600601 B1 EP 1854958 A1 RU 2005115919 A SG 117599 A1 US 2005-0267686 A1 US 2006-0271299 A1 US 7346455 B2	15/11/2008 29/11/2007 25/11/2005 08/02/2011 09/11/2007 18/12/2008 30/11/2005 01/03/2006 05/11/2008 14/11/2007 20/11/2006 29/12/2005 01/12/2005 30/11/2006 18/03/2008
US 2011-0291854 A1	01/12/2011	AU 2011-202298 A1 BR PI1102530 A2 CN 102289638 A EP 2392769 A2 GB 201008616 D0 GB 2480611 A SG 176383 A1 SG 176417 A1	15/12/2011 25/12/2012 21/12/2011 07/12/2011 07/07/2010 30/11/2011 29/12/2011 29/12/2011