removed. Using an infra red link or other wireless link, the data gathering device is put into orientation indicating mode by the remote communication device 360. The core sample and data gathering device are then rotated either clockwise or anti clockwise to establish a required orientation position. The remote communication device is then used to communicate with the data gathering device to obtain core sample orientation data from the data gathering device. No LCD or other display is needed on the data gathering device that might otherwise risk leakage in use and ingress of liquid or failure of the display due to display power demands on the limited battery life or display failure due to the harsh environment downhole. The required orientation of the core sample is then marked and the core sample can be stored and used for future analysis. The received data can be transferred to a computer for analysis.

[00197] According to an alternative embodiment of the present invention shown in figures 10a and 10b, a data gathering device 380 houses the light emitters 374,376. Light from these emitters (e.g. LEDs) passes through the window 372 (shown in figure 9). Reference arrow A refers to the drill bit end direction, and reference arrow B refers to the backend assembly direction. An optical adapter 382 is provided at the end 342 of the device and which adapter extends into the greaser unit 346 when connected thereto. The optical adapter has a reflective material. The greaser unit 346 has apertures 384 that allow light therethrough. Light from the emitters is directed onto at least one reflector 386 of the adapter. The emitted and reflected light can be observed through the apertures 384 in the greaser. It will be appreciated that the adapter need not extend into a greaser. A tube section or other component having at least one aperture to observe the light through is sufficient. The red-green indications (or whatever selected colour combination of light is used) can be observed through the aperture(s) when rotating the device to obtain core sample orientation. Thus, advantageously, when the data gathering device and core sample are recovered from down the hole, the data gathering device need not be separated from the greaser in order to determine a required orientation of the core sample. Wireless communication to a remote device, such as a hand held device, to transfer data between the data

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gathering device and the remote device, can also be effected by transmitting through the at least one aperture.

[00198] Embodiments of the present invention provide the advantage of a fully operating downhole tool/device without having to disconnect or disassemble any part of the tool/device from the inner tube and/or from the backend assembly or any other part of the drilling assembly that the tool/device would need to be assembled within for its normal operation. Disconnecting or disassembling the tool/device from the backend and/or inner tube risks failure of seals at those connections and/or risks cross threading of the joining thread. Also, because those sections are threaded together with high force, it takes substantial manual force and large equipment to separate the sections. High surrounding pressure in the drill hole means that the connecting seals between sections must function perfectly otherwise water and dirt may ingress into and damage the device. Having a tool/device that does not need to be separated from the inner tube and/or backend sections in order to determine core sample orientation and/or to gather data recorded by the device/tool means that there is less risk of equipment failure and drilling downtime, as well as reduced equipment handling time through not having to separate the sections in order to otherwise obtain core sample orientation. Known systems require end on interrogation of the device/tool. By providing a sealed device/tool and the facility to determine orientation of the core sample, by observing the orientation indications through one or more apertures in the side of the greaser or other section, reliability and efficiency of core sample collection and orientating is improved. Consequently operational personnel risk injury, as well as additional downtime of the drilling operation. Without having to separate the tool/device from the inner tube and/or backend, the orientation of the core sample can be determined and the gathered information retrieved with less drilling delay and risk of equipment damage/failure.

[00199] One or more forms of the present invention relate to asynchronous time operation for core sampling. The data recording events taken by the downhole data gathering device are not synchronized in time with the

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communication device. That is, the communication device and the data gathering device do not commence timing from a reference time, and the data gathering device does not take samples (shots) a specific predetermined time intervals. For example the data gathering device does not take a three second sample every one minute with that one minute interval synchronized to the remote which would therefore know when each sample is about to take place. The communication device of the present invention is not synchronized to the data gathering device (the downhole survey or core orientation unit) i.e. asynchronous operation, and therefore the communication device does not know if or when a sample is being taken. Thus, obtaining an indication of core sample orientation is simplified over known arrangements.

[00200] A method and system according to one or more embodiments of the present invention will hereinafter be described with reference to the Figures, particularly Figures 11 and 12.

[00201] A communication device 360 can signal to the data gathering device 342,380 to activate or come out of a standby mode. However, if preferred, the data gathering device may already be activated i.e. it is not necessary to have the data gathering device switch on from a deactivated ('turned off') state.

[00202] The communication device 360 and the data gathering device 342,380 do not require to send or exchange time information from one to the other.

[00203] The communication device 360 does not mark start time and the actual start time is not recorded by or in the communication device 360.

[00204] The communication device 360 does not start a timer, its clock (preferably a 'real time' clock) is permanently running.

[00205] The data gathering device 342,380 does not record a start time as an initial reference time. Thus, it is not necessary to make a data gathering event

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(shot) in a specific period of time beyond this reference time. The data gathering device does not start a timer, its own internal clock is always running.

[00206] No initial roll indication at the surface prior to deploying the device is required. Thus, no initial reference point is required before the device is deployed downhole of the data gathering device 342,380 is taken before lowering downhole as a reference "orientation point".

[00207] Importantly, the data gathering device only records data (takes 'shots') when it detects drilling is not occurring. That is, the data gathering device does not obtain or generate downhole data during drilling.

[00208] For the purposes of this invention, the phrase 'during drilling' means whilst drilling (i.e. rotation of the drill bit and drill string) is actually occurring rather than the general drilling operation as a whole. Data recording events ('shots') are not constantly taken on a set time period.

[00209] The data gathering device 342,380 of the present invention includes at least one vibration sensor, and preferably at least one of a gravity sensor, magnetic field sensor, accelerometer, inclinometer, and preferably a combination two or more of these devices. These 'sensors' are packaged into the data gathering device which is compatible for connection with downhole tubing, greasers and other instrumentation devices. The data gathering device is powered by an onboard battery, and preferably the data gathering device is hermetically sealed to prevent ingress of water and contaminants at pressure when 'downhole'. The data gathering device forms part of a system in conjunction with the communication device 60, and preferably any other equipment as needed.

[00210] The communication device may be incorporated in a remote controller. For example, a remote controller may be used to control or affect operation of the data gathering device. The remote controller may include an internal timer which

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operates without synchronization with an internal timer of the data gathering device.

[00211] One form of the present invention provides the following method, whereby:

1. When the data gathering device 342,380 initially detects vibration 900 it wakes 902 from a standby mode. The device determines that such vibration is because drilling is occurring. While awake at this stage the device also checks 904 whether there is a valid communication from the communication device. The device then goes back into a standby mode until vibration is not detected above a threshold, which is preferably set to be zero detected vibration. This has a valuable benefit of saving battery power. Known prior art devices, such as in WO 2006/024111 and related cases, continuously draw or on a frequent periodic basis draw on battery power, thereby vastly decreasing battery life and reducing the amount of time a device can spend in operation before the battery needs recharging or replacing. Extending battery life is a major benefit to drilling operations which occur in remote locations. Less capital investment is needed in equipment to maintain a charged standby device, and less time is lost in changing over equipment if battery life is extended.

2. Once no vibration has been detected for a desired period (e.g. 6 seconds) 906, the data gathering device determines that drilling has stopped, the device activates ('wakes up' from its standby or 'sleep' mode) 908 and records first data ('takes a 1st roll shot') 910. The device will self check 907 whether there is no vibration for the desired period of time.

3. A desired period of time later (e.g. 4 seconds) 912, the data gathering device records second data ('takes a 2nd roll shot') 914. If the second data recording event (roll) is close to the immediately previous first data recording event (1st roll shot) 910 and found to be acceptable 916, then the

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second data recording event 914 is saved to a memory and time stamped 918.

[00212] The data gathering device then stops recording data and reverts to its standby or 'sleep' mode and either:

a) waits at step 5 below) 920, or
b) continues to step 4) below 922.

4. If the second data recording event (2nd roll shot) is not similar 922 to the first data recording event, then a third data recording event is carried out ('3rd roll shot'). This 3rd shot's roll is compared to the 2nd shot's roll. If the third data recording event is close to the second data recording event, then the third data recording event is stored in memory and time stamped, and the data gathering device reverts to standby ('sleep') mode. Thus, the device compares the most recent data recording event to the immediately previous data recording event. This process continues until:
   a. one data recording event (roll) is accepted and time stamped 918; or
   b. a limit or preset maximum number of recording events is reached (e.g. five 'shots') 924

   then the data gathering device will revert to standby or 'sleep' mode (shut down) and wait for the next vibration to occur 900.

5. When the next vibration 900 event is detected, the data gathering device comes out of standby mode ('wakes up') 904. This allows the data gathering device to determine that vibration is occurring and then it reverts to standby mode ('goes to sleep again') in preparation to be re-activated at the next 'No vibration' event 906. This occurs without the need to take or record any downhole data (rolls) in memory. If none of the roll shots are acceptable, the device is set to wake on the next vibration and then go to sleep again 926.

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6. Steps 1) to 5) are repeated until the data gathering device receive a signal to enter an 'orientation process'. The signal is preferably provided by the communication device.

[00213] Remote controller (communication device)

[00214] A user inputs 950 to the communication device one or more of the following:

1. the last time when drilling has stopped
2. immediately prior to breaking off the core sample off;
3. immediately after breaking off the core sample.

[00215] The communication device identifies ('marks') a time 952, using its own real time clock, when a user selects that the core sample is to be retrieved.

[00216] Importantly, the present invention does not need or rely on an indication indicative of when during the drilling process the core sample was detached from the body of material.

[00217] Once the core sample has been broken off, and the time is marked by the communication device before, during or after that core breaking off event, the core assembly is retrieved to the surface.

[00218] Once the data gathering device is retrieved to the surface 954, the communication device communicates 956 to the device, and the device confirms communication received 958. The communication device signals to the data gathering device to halt surveying 960 and the communication device obtains from the data gathering device recoded data prior to a defined time elapsed period 960. At this point in time the communication device refers to its own internal clock and subtracts from this the time that the user indicated that the core

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was being retrieved 962. This time difference is transmitted to the data gathering device as a time value, which device enters a core orientation process stage 964.

[00219] Core orientation process

[00220] The data gathering device receives the time value (days, hours, minutes and seconds) (e.g. from the communication device) and enters an orientation process stage 964, as mentioned above.

[00221] The data gathering device deducts this time value from a predetermined time value in its own internal timer. The data gathering device checks for a saved data event 'roll' that occurred previous to this time in its memory, and retrieves that roll value. No time measurement is measured, and the data gathering device does not provide a time value indicative of when the core sample was broken off. Such a value is not required to determine orientation of the core sample.

[00222] The data gathering device then provides visual indications of which direction to rotate the core sample to indicate the 'downside' of the core. As discussed earlier in this specification, light indicators, such as the flashing coloured LEDs, and the described method of use, can be employed to indicate to the user which direction to rotate the barrel to the required 'downside'. For such use, a user rotates the barrel until the flashing stops and a solid ON LED indicates that the barrel is in the 'downside' position.

[00223] User inputs to the communication device to indicate that the core barrel, and therefore the core sample, is in the correct orientation. The communication device communicates to the data gathering device and verifies that this has occurred. This 'orientation' or 'roll' value is not transferred from the data gathering device to the communication device.

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[00224] One or more further embodiments of the present invention will hereinafter be described with reference to the accompanying Figures 13 to 19.

[00225] The present invention involves a system 460 utilising a core sample (core) orientation identification device 410 and a marker device 490. These components may be provided separately as discrete items or may be connected together, such as by an adjustment means.

[00226] Typically the extracted inner core tube 412 is placed on a support 480 for ease of work. After the inner core tube 412 containing the core sample 414 has been orientated to the up/down position (corresponding to its orientation underground before being drilled out), the pen/pencil marker 416 associated with the device 410 is adjusted to a pre-set height corresponding to the diameter size of the core tube used. The device is then activated by pulling the opposed handles 420,422 apart to a 'latched' position of the device ready to be released when signaled to do so.

[00227] The unit is placed on the core tube by opening the jaws assembly 424 sufficiently wide to allow the opposed jaws to be placed about the external diameter of the tube 412. This embodiment includes three jaws 426,428,430. The first 426 and third 428 jaws oppose the second jaw 430 with the second jaw operating between the first and third jaws. It will be appreciated that two opposed jaws can be sufficient. One or both of the opposed jaws can have a bifurcated end with rollers thereon rather than the three jaws with rollers.

[00228] The device is positioned such that the marking pen/pencil faces the exposed core face 'A'.

[00229] By closing the opposed jaws together, the rollers 432 on the jaws contact the external surface of the core inner tube 412, which allows the device to find its correct position via gravity so that the marker is pointing to the lower portion of the core face A. The device hangs or suspends from the tube.

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[00230] The device contains a self-feeding and extruding wax nib which will always be extended ready to mark the core face A. This can be position adjusted via the adjustment means 418.

[00231] Electronics within the housing 434 of the device include one or more central processors, accelerometer(s), infrared communication components, other supporting components and a battery power supply 442.

[00232] There is also an electromechanical releasing device 440 to allow the marking pencil to stamp the core face when required. This may be in the form of a solenoid which when activated, releases the compressed spring 444 previously latched when the handles 420,422 were pulled in opposite directions to set the latch 446 against a latch plate 448. As is shown, the handle 420 has sliders 450,452 which slide in bushes 454.

[00233] In preferred embodiments the electronics can operate to confirm the up/down position of the device using its accelerometer(s) and other components.

[00234] One or more light emitting diodes (LEDs) 456 can be provided behind a window 458 on the device. The window may be an IR window for communication between the device and the remote controller. The LED(s) can be set to illuminate or extinguish when not centered. In a preferred embodiment, the LED(s) flash when the device is not centred and are steady when it is centred (see infrared window 56 pointed to by the hand-held controller 460 in Figure 18).

[00235] When self-alignment is completed by the device, the hand-held controller 60 signals the device via infrared communication to release the marking pen/pencil. The embedded electronics confirms that the unit is properly aligned before allowing activation to release the marking pen/pencil towards the exposed core face and thereby mark its lower end to indicate correct orientation.

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[00236] Figure 17 shows a sectional view of the pencil holder 416. A wax pencil core 462 is held within the tubular body 464. The pencil core is spring 466 biased to protrude from the open end 468 of the holder. A removable screw cap 470 allows replacement of the pencil core.

[00237] Height adjustment for the marker is achieved by releasing the adjustment mechanism 418, raising or lowering the pencil holder 416 relative to the support 472 attached to handle 420 (seen in Fig 13, not shown in Fig 17).

[00238] In figures 20a to 20c, an embodiment of a self aligning system 560 (aligning with respect to the core 512), including core sample orientation device 510 and a marker device 590

[00239] Typically the extracted inner core tube 512 is placed on a support 580 for ease of work. After the inner core tube 512 containing the core sample 514 has been orientated to the up/down position (corresponding to its orientation underground before being drilled out), the pen/pencil marker 516 associated with the device 510 is adjusted to a pre-set height corresponding to the diameter size of the core tube used. The device is then activated by extending the pencil assembly to a 'latched' position "L" of the device ready to be released when signaled to do so.

[00240] The unit is placed on the core tube by opening the jaws assembly 520,522 sufficiently wide to allow the opposed jaws to be placed about the external diameter of the tube 512. This embodiment includes three jaws 520a,522,520b. The first 520a and third 520b jaws oppose the second jaw 522 with the second jaw operating between the first and third jaws. It will be appreciated that two opposed jaws can be sufficient. As a component saving measure and to provide a simplified device, no rollers are provided on the ends of the arms/jaws 520a,520b,522. Gravity causes the device to rotate to a stable orientated position ready for operation.

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[00241] The device is positioned such that the marking pen/pencil faces the exposed core face 'A'.

[00242] Figures 21a to 21c show an embodiment of the core sample orientation device 510 portion of the system.

[00243] There is also an electromechanical releasing device to allow the marking pencil to stamp the core face when required. Figure 21c shows the internal release mechanism. A rotary cam 550 is driven by motor when triggered. The cam acts on the lever arm 552 to retract the spring loaded detent 554. When operated, the retracted detent disengages from a latch 557 allows a spring 560 loaded slide arm 558 (shown in dotted phantom) to release. This causes the marker (e.g. wax pencil) to release and mark the end of the core. A damper spring 556 cushions the end of travel. Resetting is by pulling the latch back.

[00244] Figures 22a to 22e show steps in operation of the electro-mechanical mechanism to release the marker to mark the core. As the cam 550 rotates, the pivoting lever arm 552 is depressed. This retracts the spring loaded detent 554 and releases that detent from engagement with the latch 557. The spring 560pulls the latch which causes the marker (not shown) to contact the end of the core and mark it.

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THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method of determining orientation of a core obtained by drilling the core from a subsurface body of material, the method including:

a) determining that vibration from drilling is at or below a nominated level of vibration,

b) recording data relating to orientation of the core to be retrieved, the data recorded using a downhole core orientation data recording device,

c) separating the core from the subsurface body, and

d) obtaining from the core orientation data recording device an indication of the orientation of the core based on the recorded data obtained when the vibration from drilling was below the nominated level of vibration and before the core was separated from the subsurface body.

2. A method according to claim 1, wherein the nominated level of vibration is when drilling has ceased for that drill.

3. A method according to claim 2, wherein when drilling having ceased is at the end of a drilling activity immediately prior to separating the core.

4. A method according to any one of claims 1 to 3, wherein no further data relating to core orientation is needed to be obtained for use after separating the core from the subsurface body.

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5. A method according to any one of the preceding claims, wherein, once drilling has ceased, a predetermined time interval elapses before the core is separated from the subsurface body.

6. A method according to any one of the preceding claims, wherein the first time period is a predetermined time determined to be between drilling having ceased and the core is subsequently separated from the subsurface body of material.

7. A method according to claim 6, wherein the predetermined first time period does not exceed 90 seconds.

8. A method according to claim 7, wherein the predetermined first time period is between 10 seconds and 60 seconds.

9. A method according to any one of the preceding claims, including determining a dip value for use in determining the core orientation.

10. A method according to claim 9, wherein the dip value is obtained during the period of drilling vibration below the threshold.

11. A method according to claim 10, wherein the dip value is obtained when drilling has ceased but prior to separating the core from the body.

12. A method according to any one of the preceding claims, wherein the core is separated from the subsurface body by breaking.

13. A method according to any one of the preceding claims, wherein separating the core from the subsurface body takes less than 1 minute.

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14. A method according to any one of the preceding claims, including criteria of identifying that there is no drilling vibration, subsequently separating the core from the subsurface body and then subsequently determining that there is a period of no drilling vibration.

15. A method according to claim 14, wherein, in one or more of the criteria therein is not met, the data sample or the core orientation data obtained is disregarded for the purpose of determining core orientation.

16. A method according to any one of the preceding claims, wherein separation of the core from the subsurface body of material is determined by detecting acceleration, change of acceleration, tension or strain or change in tension or strain resulting from a force applied to the core and the core separating from the subsurface body.

17. A method according to claim 16, wherein the acceleration or change in acceleration is detected by at least one accelerometer provided within the core orientation data recording device.

18. A method according to claim 17, wherein the acceleration or change in acceleration detected is in a Z direction in line with an advancing drilling activity.

19. A method according to claim 16, wherein the tension or strain or change in tension or strain is detected by at least one strain gauge within or on a portion of the downhole equipment associated with obtaining the core.

20. A method according to claim 19, wherein the at least one strain gauge is within or on the core orientation data recording device or within or on a section of drill tube.

21. A method according to any one of the preceding claims, wherein once the core orientation is obtained, the core orientation data recording device is

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shutdown or turned to low power standby mode in preparation to be put into an orientation recording mode again.

22. A method according to any one of the preceding claims, including retrieving the core to the surface, and setting the core orientation data recording device to an orientate mode.

23. A method according to claim 22, including setting the orientate mode using a remote communication device communicating with the core orientation data recording device.

24. A method according to claim 22 or 23, the core orientation data recording device including one or more lights or other visual indicators to give an indication of required orientation and/or direction to rotate the core for marking the core.

25. A method according to claim 24, whereby, once in orientate mode, visual indications indicate to an operator which direction to rotate the core to find the correct 'down side' of the core for marking the orientation thereof.

26. A method according to any one of claims 22 to 25, whereby, communication to the core orientation data recording device is effected via the remote communication device and the remote communication device will then verify that the correct orientation was achieved based on the orientation data recorded.

27. A method according to any one of the preceding claims, including detecting pressure, a pressure differential or change in pressure to indicate that drilling should cease in order to then determine orientation of the core.

28. A method according to claim 27, including detecting increase in the pressure or detecting the pressure being above a threshold pressure in an inner core tube receiving the core.

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29. A method according to claim 27, including detecting a difference in pressure between the interior of the inner core tube and exterior of the inner core tube.

30. A method according to any one of claims 27 to 29, wherein pressure or change in pressure, or pressure differential of a drilling fluid is detected.

31. A method according to claim 30, wherein the drilling fluid is drilling mud, water or a combination thereof.

32. A method according to any one of the preceding claims, wherein the core orientation data recording device records an indication of core orientation after a predetermined period of time for the vibration being at or below the nominated level.

33. A system for determining orientation of a core using a method according to any one of the preceding claims, the system including at least a core orientation data recording device and a core drilling assembly.

34. A system according to claim 33, including a remote communication device configured to communicate with the core orientation data recording device to identify a required orientation of the core.

35. A system according to claim 33 or 34, the core orientation data recording device including at least one visual indicator to show one or more of a direction to rotate the core to obtain the required orientation or a visual indication to show the required orientation.

36. A system according to any one of claims 32 to 35, including at least one pressure sensor to detect pressure or change in pressure or a pressure differential.

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37. A system according to claim 36, wherein the at least one pressure sensor is provided on or within a core orientation data recording device and/or on or within a portion of a drilling tube.

38. A system according to claim 36, wherein the at least one sensor is operatively connected to the core orientation data recording device.

39. A method of determining orientation of a core sample obtained by drilling from aboveground into a subsurface body, the method including:

a) operating a downhole data gathering device to detect when vibration from drilling is below a threshold;

b) recording data relating to a core sample being obtained by the drilling when vibration from drilling is below a threshold;

c) providing an input to a user operated communication device;

d) the communication device identifying a time of the user input to the communication device;

e) retrieving the data gathering device and core sample;

f) communicating between the communication device and the retrieved data gathering device;

g) determining from indications provided by the retrieved data gathering device an orientation of the core sample.

40. A method according to claim 39, the input to the communication device including one or more of an indication of a most recent occurrence when drilling

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ceased, an indication immediately prior to separating the core sample from the subsurface body, an indication after separating the core sample from the subsurface body.

41. A method according to claim 39 or 40, the communication device controlling the data gathering device to cease gathering data.

42. A method according to any one of claims 39 to 41, the retrieved data gathering device providing survey data to the communication device or another receiver, the survey data being or derived from recorded data obtained when the no vibration had been detected.

43. A method according to claim 42, the data gathering device providing to the communication device survey data relating to recorded data obtained prior to a defined period of time.

44. A method according to claim 43, wherein the defined period of time is provided to the retrieved data gathering device from the communication device.

45. A method according to claim 43 or 44, wherein the defined period of time is used by the data gathering device to identify recorded data obtained during surveying at a time prior to the amount of the defined time.

46. A method according to claim 45, wherein the identified recorded data provided as survey data to the communication device or other receiver is or derives from recorded data recorded by the data gathering device at a period in time closest to the time prior to the amount of defined time than any other recorded data event.

47. A method according to any one of claims 39 to 46 wherein, the data gathering device detects that vibration is occurring and waits until a subsequent no vibration event occurs before recording data.

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48. A method according to any one of the preceding claims 39 to 47 wherein, the data gathering device detects multiple consecutive survey values during a period of no vibration.

49. A method according to claim 48, wherein acceptable recorded data is identified with a timestamp relating to real time.

50. A method of obtaining downhole survey data in a borehole created by drilling, the method including advancing a data gathering device into the borehole, the data gathering device determining that vibration is below a predetermined threshold, bringing the data gathering device out of a standby mode during a period when vibration is determined to be below the threshold, recording data during the period, returning the data gathering device to a standby mode when vibration is determined to be above the threshold or sufficient said data has recorded.

51. A method according to any one of claims 39 to 50 wherein, the threshold is no vibration from drilling.

52. A method according to any one of claims 39 to 51, whereby, when drilling is stopped; the data gathering device records core orientation data; the core is subsequently separated from its connection with the ground; the communication device signals to the data gathering device to identify the recorded core orientation data that was immediately prior to separating the core sample from the ground; and using that recorded core orientation data to identify orientation of the core sample.

53. A system for use in determining orientation of a core sample obtained by drilling from aboveground into a subsurface body, the system including a data gathering device arranged and configured with control means to detect when vibration from drilling is below a threshold, and activation means to cause the

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data gathering device to record data during the period of vibration below the threshold.

54. A system according to claim 53, wherein the threshold is no vibration from drilling.

55. A system according to claim 53 or 54, the data gathering device including a timer providing a timestamp for recorded data events.

56. A system according to claim 53, 54 or 55, including a communication device including communication means arranged and configured to communicate a time value to the data gathering device, the data gathering device including processing means which determines from the received time value the closest recorded data obtained immediately prior to a time determined by subtracting the received time value from a current time value.

57. A system according to claim 56, wherein the current time value is provided by the communication device to the data gathering device.

58. A core orientation marking system to provide an identification mark on a core indicating a desired orientation of the core extracted from a below ground body of material, the system including a core orientation identification device and a marker device, the core orientation identification device including an alignment means and a mounting means to mount the device relative to an end of a tube exposing an end of the core to be marked, the mounting means permitting the device to rotate about the end of the tube, the alignment means arranged to provide an indication of correct alignment of the device relative to a known alignment of the core, and the marker device providing an identifiable mark on the end of the core corresponding to the known alignment of the core.

59. A system according to claim 58, wherein the core orientation identification device is manually rotated about the tube end or rotated by force of gravity.

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60. A system according to claim 58 wherein the core orientation is marked manually.

61. A system according to claim 58 or 59, wherein the core orientation identification device includes at least one light arranged to indicate when the device is correctly orientated relative to the core to identify the required core orientation.

62. A system according to claim 61, wherein the at least one light is controlled to flash to indicate orientation is not yet correct.

63. A system according to claim 61 or 62, wherein the at least one light is controlled to flash slower the nearer to correct orientation is achieved by rotating the device about the tube and shows steady when correct orientation is identified.

64. A system according to any one of claims 58 to 63, wherein correct orientation is upright or substantially vertical relative to a corresponding upright or substantially vertical alignment of the orientation of the core.

65. A system according to any one of claims 58 to 64, wherein the device include two or more biased opposed members permitting width adjustment for mounting the device to respective tubes of a variety of diameters.

66. A system according to claim 65, wherein the biased opposed members include at least two opposed jaws.

67. A system according to claim 66, wherein the biased opposed members include rollers that are brought into contact with the tube when the device adjusts to the diameter of the tube and wherein the device is arranged to rotate by force of gravity about the tube.

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68. A system according to any one of claims 58 to 67, including electronics and a power source for the electronics, the electronics including one or more accelerometers to detect correct orientation of the device and to send a signal or cease send a signal to indicate the correct orientation of the device relative to the known orientation of the core.

69. A system according to any one of claims 58 to 68, wherein the marker device is actuated automatically to mark the core by remote operation from a remote controller.

70. A system according to claim 69, wherein the device includes a settable latch mechanism that is released upon receipt of a release signal to effect marking the core.

71. A system according to claim 70, wherein the latch mechanism including a solenoid operated release.

72. A system according to any one of claims 58 to 71 wherein a remote controller is arranged to send a signal to the device to effect core marking, and the device includes electronics to detect whether the device is correctly orientated relative to the core, and to effect marking if orientation of the core and device correspond, and to prevent marking if the orientation of the core and device do not correspond.

73. A system according to claim 72, wherein successful marking is logged in a memory of the remote controller or transmitted to another device.

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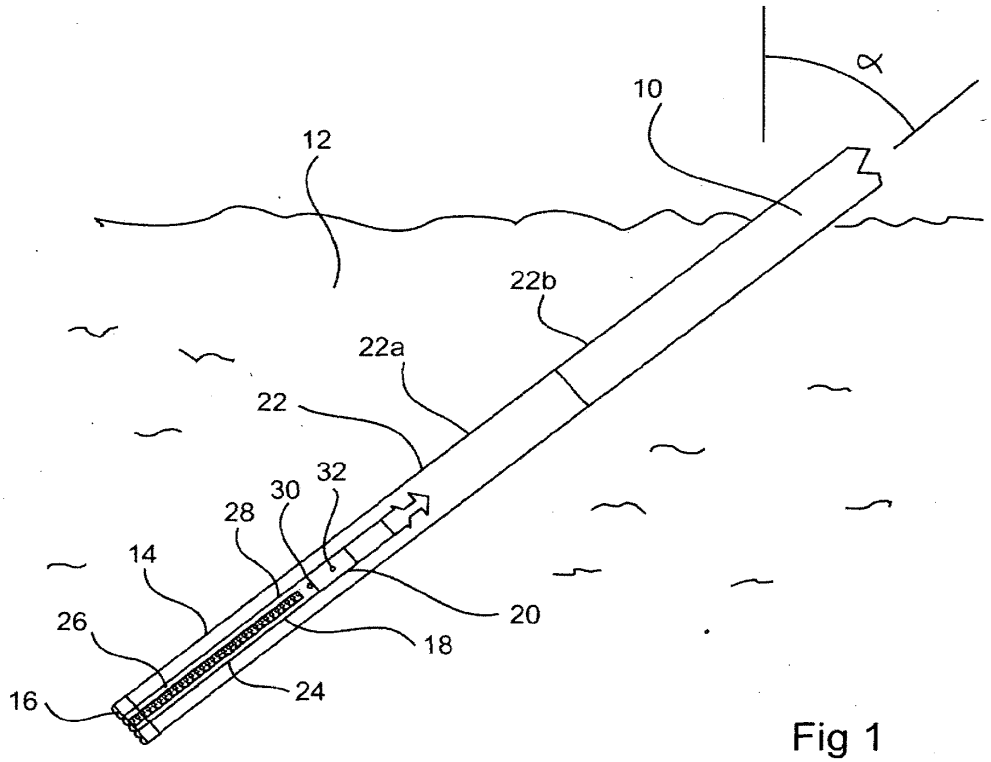

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Fig 1

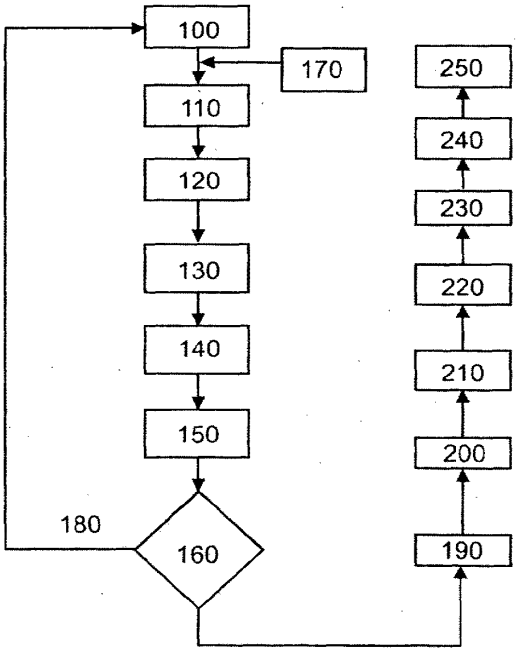

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Fig 2

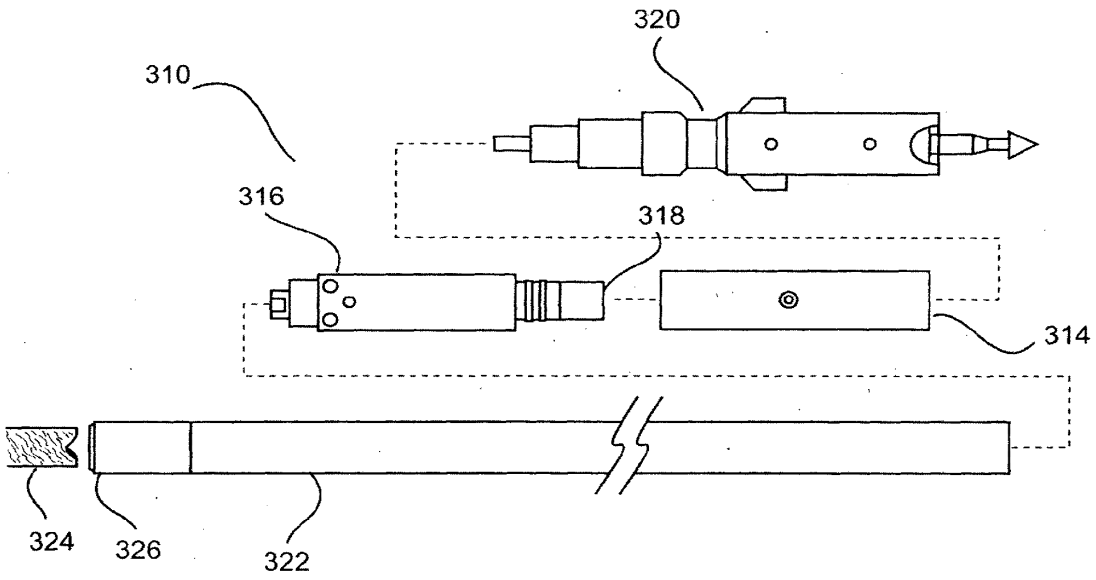


Fig 3

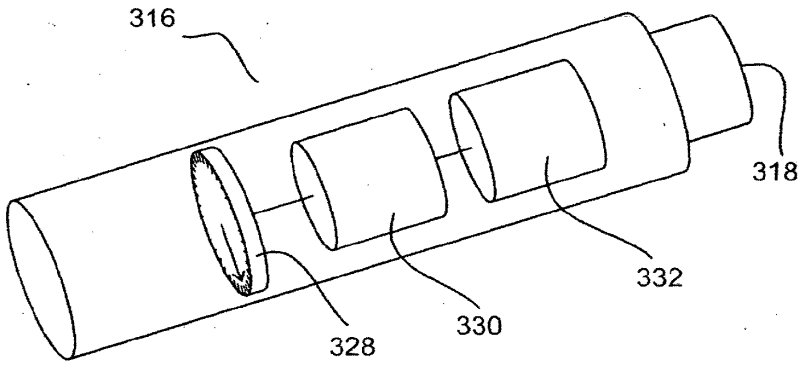


Fig 4

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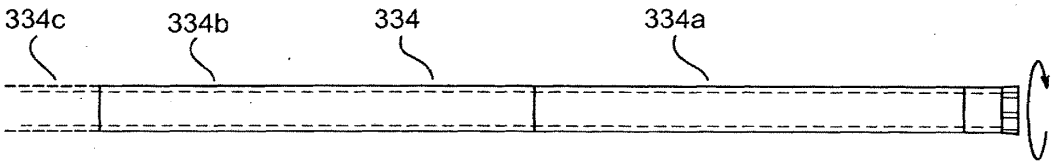


Fig 5A

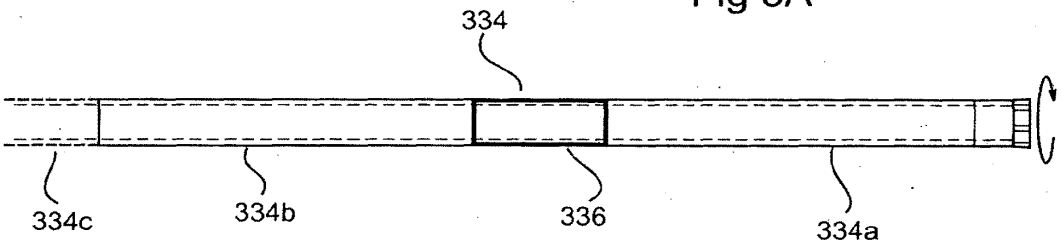


Fig 5B

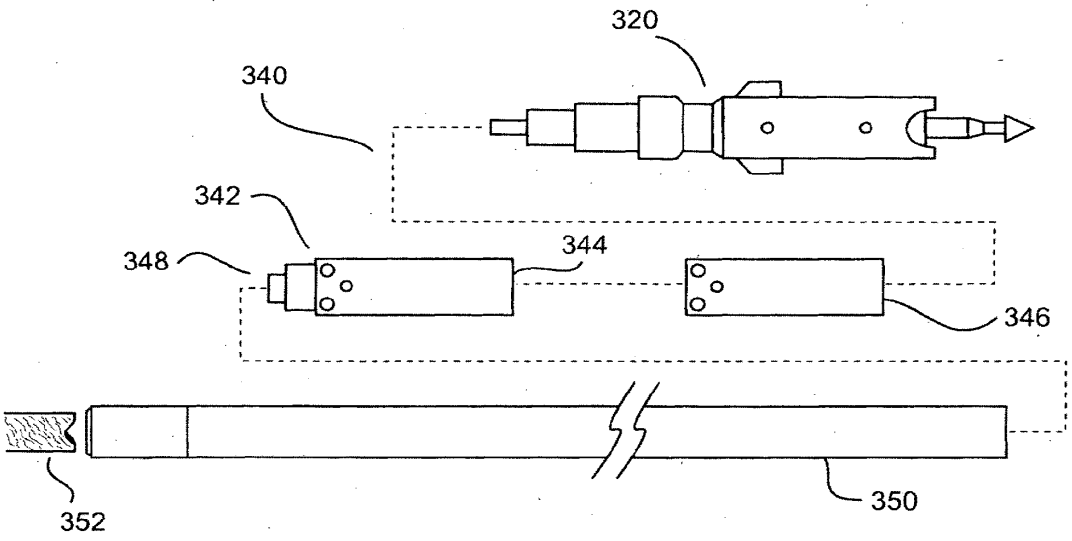


Fig 6

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Reflex USA LLC v. Longyear TM, Inc. and Globaltech Corporation Pty Ltd.

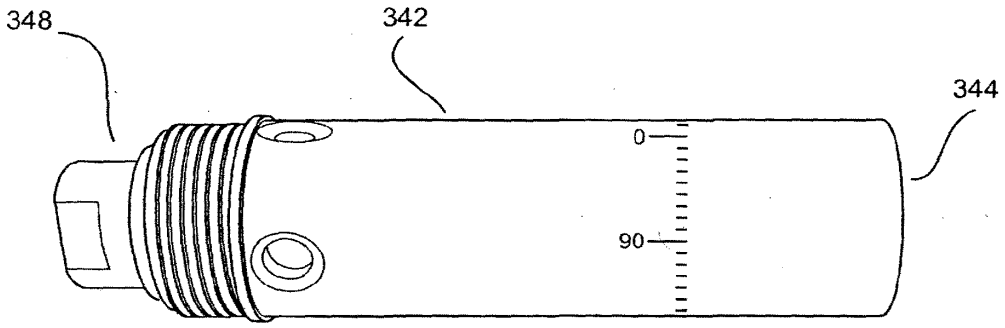


Fig 7

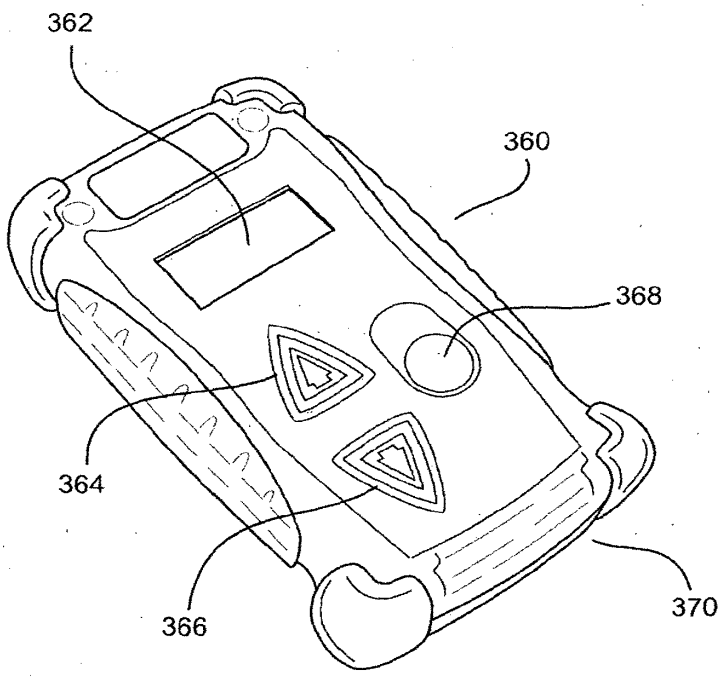


Fig 8

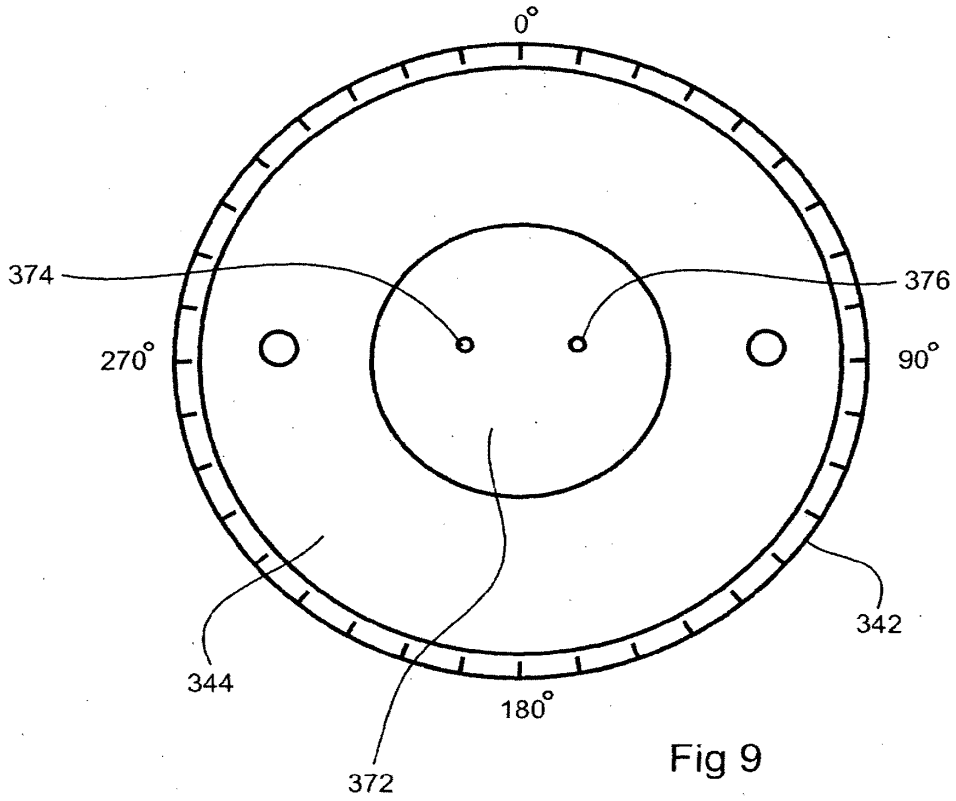


Fig 9

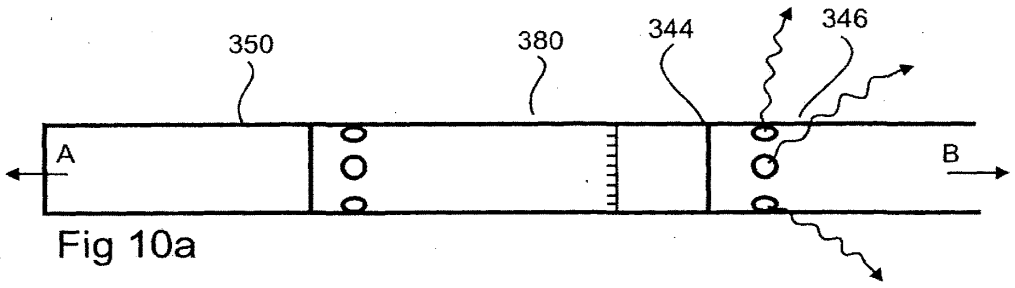


Fig 10a

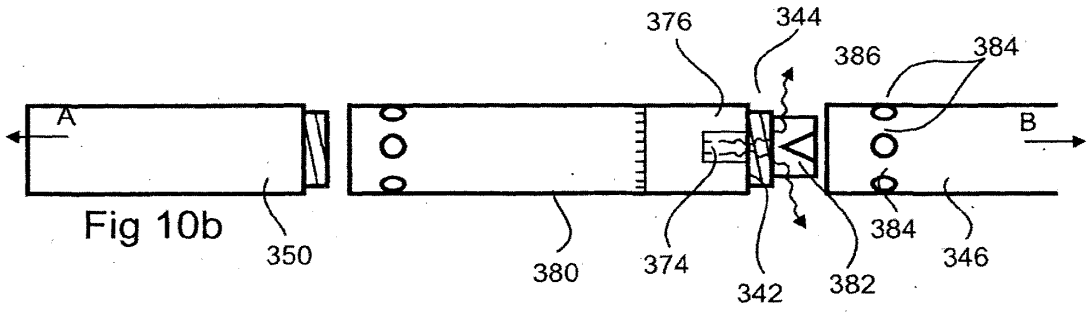


Fig 10b

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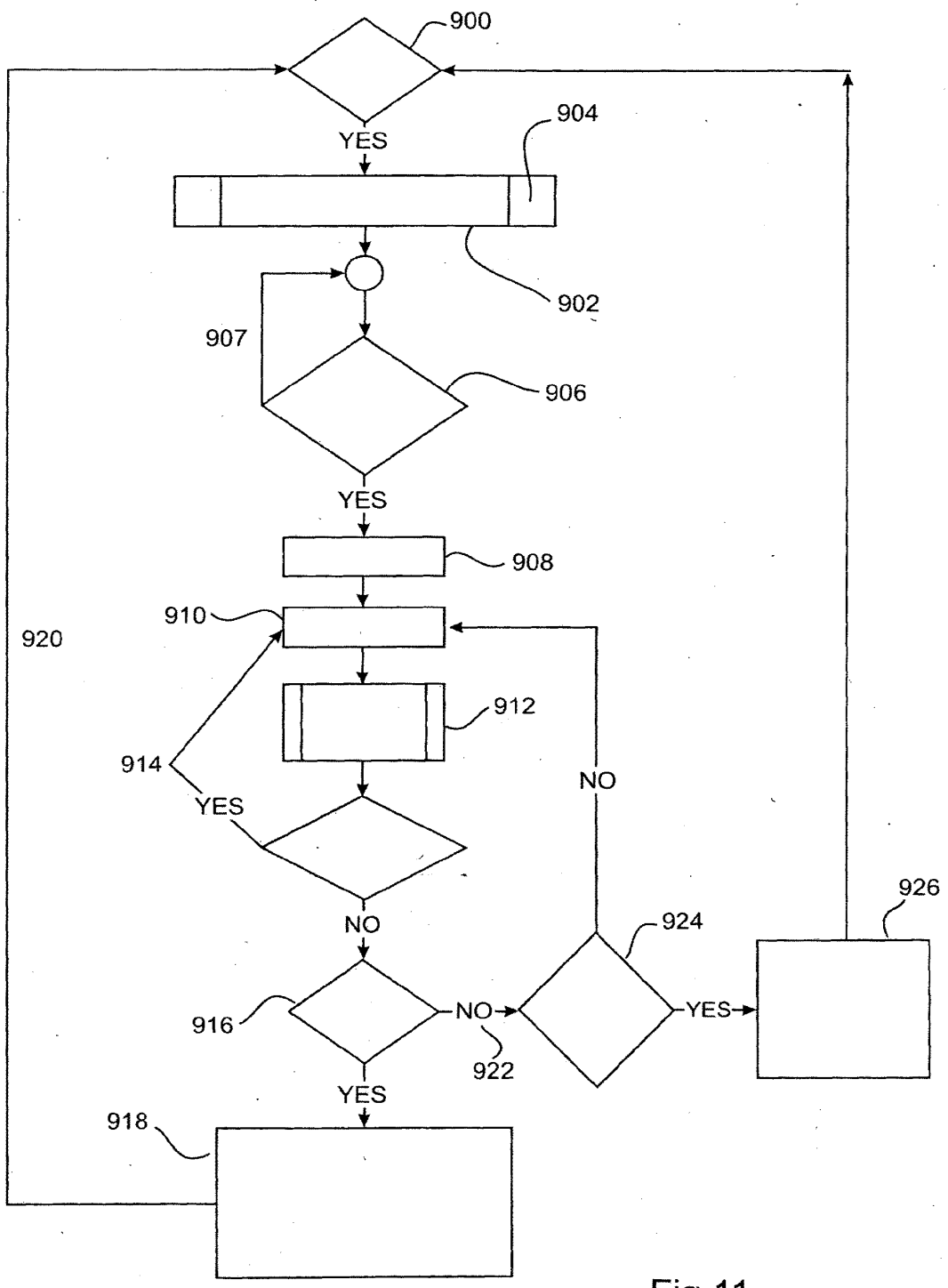


Fig 11

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Reflex USA LLC v. Longyear TM, Inc. and Globaltech Corporation Pty Ltd.

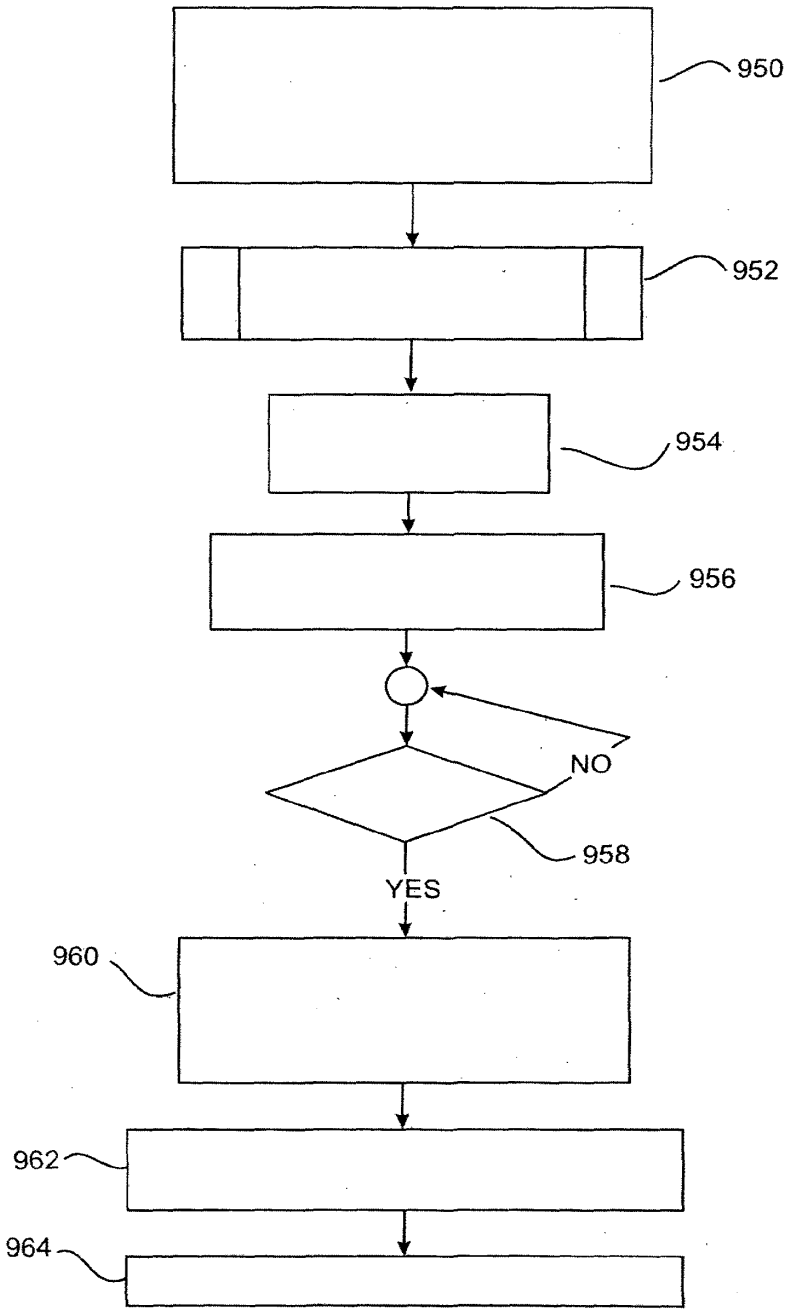


Fig 12

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Reflex USA LLC v. Longyear TM, Inc. and Globaltech Corporation Pty Ltd.

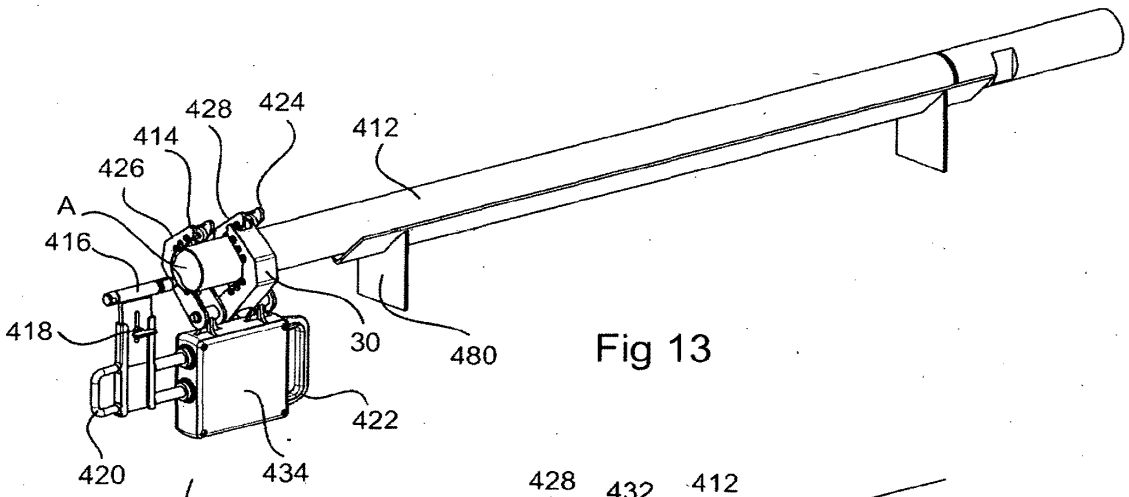


Fig 13

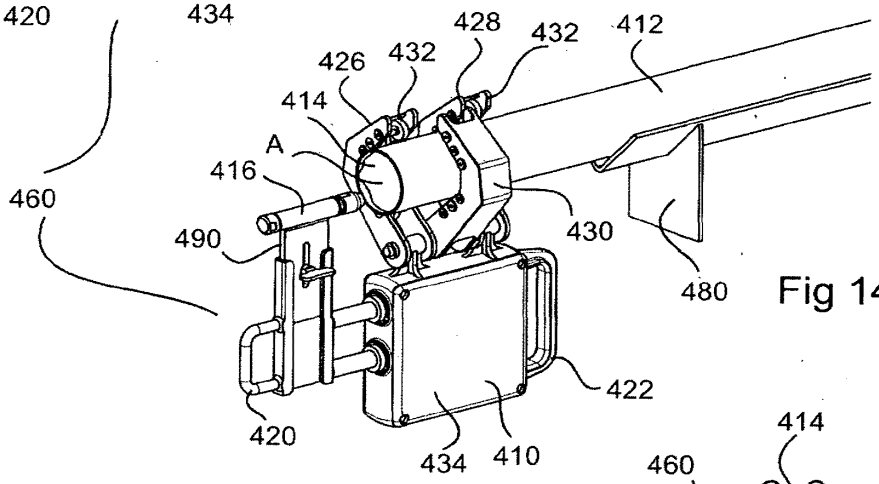


Fig 14

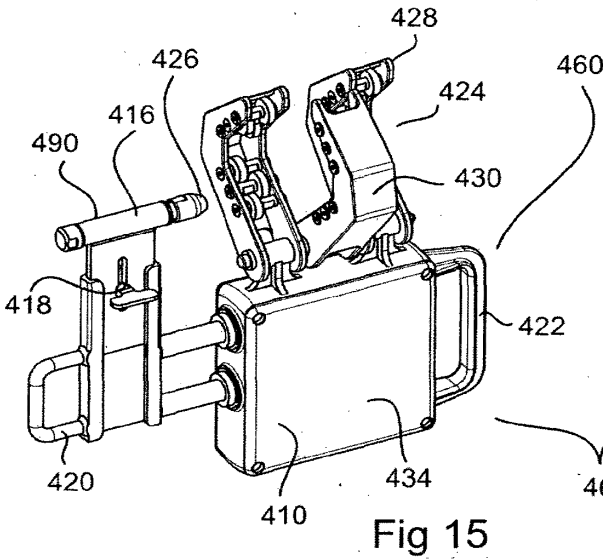


Fig 15

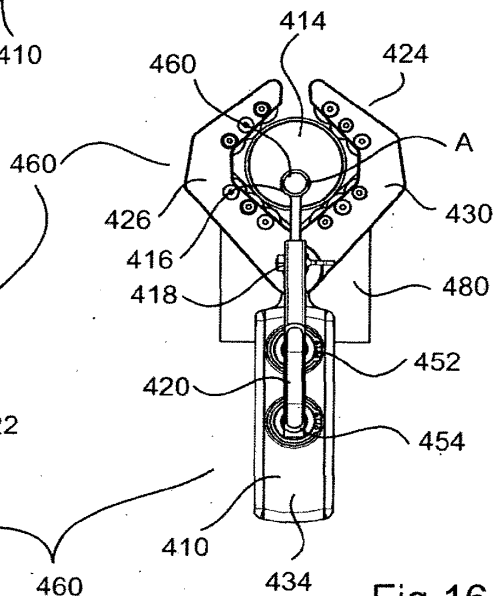


Fig 16

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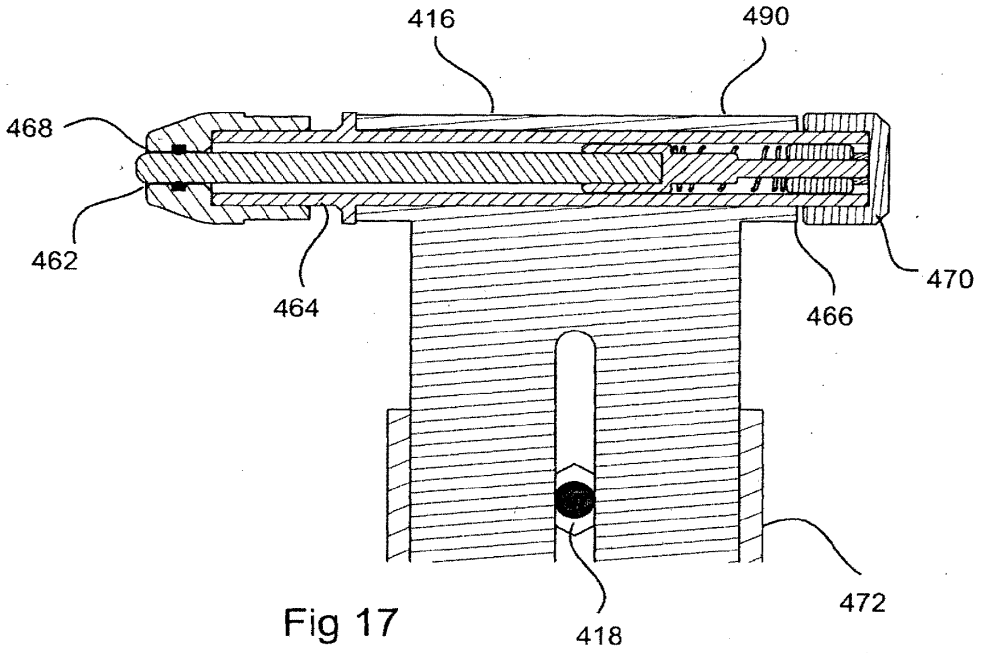


Fig 17

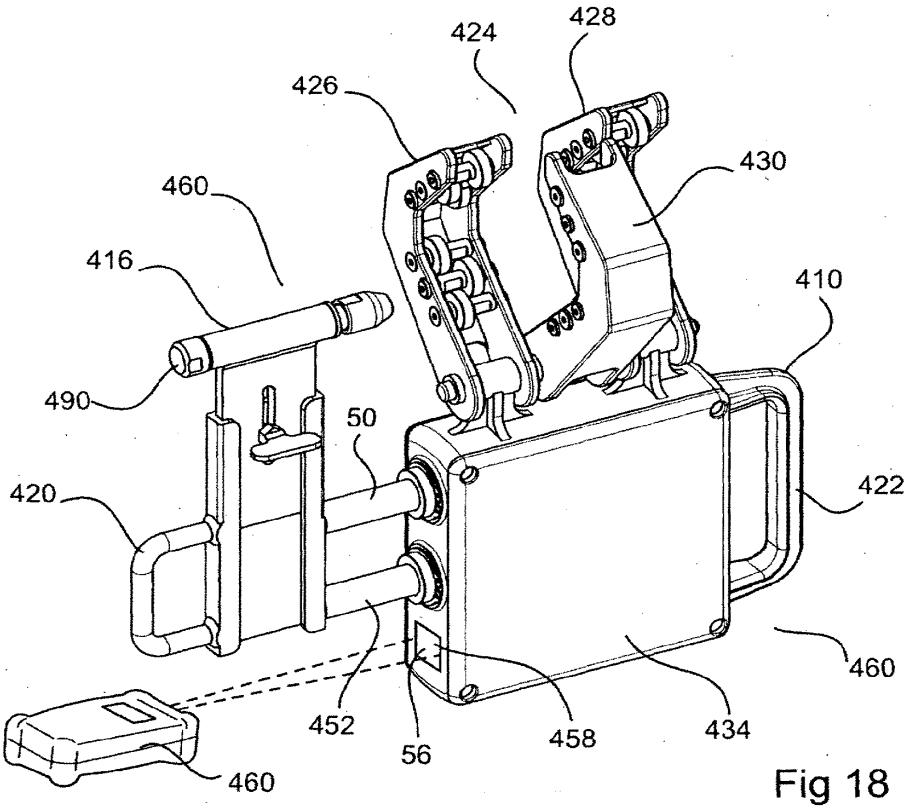


Fig 18

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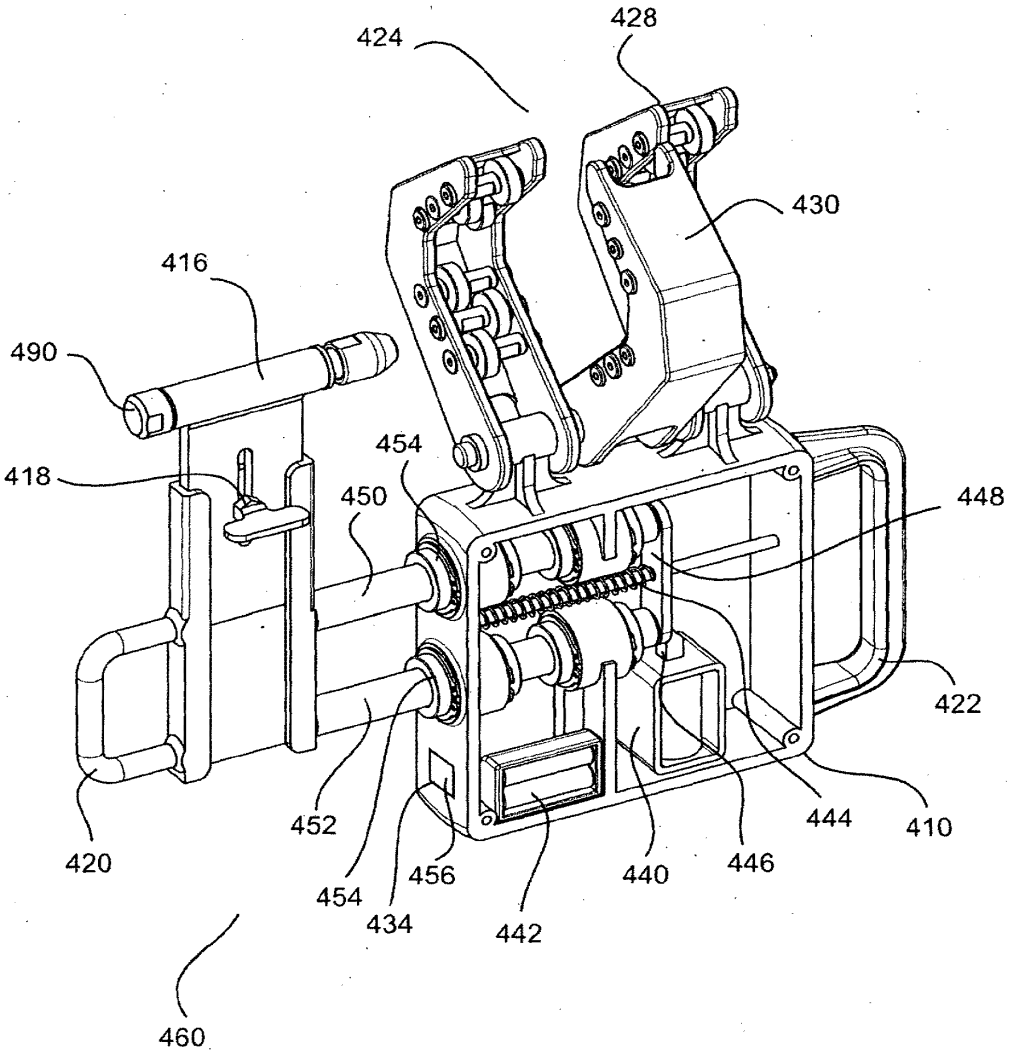


Fig 19

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Reflex USA LLC v. Longyear TM, Inc. and Globaltech Corporation Pty Ltd.

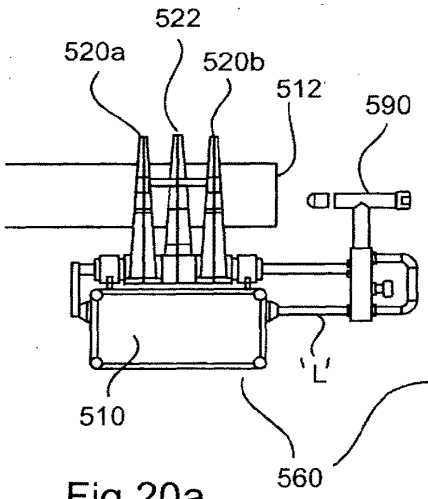


Fig 20a

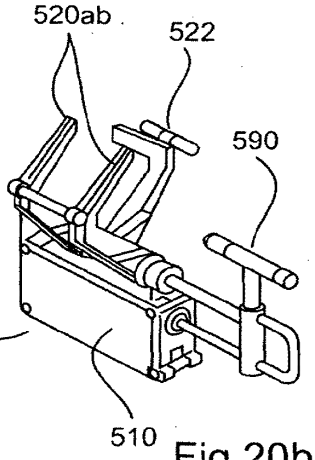


Fig 20b

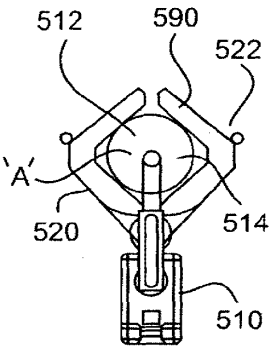


Fig 20c

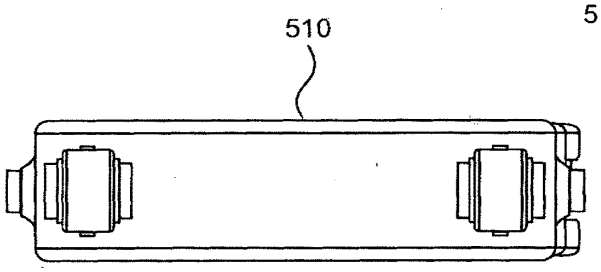


Fig 21a

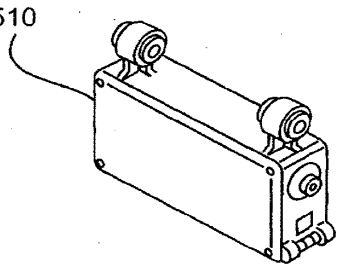


Fig 21b

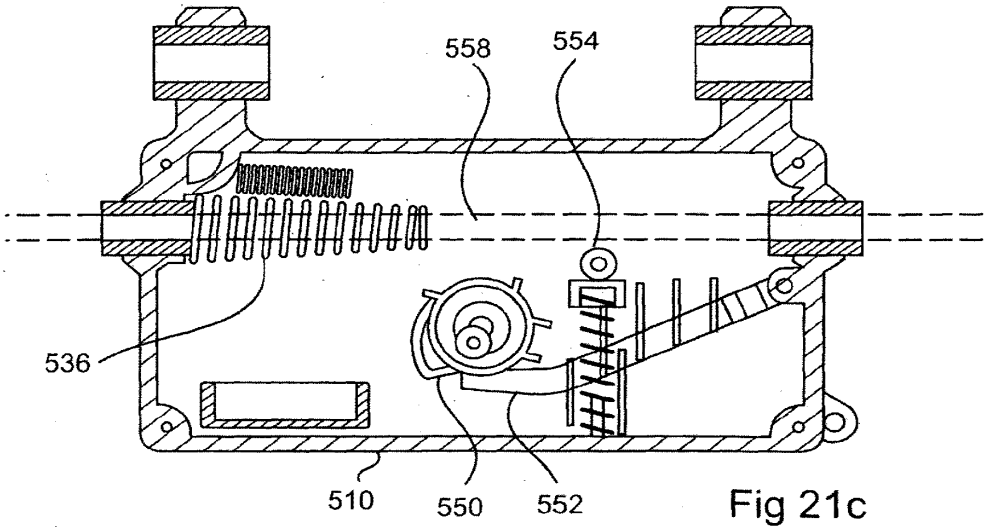


Fig 21c

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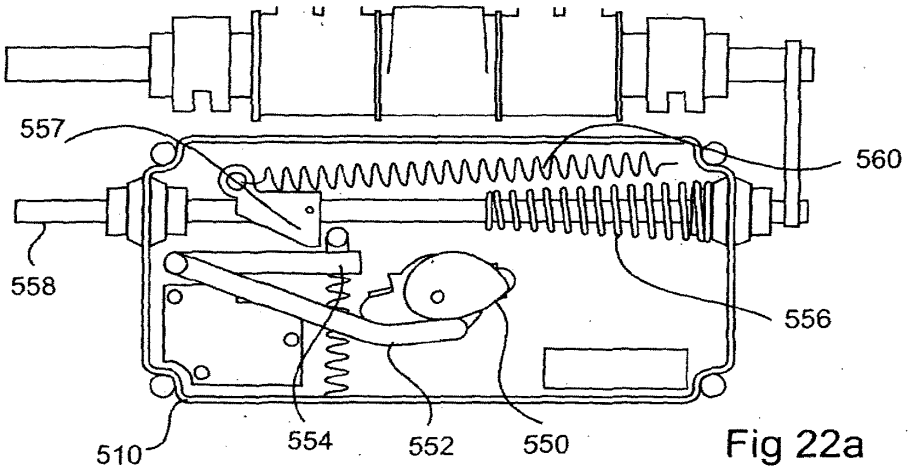


Fig 22a

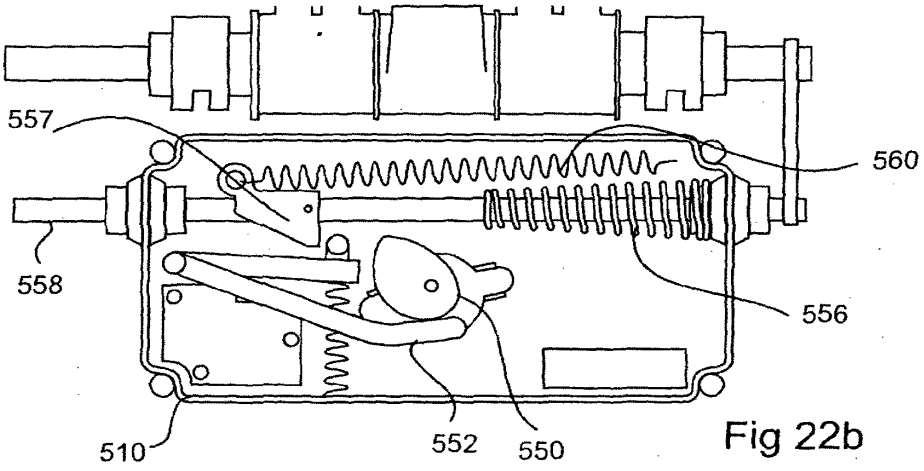


Fig 22b

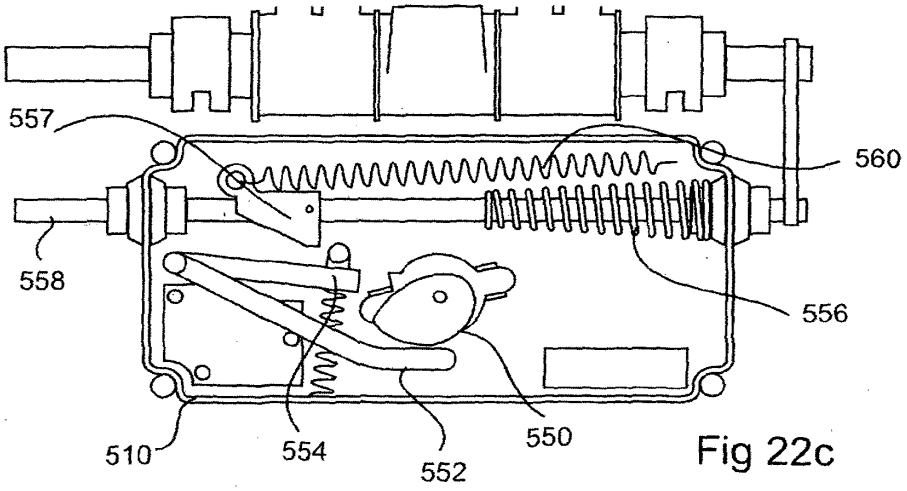


Fig 22c

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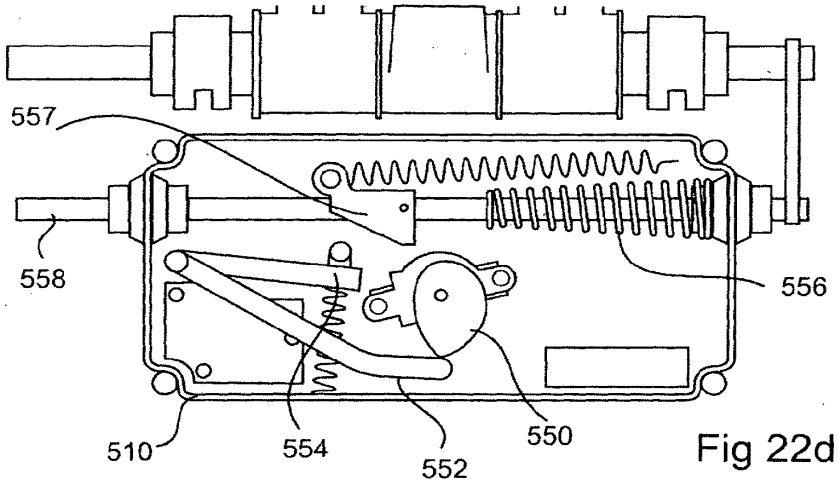


Fig 22d

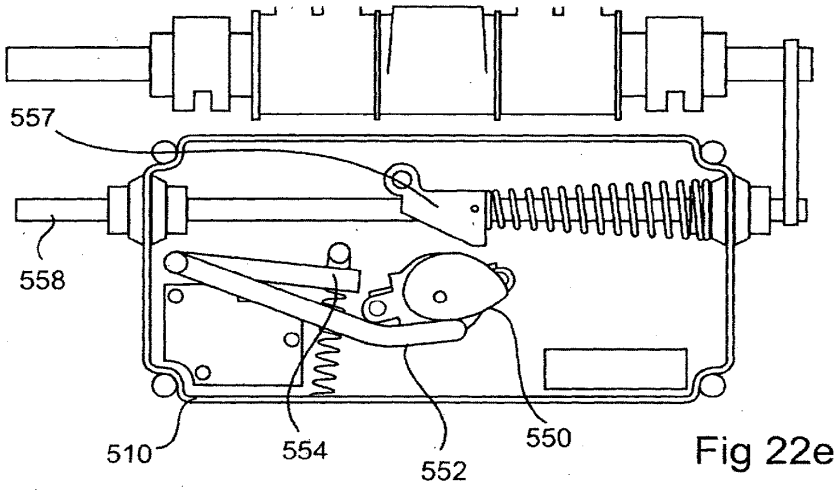


Fig 22e

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2013/000179

A. CLASSIFICATION OF SUBJECT MATTER

E21B 25/16 (2006.01) E21B 47/02 (2006.01)

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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

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

EPODOC & Derwent WPI: IPC & CPC E21B 25, E21B 47/02/low, E21B 47/09/low with keywords core, coring, vibration, oscillation, threshold, value, reference, level, nominated, set, pre-determined, sleep, wake, stand-by, below, above, larger, greater, smaller, etc; Google Patents Database with 'core' and 'orientation' with further keywords such as vibration, threshold, pre-determined, value, etc.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

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

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 June 2013	13 June 2013
Name and mailing address of the ISA/AU	**Authorised officer**
AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaustralia.gov.au Facsimile No.: +61 2 6283 7999	Jude Fernando AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. 0262832419

Form PCT/ISA/210 (fifth sheet) (July 2009)

INTERNATIONAL SEARCH REPORT C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		International application No. **PCT/AU2013/000179**
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	AU 2008230012 A1 (RESERVOIR NOMINEES PTY LTD) 14 May 2009 Abstract, page 5 line 22 - page 7 line 25, page 8 line 1 - page 10 line 1; Figure 2	1-57

Form PCT/ISA/210 (fifth sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2013/000179

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See Supplemental Box for Details

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-57

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT	International application No. PCT/AU2013/000179

Supplemental Box

Continuation of: **Box III**

This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

This Authority has found that there are different inventions based on the following features that separate the claims into distinct groups:

- Claims 1-57 are directed to a method and associated system of obtaining downhole survey data, and more particularly a method and associated system for obtaining downhole survey data that is core orientation data. The feature of determining that vibration from drilling is at or below a nominated (threshold) value and then recording survey data is specific to this group of claims.

- Claims 58-73 are directed to a core orientation marking system. The feature of an alignment means arranged to provide an indication of correct alignment of the device relative to a known alignment of the core and a marker device providing an identifiable mark on the end of the core corresponding to the known alignment of the core is specific to this group of claims.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

When there is no special technical feature common to all the claimed inventions there is no unity of invention.

In the above groups of claims, the identified features may have the potential to make a contribution over the prior art but are not common to all the claimed inventions and therefore cannot provide the required technical relationship. Therefore there is no special technical feature common to all the claimed inventions and the requirements for unity of invention are consequently not satisfied *a priori*.

INTERNATIONAL SEARCH REPORT Information on patent family members		International application No. **PCT/AU2013/000179**	
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.			
Patent Document/s Cited in Search Report		**Patent Family Member/s**	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**
AU 2008230012 A1	14 May 2009	AU 2008230012 A1	14 May 2009
End of Annex			

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
19 June 2014 (19.06.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/089618 A1

(51) International Patent Classification:
E21B 25/16 (2006.01) *E21B 25/00* (2006.01)

(21) International Application Number:
PCT/AU2013/001444

(22) International Filing Date:
10 December 2013 (10.12.2013)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2012905398 11 December 2012 (11.12.2012) AU

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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, 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))*

(54) Title: ROTATION ACTIVATED DOWNHOLE ORIENTATION SYSTEM AND METHOD

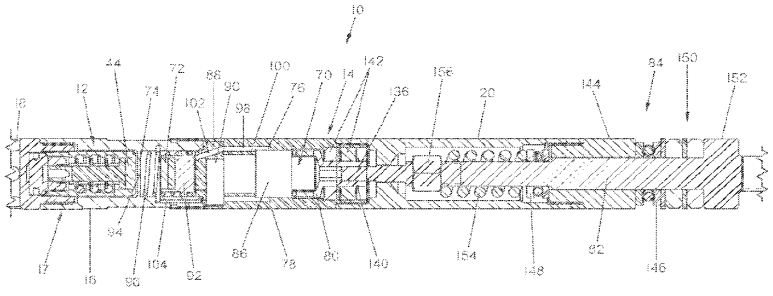


FIGURE 1

(57) Abstract: A rotation activated orientation system (10) for a ground drill is operated by action of magnetic fields. The system (10) incorporates a magnetically operated orientator (12) having a free state where the orientator (12) provides a substantially instantaneous indication of a position of a reference bearing of a hole being drilled by the ground drill, and a locked state where the orientator maintains the indication. The system (12) also includes a magnetic actuator (14) operatively associated with the magnetically operated orientator (12). When the rotational speed of the ground drill is greater than a threshold speed the magnetic actuator (14) supplies a magnetic field effective to place the orientator (12) in the free state. When the rotational speed of the drill is less than the threshold speed the magnetic actuator (14) does not supply a magnetic field effective to operate the orientator so that the orientator (12) reverts to or remains in the locked state.

WO 2014/089618 A1

ROTATION ACTIVATED DOWNHOLE ORIENTATION SYSTEM AND METHOD

Technical Field

A rotation activated downhole orientation system and method is disclosed. The system and method may be used to determine the orientation of a core sample extracted from the ground by a core or diamond drill.

Background of the Disclosure

Core sampling is used to enable geological surveying of the ground for various purposes including exploration, mine development and civil construction. Analysis of the material within the core sample provides information of the composition of the ground. Visual inspection of the core also enables a geologist to map ore veins and boundaries between different types of materials. However, to do so it is necessary to know the orientation of the core relative to the ground from which it was cut.

Many types of core orientation systems are currently available. Some of these systems comprise a bottom orientator that provides an indication of the bottom of the hole from which the core is extracted and an associated trigger mechanism. One type of trigger mechanism operates when the core drill contacts a toe of the hole to freeze or capture the bottom orientation of the hole indicated by the bottom orientator. An alternate type of trigger mechanism operates by the act of breaking the core from the ground.

The above reference to the background art does not constitute an admission that the art forms a part of the common general knowledge of a person of ordinary skill in the art. The above reference is also not intended to limit the application of the system and method as disclosed herein.

Summary of the Disclosure

Various aspects are disclosed of a system and method that enable the actuation or triggering of an orientator for a ground drill on the basis of rotational speed of the ground drill. The orientator provides an indication of the position of a reference bearing or location in or of a hole being drill by the core drill. The orientation of the core extracted from the hole is the same as the orientation of the section of the hole from

which the core is extracted.

Embodiments of the system rely on magnetic fields to switch the orientator between a free state in which the orientator is operable to provide an instantaneous indication of the orientation of the hole in which it resides; and a locked state which locks or freezes the instantaneous indication. In general terms, two embodiments of the system are disclosed for providing the magnetic field to actuate the orientator. In one embodiment a pump is operated by action of the rotation of the drill to apply a pressurised fluid that in turn moves a magnet to a position where its magnetic field is effective to switch the orientator from its locked state to its free state. When the speed of rotation of the drill drops below a threshold level, a bias mechanism operates to move the magnet in an opposite direction away from the orientator so that its magnetic field is no longer effective on the orientator thereby enabling the orientator to revert to its locked state. In an alternate embodiment an electric motor is provided that is operated by rotation of the drill. The electric motor produces a current that in turn drives an electromagnet. When the speed of the drill is greater than a threshold speed the electric current causes the generation of a magnetic field of sufficient strength to switch the orientator from its locked state to its free state. When the speed of the drill falls below the threshold speed the resultant current flow is insufficient to generate a magnetic field of a strength effective to hold the orientator in the free state. In that event the orientator reverts to the locked state.

Those of ordinary skill in the art of core or diamond drilling will recognise that a rotational speed of the drill string is 0 rpm immediately prior to a core break. Thus in one embodiment the threshold rotational speed of the drill may be set as 0 rpm. When the drill is being operated to drill a core the drill speed is greater than 0 rpm and the magnetic actuator acts to urge or hold the orientator in the free state. When the drill has stopped prior to a core break the drill speed is at the threshold speed of 0 rpm. The magnetic actuator no longer provides an effective magnetic field and allows the orientator to revert to the locked state to freeze the indication of orientation immediately prior to core breaking. However in alternate embodiments the threshold speed may be greater than 0 rpm. In one example the threshold speed could be up to 5 rpm. In this regard in embodiments of the system the orientator is biased in the absence of an external force to the locked state. Thus the magnetic actuator must overcome this bias to switch the orientator to the free state. According the threshold speed is just below the speed at which the magnetic field of the actuator becomes effective to overcome this bias of the orientator.

In one aspect there is disclosed a rotation activated orientation system for a ground drill comprising:

a magnetically operated orientator having a free state where the orientator provides a substantially instantaneous indication of a position of a reference bearing or location in or of a hole being drilled by the ground drill, and a locked state where the orientator maintains the indication; and,

a magnetic actuator operatively associated with the magnetically operated orientator wherein when the rotational speed of the ground drill is greater than a threshold speed the magnetic actuator supplies a magnetic field effective to place the orientator in the free state, and when the rotational speed of the drill is less than the threshold speed the magnetic actuator does not supply a magnetic field effective to operate the orientator so that the orientator reverts to or remains in the locked state.

In one embodiment the rotation activated orientation system comprises a time delay system arranged to delay the orientator in reverting from the free state to the locked state when the drill is rotating at a speed below the threshold speed.

In one embodiment the time delay system comprises a bleed path acting to restrict a flow rate of a fluid draining from a region which enables the orientator to move from a location corresponding to the free state to a location corresponding to the lock state.

In one embodiment the fluid is oil and the time delay system is a hydraulic time delay system which provides the time delay by restricting flow of oil through the bleed path.

In one embodiment the oil is transparent or translucent such that the indication provided by the orientator is visible through the oil.

In one embodiment the magnetic actuator comprises an electric machine or a fluid pump; and a coupling connected between the machine or the pump and the drill to impart torque to the machine or the pump when the drill rotates.

In one embodiment when the magnetic actuator is the pump, the magnetic actuator further comprises a magnet producing a magnetic field and a cavity in which the magnet is able to move between a first position where the magnet is spaced a distance from the orientator so that the magnetic field is not effective to place the orientator in the free state; and a second position where the magnet is sufficiently close to the

orientator so that its magnetic field places the orientator in the free state, and wherein the pump is operable to pressurise the fluid to move the magnet from the first position to the second position.

In one embodiment the magnetic actuator comprises a bypass flow path enabling fluid between the magnet and the orientator to flow from the cavity in response to the magnet moving from the first position toward the second position.

In one embodiment wherein the magnetic actuator comprises a high pressure path providing fluid communication between an outlet of the pump and the cavity on a side of the magnet distant the orientator wherein when the drill is rotating with a speed greater than the threshold speed the pump provides pressurised fluid through the high pressure flow path to move the magnet toward the second position.

In one embodiment the magnetic actuator comprises a fluid return path providing fluid communication between the cavity and an inlet of the pump.

In one embodiment the bleed path is arranged to enable a continuous circulating flow of fluid when the magnet is in the second position and while the drill is rotating at a speed greater than the threshold speed, wherein fluid flowing through the high pressure flow path and exerting pressure on the magnet holding the magnet in the second position is returned to the pump via the bleed path.

In one embodiment the rotation activated orientation system comprises a sump block disposed between the pump and the magnet, the sump block defining a fluid sump and being in direct fluid communication with the bleed path, the bypass path and the fluid return path.

In one embodiment the bleed path is formed in the sump block and provides fluid communication between the fluid sump and the side of the cavity distant the orientator.

In one embodiment the sump block comprises a bore that forms a part of the high pressure flow path.

In one embodiment the rotation activated orientation system comprises a bias mechanism acting to bias the magnet away from the second position and toward the first position, the bias mechanism arranged so that when the drill is rotated at a speed

greater than the threshold speed fluid pressure produced by the pump overcomes the bias mechanism and moves the magnet from the first position toward the second position; and when the drill is operated at a speed less than the threshold speed the bias mechanism is operable to move the magnet in a direction from the second position toward the first position.

In one embodiment when the magnetic actuator is an electric machine the electric machine comprises and electric generator arranged to generate an electric current when the drill is being rotated at a speed greater than the threshold speed.

In one embodiment the electric machine comprises an electro-magnet connected to the electric generator, the electro-magnet arranged to produce a magnetic field effective to place the orientator in the free state when the drill is being rotated at a speed greater than the threshold speed.

In one embodiment the orientator comprises a bias mechanism which accumulates potential energy when the orientator is being moved toward the free state by action of the magnetic actuator and converts the accumulated potential energy to kinetic energy when the drill is being rotated at a speed less than the threshold speed to return the orientator to the locked state.

In embodiments of the rotation activated orientation system the bleed path may operate as a fluid brake against action of the bias mechanism to restrict a rate of action of the bias mechanism in moving the orientator towards the locked position.

In a further aspect there is disclosed an orientation device comprising at least one orientation element and an associated closed loop race having a central axis in which the orientation element is confined, the race comprising first and second clamp members between which the orientation element is located the first and second clamp members being movable relative to each other between a free position where the clamp members are spaced sufficiently to enable the orientation element to roll about the axis within the closed loop race, and a locked position where the clamping members are moved toward each other to contact the orientation element, and wherein at least one of the clamping members is resiliently deformable wherein when the orientator is in the locked state, the resiliently deformable clamping members deforms about the orientation element.

In one embodiment clamping members comprises a resilient washer.

Brief Description of the Drawings

Notwithstanding any other forms which may fall within the scope of the system and method as set forth in the Summary, specific embodiments will now be described by way of example only with reference to the accompanying drawings in which:

Figure 1 is a longitudinal section view of a first embodiment of the system;
Figure 2 is an enlarged view of a portion of the system shown in Figure 1;
Figure 3 is an enlarged view of a portion of the system shown in Figure 1 and indicating an initial flow of fluid for switching an associated magnetically operated orientator from a locked to free state;
Figure 4 is a further view of the section of the system shown in Figure 3 of fluid now flowing in a steady state condition and holding the magnetically operated orientator in the free state;
Figure 5 is a view of the portion of the system shown in Figure 2 when the drill is stationary and the magnetically operated orientator is switching from the free state to the locked state;
Figure 6a is an isometric view from one angle of a sump block incorporated in the embodiment of the system shown in Figures 1 – 5;
Figure 6b is an isometric view of the sump block of Figure 6a but from an opposite angle;
Figure 7 is an isometric view of a magnetic coupling incorporated in the embodiment of the system shown in Figure 1;
Figure 8 is an isometric view of a spindle incorporated in the system shown in Figure 1;
Figure 9 is a representation of a core marking system that may be used in conjunction with the orientation system shown in Figure 1 for the purposes of providing an orientation mark on a core sample extracted by a core drill in relation to which the orientation system is used;
Figure 10 illustrates the core marking system coupled with a portion of the orientation system shown in Figure 1;
Figure 11a is an isometric view from the bottom of a magnetic cradle incorporated in the core marking system shown in Figures 9 and 10;
Figure 11b is an isometric view of the magnetic cradle shown in Figure 11a;
Figure 11c is an end view of the magnetic cradle shown in Figures 11a and 11b;
Figure 12 is a section view of a core tube assembly incorporating a second

embodiment of the orientation system;
Figure 13 is an enlarged view of a magnetically operated orientator incorporated in the embodiment of the system shown in Figure 12 when in a locked state;
Figure 14 is a representation of the magnetically operated orientator of Figure 13 in a free state;
Figure 15 is a representation of the orientator of Figure 14 illustrating a final possible position when in the free state; and,
Figure 16 is a representation of the orientator of Figures 13 – 15 when transitioning from the free state back to the locked state.

Detailed Description of the Preferred Embodiments

Figure 1 illustrates a pump embodiment of a rotation activated orientation system 10 (herein after "system 10") for a ground drill (not shown). The system 10 has a magnetically operated orientator 12 and an operatively associated magnetic actuator 14. The orientator 12 is disposed in a lower housing 16. A down hole end 17 of the housing 16 is coupled to an inner core tube 18 (which is only partly shown). The magnetic actuator 14 is coupled intermediate of the lower housing 16 and an upper housing 20. The upper housing 20 is connected at an up hole end to a back end assembly (not shown). The back end assembly enables the system 10 to be lowered and latched to a core barrel of the core drill and subsequently released and retrieved from the core barrel together with the inner core tube 18 and a core sample captured therein.

With particular reference to Figure 2, the orientator 12 has casing 22 with a cylindrical wall 24 and integrated radial wall 26 at one end, and a plug 28 that screws into an opposite end of the cylindrical wall 24. The casing is made of a transparent material so that its internal moving parts can be seen when lower housing 16 is separated from the screw coupling 64. An inside surface of the cylindrical wall 24 is formed with three axially spaced apart races 30a, 30b and 30c (hereinafter referred to in general as "races 30"). The races 30 are in the form of grooves which have a concave profile. Interleaved with the races 30 is a set of grooves 32a – 32c (hereinafter referred to in general as "grooves 32"). The races 30 are configured to partially seat and receive respective orientation elements in the form of balls 34a – 34c respectively (hereinafter referred to in general as "balls 34"). Each of the grooves 32 seat respective O-rings 36a – 36c (hereinafter referred to in general as "O-rings 36").

A "T" shaped plunger 38 extends coaxially within the casing 22. The plunger 38 is formed with a stem 46 having an increased diameter cap 40 at an end nearest the radial wall 26. The cap 40 has an outer diameter marginally smaller than an inner diameter the cylindrical wall 24. This provides a small clearance and fluid flow path to enable pressure equalisation on opposite sides of the disc as the plunger 38 slides axially within the casing 22. A permanent magnet 44 is disposed between the cap 40 and the radial wall 26. The magnet 44 is able to move or slide axially within the up hole portion 42. Optionally the magnet 44 can be attached to the cap 40.

The stem 46 has a constant outer diameter. A transverse through hole 48 is formed near a down hole end 50 of the stem 46. Additionally, a hole 52 is formed from the end 50 and extends axially along the stem 46 to the transverse hole 48.

Four spacer rings 54a-54d (hereinafter referred to in general as "spacer 54" or "spacers 54") are co-axially arranged on the plunger 38 about stem 46. The spacers 54 are separated by respective elastically deformable washers 56a – 56c (hereinafter referred to in general as "washers 56"). Specifically, washer 56a separates or is otherwise disposed between spacers 54a and 54b; washer 56b separates or is otherwise located between spacers 54b and 54c; and washer 56c separates or is otherwise disposed between the spacers 54c and 54d.

A bias mechanism in the form of a metal coil spring 58 is located about the stem 46 between the spacer 54d and the end 50. Further, the spring 58 is retained in a circumferential rebate 60 formed in the plug 28. The spring 58 is arranged to apply bias to the spacers 54 and consequently to the plunger 38 in a direction pushing the plunger 38 toward the radial wall 26. Thus the spring acts to bias the orientator toward the locked state. The plug 28 is formed with an axially cavity 62. The plunger 38 and cavity 62 are relatively dimensioned so that the plunger 38 can slide axially further into the cavity 62.

In the configuration shown in Figure 2, the orientator 12 is in its locked state with the spring 58 biasing the plunger 38 toward the radial wall 26 so that there balls 34 are clamped between the washers 56 and O-rings 36. It will also be seen that a space or gap exists between the end 50 and the bottom wall of the cavity 62. When the orientator 12 is in the free state (as shown in Figure 4) the plunger 38 is moved axially in a down hole direction so that the balls 34 are free to roll in their races. Additionally the end 50 is closer to or indeed contacts the bottom wall of the cavity 62.

The orientator 12 threadingly engages an inner circumferential wall of a screw coupling 64. The screw coupling 64 is integrally formed at the uphole end of the inner core tube 18. The lower housing 16 screws onto the screw coupling 64.

The interior of the outer casing 22 may be filled with a light transparent oil or at least translucent liquid. The balls 34 are made of a specific gravity greater than that of the oil. Therefore provided the orientator is in its free state and assuming that the system 10 is inclined from the vertical, the balls 34 will sink in the oil to a lowest point of their respective races 30. This results in the orientator 12 being a bottom of a hole orientator.

The depth of the races 30 and the outer diameter of the spacers 54 are arranged so that the balls 34 are confined in axial direction. That is, while the balls 34 many roll or otherwise move about their respective races 30 they are unable to roll out in an axial direction from their respective races 30.

The washers 56 and O-rings 32 co-operate to form respective clamps that either hold the balls 34 in place or release the balls 34 enabling them to roll in their respective races 30 about the stem 46. Thus the O-rings 32 and the washers 56 constitute first and second clamping members of the clamp. One or both of the claiming members can be resiliently deformable. In one embodiment at least the washers are resiliently deformable.

The orientator 12 is in the free state when a washer 56 and its corresponding O ring 32 are sufficiently spaced apart to not simultaneously contact the corresponding ball 34 to the extent to impede rolling of a ball 34 with a corresponding race 30. This configuration is depicted in Figure 4. However, when the orientator 12 is in the locked state for example is shown in Figure 2, the balls 34 are contacted on opposite sides by its respective washer 56 and O-ring 36. This achieved by action of the spring 58 pushing the spacer rings and plunger 42 hard up against the end wall 26.

The washers 56 of each clamp are configured so that when the orientator is in the locked state parts of the washers in contact with the ball resiliently deform about the ball by action of the spring. This forms a depression in the washers that cradle the balls. This provides greater contact area between a ball 34 and washer 56 than that in the event where the washer is not resilient deformable under the action of the spring.

With particular reference to Figures 1, 2 and 3, the magnetic actuator 14 in this embodiment comprises a magnetic drive gear pump 70 and magnets 72. The magnets 72 are axially moveable within a cavity 74. Magnetic drive gear pumps are readily available. One example of current use of such pumps is in the metering of liquid medicaments. The pump 70 is provided with a high pressure outlet 76 and lower pressure inlet port 78. The gears of the pump 70 are rotated by way of a magnetic coupling 80 which in turn is coupled to a spindle 82 (Fig 1). The spindle 82 is coupled to the back end assembly and rotates about its longitudinal axis when a corresponding drill rotates. The upper housing 20, the lower housing 16 and orientator 12 are rotationally decoupled from the spindle 82 by way of a swivel arrangement 84. The magnets 44 and 72 are arranged to have like poles facing each other. That is the magnets 44 and 72 produce magnetic fields that mutually repel.

The pump 70 is provided with a body 86 which houses the pump gears. The magnetic actuator 14 further includes a sump block 88 and an optional oil reservoir 90. The magnets 72 are retained within a piston 92 that is able to slide in axially direction within the cavity 74. The cavity 74 is defined between a dividing wall 94 formed in the lower housing 16 and the sump block 88. The sump block 88 is clamped onto the opposite end of the cavity 74 when the magnetic actuator 14 is attached to the lower housing 16. A return spring 96 acts between the dividing wall 94 and the piston 92/magnets 72 biasing the magnets 72 away from the magnet 44 of the orientator 12.

A high pressure flow path 98 extends from the pump outlet 76 and through the sump block 88 to provide high pressure fluid to a side of the magnets 72/piston 92 distant the orientator 12. The path 98 comprises a bore 100 formed in a body of the magnetic actuator 14 and a bore 102 formed in the sump block 88. The pump block 88 is further provided with an oil sump 104 and bleed path 106. The bleed path 106 extends through a plug 108 of the sump block 88 which fits in to the cavity 74. Further, the bleed path 106 provides fluid communication between sump 104 and a side of the magnets 72/piston 92 distant the orientator 12.

A bypass flow path 110 provides fluid communication between the cavity 74 and sump 104. The flow path 110 comprises in combination a bore 112 formed in the body of the lower housing 16 and which extends in an axially direction, and circumferential feed groove 114 formed on the inside wall of the cavity 74. A hole 116 formed in the sump block 88 provides fluid communication between the bypass flow path 110 and the

sump 104. Oil is returned from the sump 104 to the inlet port 78 via return path 118 which is formed as an axially extending bore in the body of the actuator 14.

The piston 92 is formed with a head 120 of an outer diameter marginally smaller than the inner diameter of the cavity 74. The head 120 is formed with a circumferential groove which seats a sealing ring 122. At an end of the piston 92 opposite the head 120 a cavity 124 is provided for seating and retaining the magnets 72. The return spring 96 is arranged to bias the piston 92 away from the orientator 12.

With particular reference to Figures 1, 7 and 8, the magnetic coupling 18 comprises a cup like structure 126 which is configured to fit over an end portion of the pump 70. The cup like structure 126 is formed with a plurality of recesses 128 which seat drive magnets 130. A connection post 132 extends axially from the cup like structure 126 in a direction way from the orientator 12. A hexagonal shaped hole 134 is formed axially in the post 132 and receives a hex key 136 formed at an end of the spindle 82. A circumferential groove 138 is formed in the post 132 near but inboard of its free end. The groove 138 seats a circlip 140 which holds the post 132 within bearings 142 seated in the upper end of the body of the actuator 14.

The spindle 82 extends through and is able to rotate axially within a spindle bearing 144 which threadlingly engages upper end of the upper housing 20. The spindle 82 also extends through upper and lower thrust bearings 146 and 148 respectively. The thrust bearing 146 and 148 are located adjacent opposite side of the spindle bearing 144. The thrust bearing 146 is also located adjacent a shut off valve 150. The shut off valve 150 is seated about the spindle 82 between the thrust bearing 146 and a stop 152 of the spindle 82.

A spring 154 acts between the thrust bearing 148 and a nut 156 threaded onto the spindle 82. The spring 154 acts to bias the spindle 82 in a direction toward the orientator 12 to maintain engagement of the hex key 136 in the hex hole 134. To this end, the spindle 82 is able to slide in an axial direction to operate the shut off valve 150.

The operation of the system 10 will now be described in detail.

As previously explained the system 10 is attached to a back end assembly and lowered by a wire line into a core drill. An inner core tube 18 is attached to an opposite

end of the system 10. Figures 1 and 2 depict the locked state of the system 10 which occurs when the rotational speed of the drill is at or below a threshold speed. In this example the threshold speed is 0 rpm. When the drill is at this speed (i.e. is not rotating) the pump 70 is not operating to pump oil from its outlet 76. Thus no fluid pressure is exerted on the magnets 72/piston 92. Rather the return spring 96 biases the magnets 72/piston 92 away from the orientator 12. Also the spring 60 is biasing the plunger 38 toward the wall 26 of the casing 22. This pushes the spacer rings 54 hard up against the cap 40 of plunger 38. This in turn brings the washers 56 in their closest proximity to the O-rings 36 clamping the balls 34 there between and preventing them from rotating in their races 30. The orientator 12 is accordingly in the locked state with the position of the balls 34 being locked or fixed by clamping action of the washers 56 and O-rings 36 on opposite sides of the balls 34. Due to the distance between the magnets 44 and 72 the magnetic field of the magnets 72 has no effect or at least has no effective interaction with the magnetic field of the magnet 44 for the purposes of pushing the plunger 38 in a down hole direction to release the balls 34 and the orientator 12 from the locked state.

When the drill rotates for example when operating to drill a core sample, torque is transferred via the spindle 82 to the magnetic coupling 80. The upper body 20, lower body 16 and the orientator 12 are rotationally decoupled from the drill by virtue of the swivel 84. The rotation of the magnetic coupling 80 operates the pump 70 causing fluid to be pumped from the high pressure port 76 through the high pressure path 98 to a region in the cavity 74 between the piston head 120 and the plug 108. Provided the flow rate is greater than the return flow rate through the bleed path 106 and the pressure of the fluid on the piston 92 is greater than that applied in a reverse direction by the spring 96, then the piston 92/magnets 72 will slide in an axial direction toward the orientator 12 compressing the spring 96. This flow rate may be considered to be the operational flow rate. The operational flow rate will occur when the drill rotates at a speed greater than the threshold speed. As previously exemplified this may be 0 rpm. However the threshold speed may be greater than 0 rpm. For example this may be 1-5 rpm. The threshold speed is set by design and is influenced by several factors including but not limited to the diameter of the bleed path 106 and spring constant of the spring 96.

As the magnets 72 move toward the orientator 12, oil within the cavity 74 between the piston head 120 and the wall 94 flows through the bypass flow path 110 and hole 116 into the sump 104 to be subsequently circulated through the pump 70 via the return

flow path 118. This circulation and movement of oil is depicted in Figure 3. Eventually the magnets 72 will move to within a distance where its magnetic field will be effective in repelling the field the magnet 44. Now the magnetic field from the magnets 72 is able to interact with the field of the magnet 44 repelling the magnet 44 and causing the magnet 44 together with the plunger 38 to move in a down hole direction away from the magnets 72. This releases the balls 34 enabling them to rotate in their respective races.

Eventually, the pumping of oil by the pump 70 through the high pressure path 98 forces the magnets 72/piston 92 to the bottom of the cavity 74 and abutting the wall 96. During continued rotation of the drill a small amount of oil is recirculated through the bleed path 106 to the sump 104 and return flow path 118. Thus the continued rotation of the drill maintains the operation of the pump 70 and fluid pressure on the magnets 72 holding the orientator 12 in the free state.

When the inner core tube 18 is full and it is necessary to break the core sample from the ground, the rotation of the drill is stopped. This results in the ceasing of rotation of the magnetic coupling 80 and consequently the pump 70 ceases pumping oil and applying pressure to the magnets 72/piston 92. As a consequence, the return spring 96 is now able to move or slide the magnets 72 axially away from the orientator 12 and toward the plug 108. This is achieved by way of a slow flow of oil through the bleed path 106. The bleed path 106 is of a relatively small diameter so that the flow of oil is relatively slow and thus the motion of the magnets 72 is slow. Oil which passes through the bleed path 106 to the sump 104 is then caused to flow back into the cavity 74 through the bypass flow path 110 as shown in Figure 5.

Due to the slow return motion of the magnets 72 the effect on the magnet 44 diminishes slowly resulting in the slow up hole motion of the plunger 38. This produces a time delay for the orientator 12 to switched back to its locked state from the time the drill speed is at or below its threshold speed. The time delay provides the balls 34 with time to settle to the lowest point within their respective races 30 and thereby provide an accurate indication of the bottom of the hole. The delay may mitigate effects of vibrations and linear movement of the drill after rotation has ceased and in preparation for a core breaking operation. In one example, the time delay for the orientator 12 to switch back to its lock position may be for example a time in the range of thirty seconds to one minute from the time the drill speed drops to or below the threshold speed. In

this way the bleed path 106 may be seen as forming at least in part a time delay system 160.

The pump 70 acts as a flow restriction and indeed a shut off valve in relation to fluid flowing from the inlet 78 to the outlet 76 when pump 70 is not rotating. This assists in restricting oil flow when the drill is not rotating. As such the pump when not rotating may also be considered as forming part of the time delay system.

The time delay system 160 in this embodiment is a hydraulic time delay system as it operates by restricting flow of a fluid through the bleed path 106. More particularly the time delay system 160 restricts the flow of fluid draining from a region 77. In this embodiment fluid may be in the form of a liquid. The liquid may have a viscosity greater than water. Further the liquid may have lubricating properties and/or provide protection against corrosion. The liquid may take the form of oil. Examples of oils that may be used include but are not limited to paraffin oil; engine oil and hydraulic oil. The region 77 in this embodiment is between the piston 92 and the sump block 88. Draining of the fluid from the region 77 enables the orientator 12 to move from a down hole location corresponding to the free state (Fig 4) to an up hole location corresponding to the locked state (Fig 2). The orientator 12 is enabled to move between these locations to effect the change from free state to locked state by virtue of the piston 92 and magnets 72 moving axially away from the magnet 44 of the orientator 12.

As will be understood if the drill speed where to increase to be above the threshold speed then the orientator 12 will revert to or at least tend towards the free state. This provides a self- setting or re-setting feature where for example the drill speed fell below the threshold speed prior to a core breaking operation and subsequently speed up back to the normal drilling speed.

The system 10 can then be returned to the surface with the inner core tube 18.

Once returned to the surface, the bottom of hole indication provided by the orientator 12 can be transferred to a core sample 170 held in the inner core tube 18 by use of a core marking system 180 depicted in Figures 9-11c. The core marking system 180 comprises a magnetic cradle 182, an orientation guide 184, and a core marking guide 186.

The magnetic cradle 182 comprises a block 188 having a planar base 190 of a rectangular shape and two opposed upright planar surfaces 192a and 192b. Two further side walls 194a and 194b are convexly curved and extend between the side walls 192a and 192b. A portion of the block 188 opposite the base 190 is formed with a channel 196 having a planar bottom 198 and opposite outwardly diverging planar walls 200a and 200b. One or more magnets 202 are embedded in each of the side walls 200a, 200b and the base 190.

The orientation guide 184 comprises a tube 204 having an inner diameter which is able to fit with light to moderate interference onto the outer casing 22 of the orientator 12. A longitudinal window or slot 206 is formed in the tube 204 and is dimensioned so that when the orientation guide 184 is fitted onto the orientator 12 each of the three orientation balls 34 can be viewed through the window 206 assuming that the balls 34 are substantially aligned. One end of the tube 204 is provided with a knob 208 in which is fitted a spirit level 210.

The core marking guide 186 comprises a tube 212 which is opened at one end 214. The tube 212 has an inner diameter which is dimensioned to engage and fit over the inner core tube 18 with light to moderate interference. The light to moderate interference fitting of the orientation guide 184 and core marking guide 186 is to enable the respective guides to be fitted on and removed by hand but maintain sufficient grip so as to maintain their position in the absence of being manipulated by hand.

A longitudinal slot 216 is formed in the tube 212 from an intermediate location 218 inboard of the opening 214 and extending to a radial semicircular face 220 at an opposite end of the tube 212. A marking hole 222 is formed in the face 220 in alignment with the slot 216. A semi cylindrical extension 224 projects axially of the tube 212 and is fitted with a spirit level 226.

The manner of use of the core marking system 180 will now be described. Once the core breaking operation has been completed and the system 10 has been retrieved the lower housing 16 together with the actuator 14 and upper housing 20 is unscrewed or otherwise decoupled from the inner core tube 18 and the orientator 12. This is achieved by unscrewing the thread about the screw coupling 64 at an uphole end of the inner core tube 18. Thus the orientator 12 remains with the inner core tube 18 and the casing 22 and orientation balls 34 are now exposed and visible.

The magnetic cradle 182 is placed on a ferromagnetic (for example steel) bench. Due to the magnets 202 in the bottom wall 190 the cradle 182 is magnetically held on the bench. Next the inner core tube 18 is seated in the valley 196 with the orientator 12 extending from one side of the cradle 182 and the core sample 170 extending from an opposite side. The magnets 202 in the inclined walls 200a and 200b hold the rotational and translational position of the core tube 18 until changed by manually rotating or translating the tube 18 against the magnetic attraction force applied by the magnets 202.

The position of the balls 34 is fixed or locked by action of the orientator 12. When placing the inner core tube 18 on the cradle 182 the balls 34 should be visible and in particular approximately in a vertical plane. The orientation guide 184 is now fitted over the outer casing 22 and manipulated so that the orientation balls 34 are visible through the slot 206. The position of the spirit level 208 is now viewed. If the spirit level 208 does not indicate a horizontal plane then the inner core tube 18 is manually rotated within the valley 196 so that the spirit level 210 indicates that it is now lying in a horizontal plane. The core marking guide 186 is now fitted on an opposite end over a portion of the core sample 170 and onto the inner core tube 18. The core marking guide 186 is rotated about the inner core tube 18 until the spirit level 226 indicates that it is lying in a horizontal plane. Thus now the two spirit levels 226 and 210 indicate that the slots 216 and 206 are aligned.

In the present embodiment, the balls 34 are locked by the system 10 when in use to indicate the location of the bottom of a hole from which the core sample 170 is extracted. By using a marker pencil or a scribe, a mark is placed through the slot 216 on the circumferential portion of the core sample 170 extending from a core lifter case 228 of the inner core tube 18. This mark will be in the form of a line if the pencil or scribe is moved along the slot 216. Additionally, if desired or required a further bottom of the hole mark can be placed on a radial face of the core sample 170 by inserting a pencil or marking scribe through the hole 222.

Now that an indication of the bottom of the hole has been transferred onto the core sample 170 the orientation guide 184 and core marking guide 186 can be removed and the core sample 170 extracted from the inner core tube 18. The inner core tube 18 and orientator 12 can then be reconnected to the remaining parts of the system 10 and reused to orientate a subsequent core sample.

Figure 12 illustrates a further embodiment of the system designated as system 10'. The features of the system 10' that are identical to those of the system 10 are denoted with the same reference numbers. The features however which differ but function in a similar manner are indicated with the same reference number as for the system 10 but with the addition of the prime symbol (').

The substantive differences between the systems 10 and 10' lie in the: form of the actuator 14'; and, various components of the orientator 12' to provide the return time delay when the rotational speed of the drill drops below the threshold speed. The magnetic actuator 14' in this embodiment comprises an electric generator 230 and an electromagnet 232 which together produce a magnetic field to repel the magnet 44 when the rotational speed of the drill is greater than the threshold speed. The generator 230 has a drive shaft 234 at an uphole end which may be formed with a hexagonal hole (not shown) of the same configuration as the hole 134 of the coupling 80 in the first embodiment. This hole receives the hex key 136 of the spindle 82. Engagement of the hexagonal hole 134 and the key 34 enables axial motion of the spindle 82 when the shut off valve 150 is activated and subsequently released. This action is exactly the same as in the first embodiment.

The electromagnet 232 comprises an outer magnetic coil 236 and an electro-magnet core 238. When the drill is rotated the electric generator 230 generates a current that is fed to the coil 236 to induce a magnetic field in the core 238. The current circulates in a direction so that lines of magnetic flux of the electro magnet 232 at a down hole end produce a pole of the same polarity as the facing end of the magnet 44. An electronic control chip 240 of the magnetic actuator 14' regulates the current/voltage to the coil 236. In particular, the electronic control chip 240 limits the maximum current delivered to the coil 236. This is provided as a safety mechanism to minimise the risk of burning out the coil 236 in the event that the rotational speed of the drill for some reason substantially exceeds the expected normal drilling speed.

The orientator 12' in the system 10' comprises an outer casing 22' made of a transparent plastics material and of generally the same shape and configuration as that of the orientator 12. However an additional race 242 is formed in the inner circumferential surface of the casing 22' for seating a floating ball 244. The ball 244 has a specific gravity greater than that of the oil in which it is immersed and will float to a highest position in a hole containing the system 10' when the system 10' is inclined from the vertical. The ball 244 however is not clamped and is always able to freely

move within the race 242.

The plunger 38' comprises a stem 46' having an axially extending blind hole 246 which terminates at an intermediate location 248 along the length of the stem 46'. The purpose of the hole 246 is simply to reduce the weight of the stem 46'. The open end of the hole 246 is closed by a cap 40' which is provided with a seat for holding the magnet 44. Axially extending holes 247 are formed in the cap 40'. The stem 46' is also formed with a transverse through hole 48 and a hole 52 extending axially from the end 50 to the hole 48 as in the plunger 38. However in this embodiment a one way or non-return valve 250 is seated in the hole 52. The valve 250 enables a flow of oil in a direction from the end 50 up through the hole 52 and into the transverse hole 48. However the valve 250 prevents a flow of oil in a direction from the hole 48 into the hole 52. A lower end of the cavity 62' is formed with a circumferential shoulder 257 that acts as a stop to limit for the travel of the plunger 38' when being stoked down by the magnetic field of the actuator 14'. The shoulder is created by tapering the bottom portion of the interior surface of the cavity 62' to form a conical surface 259.

The time delay in the return stroke of the plunger 38', which changes the state of the orientator from the free state to the locked state, is achieved by the provision of a time delay system 160' that is housed within the plug 28' of the orientator 12' and interact with the plunger 38' in its return stroke to the locked position.

The plug 28' is of a different configuration to that of the orientator 12 and has an up hole portion 256 that progressively reduces in outer diameter in an up hole direction. This forms an annular flow path 258 between the inner surface of the casing 22' and the outer circumferential surface of the up hole portion 256. A transversely extending through hole 260 is formed in the up hole portion 256. A bleed path 106' extends in an axial direction from the hole 260 to axial cavity 62' formed in the plug 28'. An adjustable needle valve 264 is housed in a cavity 266 in the plug 28' and is provided with a tapered needle point 268 that extends into the bleed path 106'. The position of the needle point 268 in the bleed paths 106' can be controlled by a screw disc 270 that threadingly engages the cavity 266. A spring 272 is retained about the needle valve 264 and maintains the position of the needle point 268 in the bleed path 106' in accordance with the position of the screw disc 270. By turning the screw disc 270 either clockwise or anticlockwise the position of the needle point 268 in the bleed path 106' can be controlled thereby controlling the amount of oil that can flow through the bleed path 106'.

The operation of the system 10' will now be described in detail. When the rotational speed of the drill is at or below the threshold rotational speed the generator 230 produces current but not sufficient to generate a magnetic field of a strength that is effective to interact with the magnet 44 of the orientator 12' for the purpose of changing its state from its rest or initial locked state where the balls 34 are clamped between washers 56 and O-rings 36. Again, this threshold speed can be 0 rpm or a higher speed. However when the drill is in operation drilling a core sample, the rotational speed of the drill is above the threshold speed. In this event the electric generator 230 generates a voltage and current sufficient such that the electromagnet 232 produces a magnetic field of an intensity effective to interact with the magnetic field of the magnet 44 to push the plunger 38' in a down hole direction against the bias of spring 58.

Figure 14 depicts the axial motion of the plunger 38' in the downhole direction caused by the magnetic field applied by the electromagnet 232. As the plunger 38' moves in this direction the washers 56 are moved away from the balls 34 thereby allowing them to freely roll in their respective races 30 under the influence of gravity. The non-return valve 250 allows oil within the cavity 62' to flow through the hole 52 and hole 48 thereby preventing a hydraulic lock which may otherwise resist the downward motion of the plunger 38'. Additionally, a flow of oil occurs through the holes 247 formed in the cap 40'. This allows an equalisation of oil pressure on opposite sides of the cap 40'.

The non-return valve 250 is of a conventional construction having a valve ball/head that is lightly biased by a spring (not shown) onto a valve seat (not shown). When the plunger 38' is moved in a downhole direction as indicated in Figure 14, the oil is able to push the ball against the light spring opening the non-return valve. However once the flow of oil ceases, the valve spring is able to return the valve ball/head back on its seat thereby closing the valve.

Figure 15 depicts the configuration of the orientator 12' after the drill has been rotating at a speed greater than the threshold speed for a relatively short period of time such as but not limited to 20 – 30 seconds. The plunger 38' is moved to its maximum extent in the down hole direction with the down hole end 50 of the stem 46 abutting the circumferential shoulder 257 formed in the cavity 62' by the tapered side walls 259.

As drilling continues, the plunger 38' is maintained in the position shown in Figure 15. However there is now no flow of oil within the housing 22'. The bias mechanism, i.e.

spring 58 is now in its most compressed state and has accumulated potential energy from the kinetic energy of the previously moving plunger 38'.

When the speed of the drill drops to or below the threshold speed, for example when the drill stops rotating prior to performing a core breaking operation, the magnetic field provided by the electromagnet 232 no longer exists. Thus the plunger 38' is now urged to return to the locked position by action of the spring 58. The spring 58 releases its accumulated potential energy which is converted to kinetic energy in moving the plunger 38' toward locked state. The spring 58 pushes the spacer rings 54a – 54d hard up against the cap 40' and consequently biases the plunger 38' and the washers 56 in an up hole direction. This action returns the orientator 12' back to the locked state. During this return action the time delay system 160' operates to enable a flow of oil back into the cavity 62' with a time delay. Without this oil flow the plunger 38' may be hydraulically held in the free state due to the non-return valve 250 preventing a flow of oil in a direction from the hole 48 through the hole 52 back into the cavity 62'.

The flow of oil into the cavity 62' via the time delay system 160' is shown by arrows 275 in Figure 16. The time delay system 160' acts to allow oil to flow back into the cavity 62' via the annular flow path 258, hole 260 and bleed path 106'. The amount of oil admitted through the bleed path 106' is controlled to provide a time delay for switching of the orientator 12' back to the locked state. The flow of fluid back to the cavity 62' acts as a fluid brake against the release of the potential energy of the spring 58 thus providing the time delay. This time delay may for example be in the order of thirty seconds to one minute. As with the previous embodiment, the time delay provides time for the balls 34 to fall to the lowest position in their races 30 prior to the core breaking action. As with the embodiment of Figures 1 – 5 the time delay system 160' also acts to restrict the flow of fluid draining from a region 77'. Here the region 77' is the volume of the casing 22' bar the cavity 62'. The bleed path 106' provides restricted flow of fluid from the region 77' into the cavity 62' thereby enabling the orientator 12' to move from a down hole location corresponding to the free state (Fig 15) to an up hole location corresponding to the locked state (Fig 13).

The floating ball 244 is always free to rotate or roll within its race 242 and thus will always position itself at the highest location within the race 242 commensurate with the inclination of the system 10'.

Once the system 10 has been retrieved the location of the bottom of the hole from

which the core sample was extracted can be marked in exactly the same way as described herein before above using the core marking system 180. The provision of the floating ball 244 provides an additional level of confidence or accuracy in provision of the marking. Specifically, when the inner core tube 18 has been rotated within the magnetic cradle 182 so that the balls 34 are in alignment and both the spirit levels 220 and 226 are indicative of respective horizontal planes, the floating ball 244 should also be in alignment with the balls 34 and the slots 206 and 216.

However the provision of the floating ball 244 provides an alternate and slightly simpler way of marking the location of the bottom of the hole. This method still utilises the cradle 182 but does not require the orientation guide 184. In effect the floating ball 244 within the race 242 acts in a manner identical to the spirit level 210. Thus all that is required is that once the inner core tube 18 is placed within the cradle 182, inner core tube 18 needs to be rotated so that the ball 244 is in alignment with the balls 34. When this occurs, a line that passes through the balls 34 and 244 is representative of the bottom of the hole and thus marking or transferring such a line onto the core sample 170 via the core marking slot 216 and/or hole 222 provides a record on the core 170 itself of the position of the bottom of the hole.

Now that embodiments of the invention have been described in detail it will be apparent to those skilled in the art that numerous modifications and variations can be made without departing from the basic inventive concepts. For example the orientators 12 and 12' are described as comprising three rolling balls, however the number of rolling balls greater than one is not critical to the operation of the embodiment, only to the degree of confidence of the bottom of hole indication. Also in the embodiment comprising the pump 70, the fluid is described as oil, however the fluid can be other liquids or indeed could be a gas. Further while the embodiments are described in the context of core drilling and core orientation their application extends to at least hole orientation irrespective of whether or not a core sample is being extracted. All such modifications and variations together with others that would be obvious to those of ordinary skill in the art are deemed to be within the scope of the disclosed orientation system and method the nature of which is to be determined from the above description and the appended claims.

The claims defining the invention are as follows:

1. A rotation activated orientation system for a ground drill comprising:

a magnetically operated orientator having a free state where the orientator provides a substantially instantaneous indication of a position of a reference bearing or location in or of a hole being drilled by the ground drill, and a locked state where the orientator maintains the indication; and,

a magnetic actuator operatively associated with the magnetically operated orientator wherein when the rotational speed of the ground drill is greater than a threshold speed the magnetic actuator supplies a magnetic field effective to place the orientator in the free state, and when the rotational speed of the drill is less than the threshold speed the magnetic actuator does not supply a magnetic field effective to operate the orientator so that the orientator reverts to or remains in the locked state.

2. The rotation activated orientation system according to claim 1 comprising a time delay system arranged to delay the orientator in reverting from the free state to the locked state when the drill is rotating at a speed below the threshold speed.

3. The rotation activated orientation system according to claim 2 wherein the time delay system comprises a bleed path acting to restrict a flow rate of a fluid draining from a region which enables the orientator to move from a location corresponding to the free state to a location corresponding to the lock state.

4. The rotation activated orientation system according to claim 3 wherein the fluid is oil and the time delay system is a hydraulic time delay system which provides the time delay by restricting flow of oil through the bleed path.

5. The rotation activated orientation system according to claim 4 wherein the oil is transparent or translucent such that the indication provided by the orientator is visible through the oil.

6. The rotation activated orientation system according to any one of claims 1 to 5 wherein the magnetic actuator comprises an electric machine or a fluid pump; and a coupling connected between the machine or the pump and the drill to impart torque to the machine or the pump when the drill rotates.

7. The rotation activated orientation system according to claim 6 when dependant

directly or indirectly on claim 3 wherein when the magnetic actuator is the pump, the magnetic actuator further comprises a magnet producing a magnetic field and a cavity in which the magnet is able to move between a first position where the magnet is spaced a distance from the orientator so that the magnetic field is not effective to place the orientator in the free state; and a second position where the magnet is sufficiently close to the orientator so that its magnetic field places the orientator in the free state, and wherein the pump is operable to pressurise the fluid to move the magnet from the first position to the second position.

8. The rotation activated orientation system according to claim 7 wherein the magnetic actuator comprises a bypass flow path enabling fluid between the magnet and the orientator to flow from the cavity in response to the magnet moving from the first position toward the second position.

9. The rotation activated orientation system according to claim 7 or 8 wherein the magnetic actuator comprises a high pressure path providing fluid communication between an outlet of the pump and the cavity on a side of the magnet distant the orientator wherein when the drill is rotating with a speed greater than the threshold speed the pump provides pressurised fluid through the high pressure flow path to move the magnet toward the second position.

10. The rotation activated orientation system according to any one of claims 7 to 9 wherein the magnetic actuator comprises a fluid return path providing fluid communication between the cavity and an inlet of the pump.

11. The rotation activated orientation system according to any one of claims 7 to 10 wherein the bleed path is arranged to enable a continuous circulating flow of fluid when the magnet is in the second position and while the drill is rotating at a speed greater than the threshold speed, wherein fluid flowing through the high pressure flow path and exerting pressure on the magnet holding the magnet in the second position is returned to the pump via the bleed path.

12. The rotation activated orientation system according to claim 11 comprising a sump block disposed between the pump and the magnet, the sump block defining a fluid sump and being in direct fluid communication with the bleed path, the bypass path and the fluid return path.

13. The rotation activated orientation system according to claim 12 wherein the bleed path is formed in the sump block and provides fluid communication between the fluid sump and the side of the cavity distant the orientator.

14. The rotation activated orientation system according to claim 12 or 13 wherein the sump block comprises a bore that forms a part of the high pressure flow path.

15. The rotation activated orientation system according to any one of claims 7 to 14 comprising a bias mechanism acting to bias the magnet away from the second position and toward the first position, the bias mechanism arranged so that when the drill is rotated at a speed greater than the threshold speed fluid pressure produced by the pump overcomes the bias mechanism and moves the magnet from the first position toward the second position; and when the drill is operated at a speed less than the threshold speed the bias mechanism is operable to move the magnet in a direction from the second position toward the first position.

16. The rotation activated orientation system according to claim 15 wherein the bleed path operates as a fluid brake against action of the bias mechanism to restrict a rate of action of the bias mechanism in moving the orientator towards the locked position.

17. The rotation activated orientation system according to claim 6 when dependent directly or indirectly on claim 3 wherein when the magnetic actuator is an electric machine the electric machine comprises and electric generator arranged to generate an electric current when the drill is being rotated at a speed greater than the threshold speed.

18. The rotation activated orientation system according to claim 17 wherein the electric machine comprises an electro-magnet connected to the electric generator, the electro-magnet arranged to produce a magnetic field effective to place the orientator in the free state when the drill is being rotated at a speed greater than the threshold speed.

19. The rotation activated orientation system according to claim 17 or 18 wherein the orientator comprises a bias mechanism which accumulates potential energy when the orientator is being moved toward the free state by action of the magnetic actuator and converts the accumulated potential energy to kinetic energy when the drill is being

rotated at a speed less than the threshold speed to return the orientator to the locked state.

20. The rotation activated orientation system according to claim 19 wherein the bleed path operates as a fluid brake against action of the bias mechanism to restrict a rate of action of the bias mechanism in moving the orientator towards the locked position.

21. An orientation device comprising at least one orientation element and an associated closed loop race having a central axis in which the orientation element is confined, the race comprising first and second clamp members between which the orientation element is located the first and second clamp members being movable relative to each other between a free position where the clamp members are spaced sufficiently to enable the orientation element to roll about the axis within the closed loop race, and a locked position where the clamping members are moved toward each other to contact the orientation element, and wherein at least one of the clamping members is resiliently deformable wherein when the orientator is in the locked state, the resiliently deformable clamping members deforms about the orientation element.

22. The orientation device according to claim 21 wherein one of the clamping members comprises a resilient washer.

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FIGURE 1

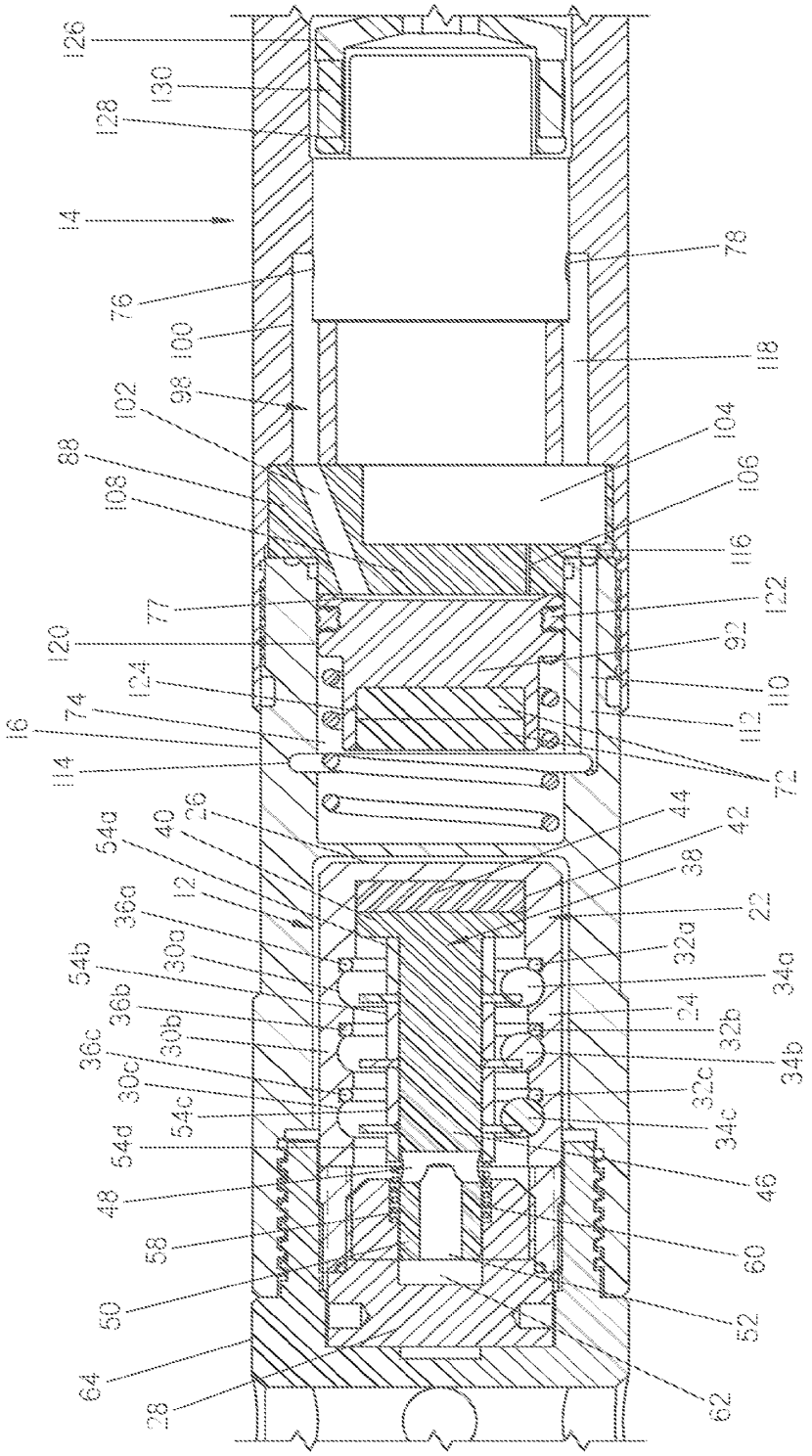

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36a
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30a
32a
54b
34a
36b
24
32b
30b
36c
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FIGURE 2

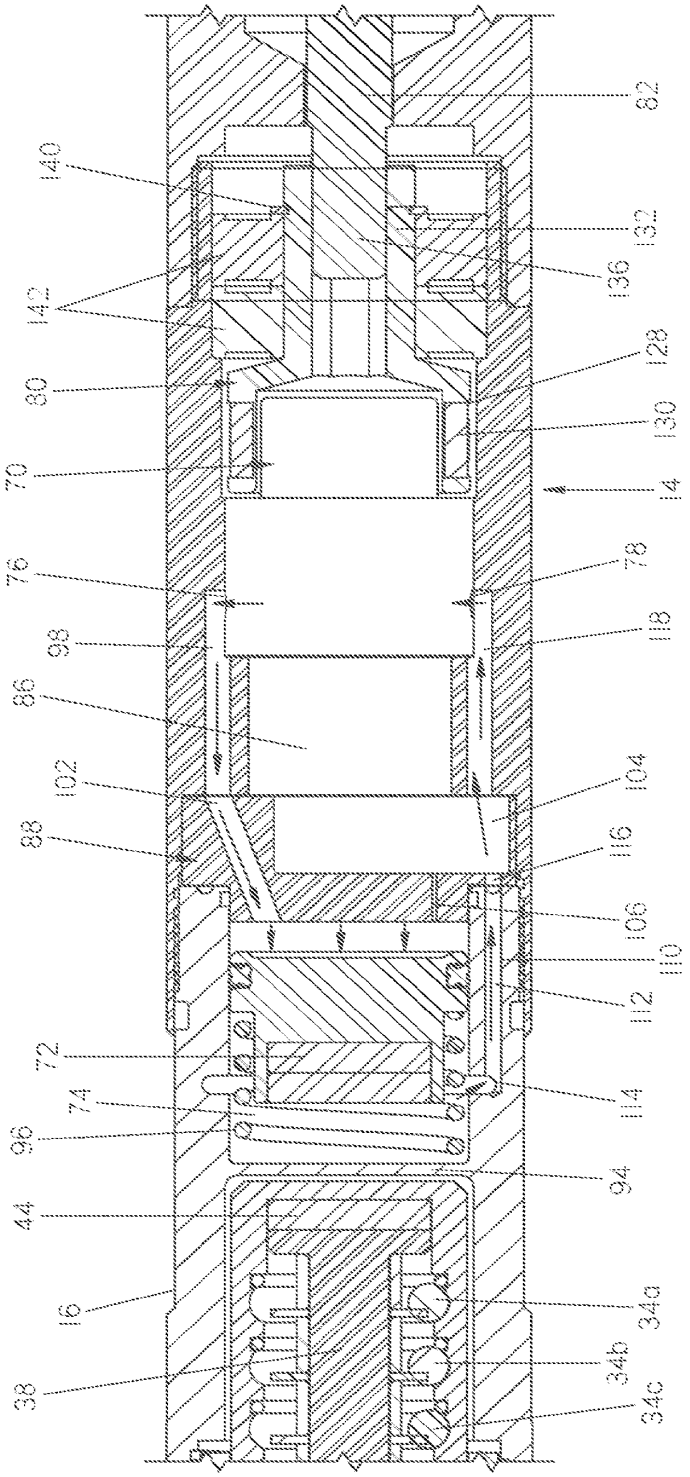

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34b
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FIGURE 3

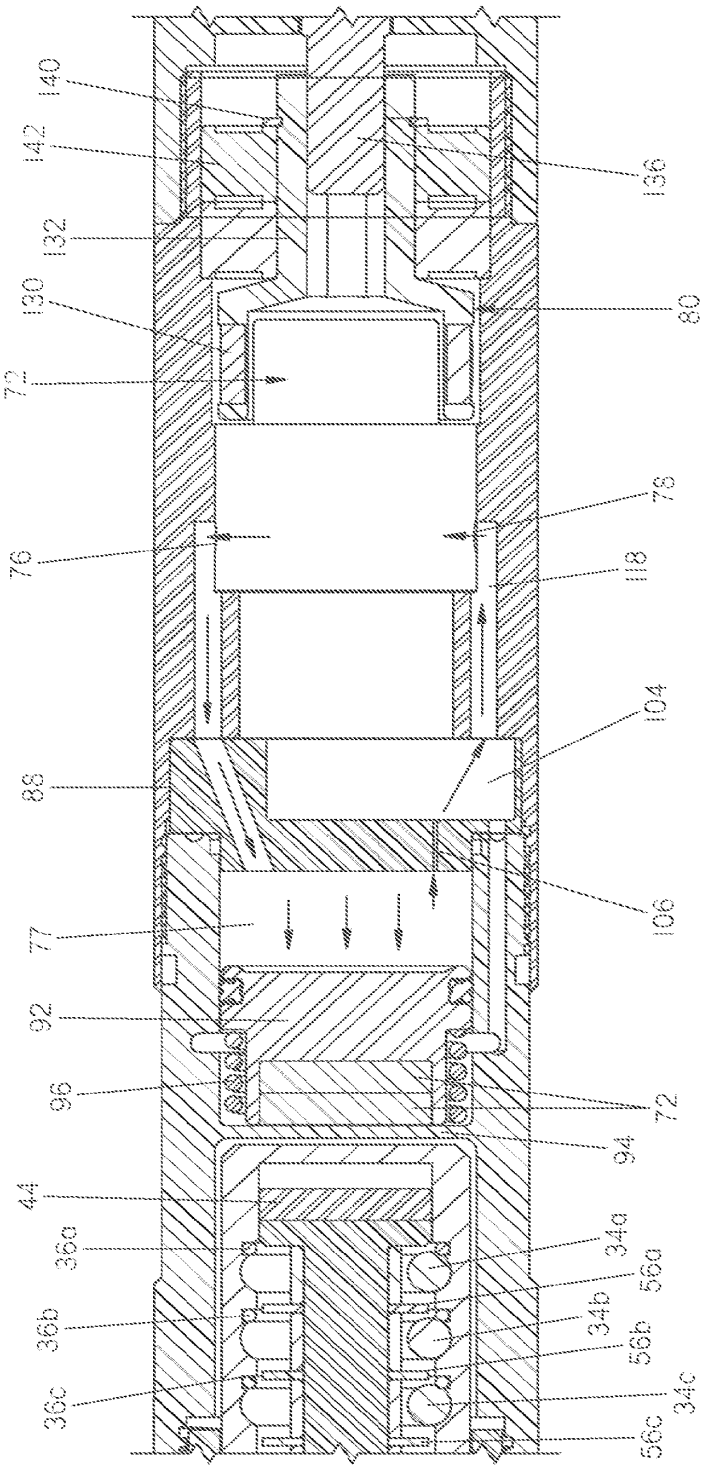

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34a
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36b
34b
56b
36c
34c
56c

FIGURE 4

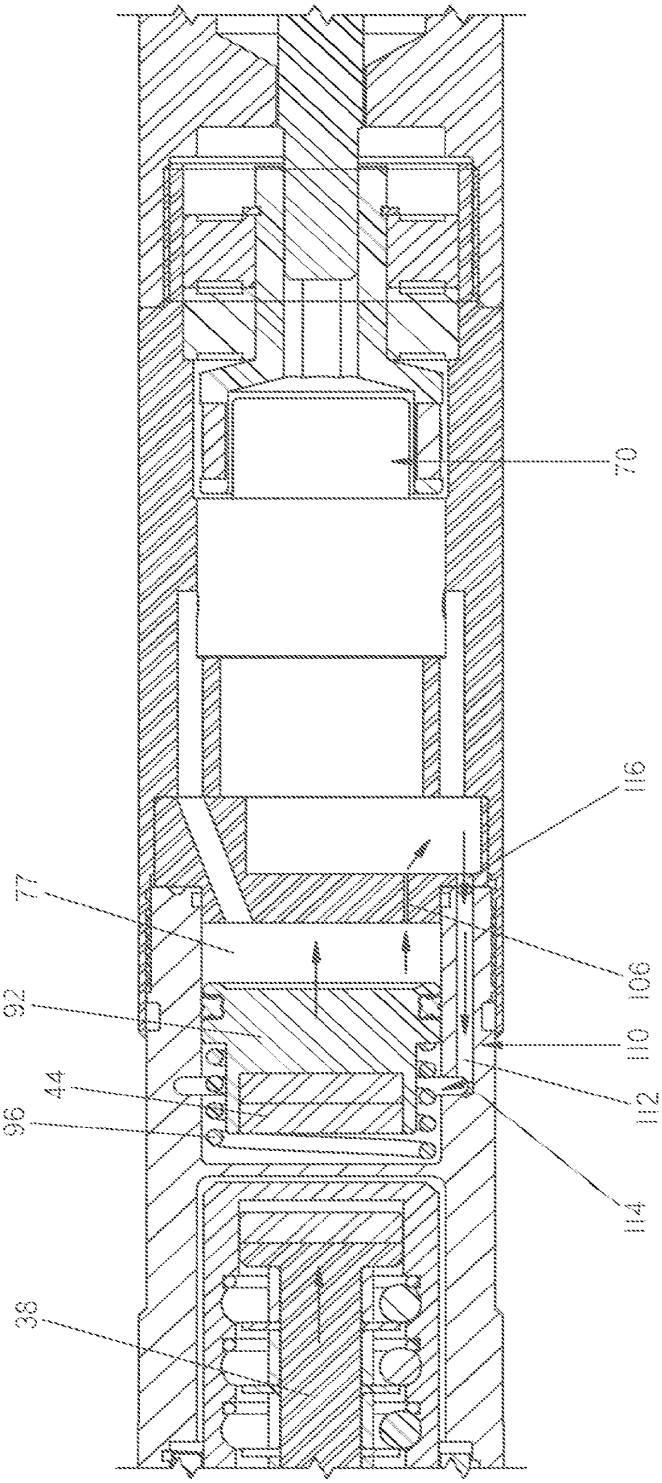


FIGURE 5

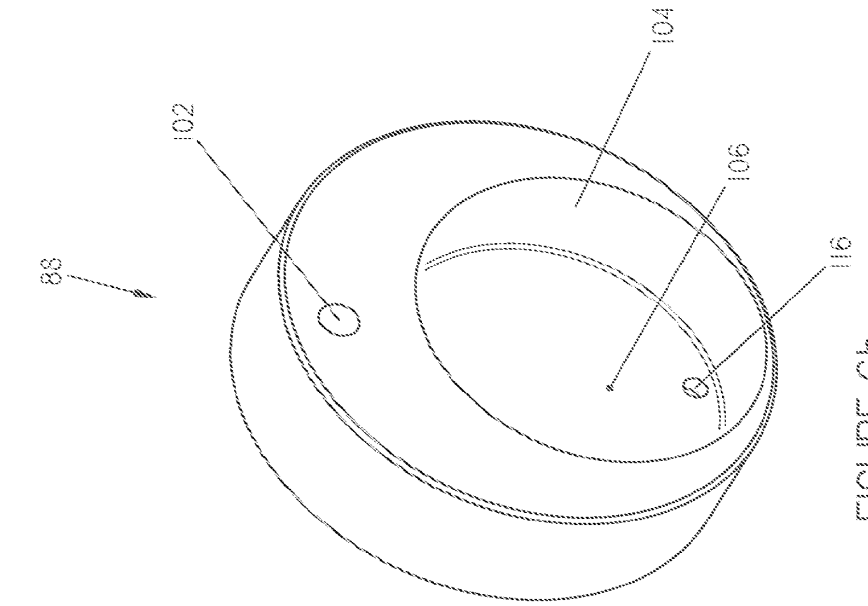


FIGURE 6b

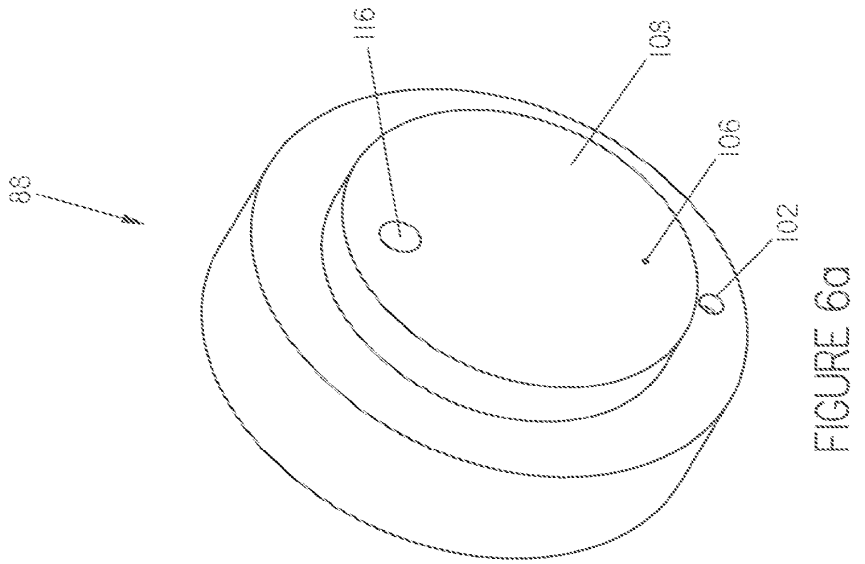


FIGURE 6a

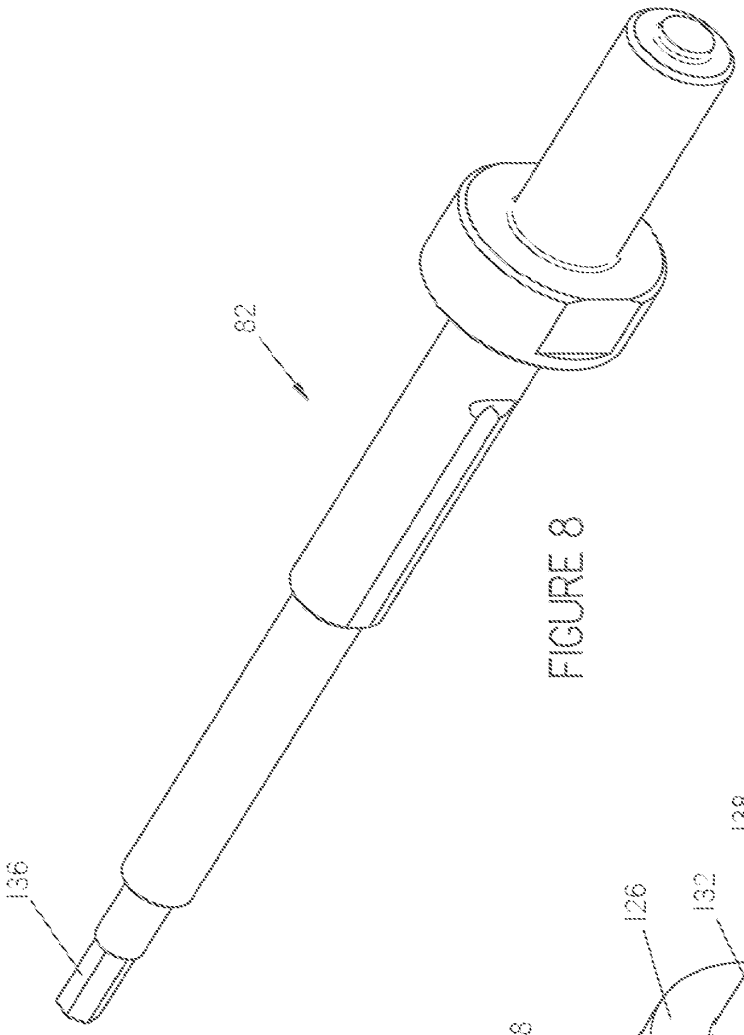


FIGURE 8

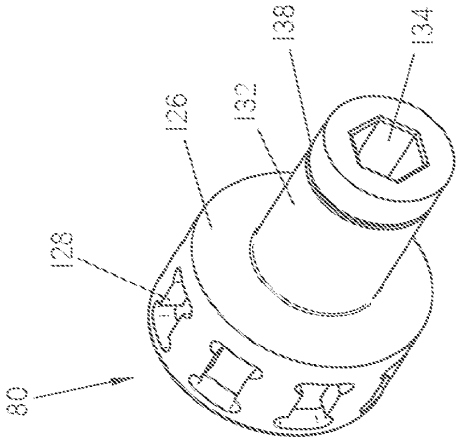


FIGURE 7

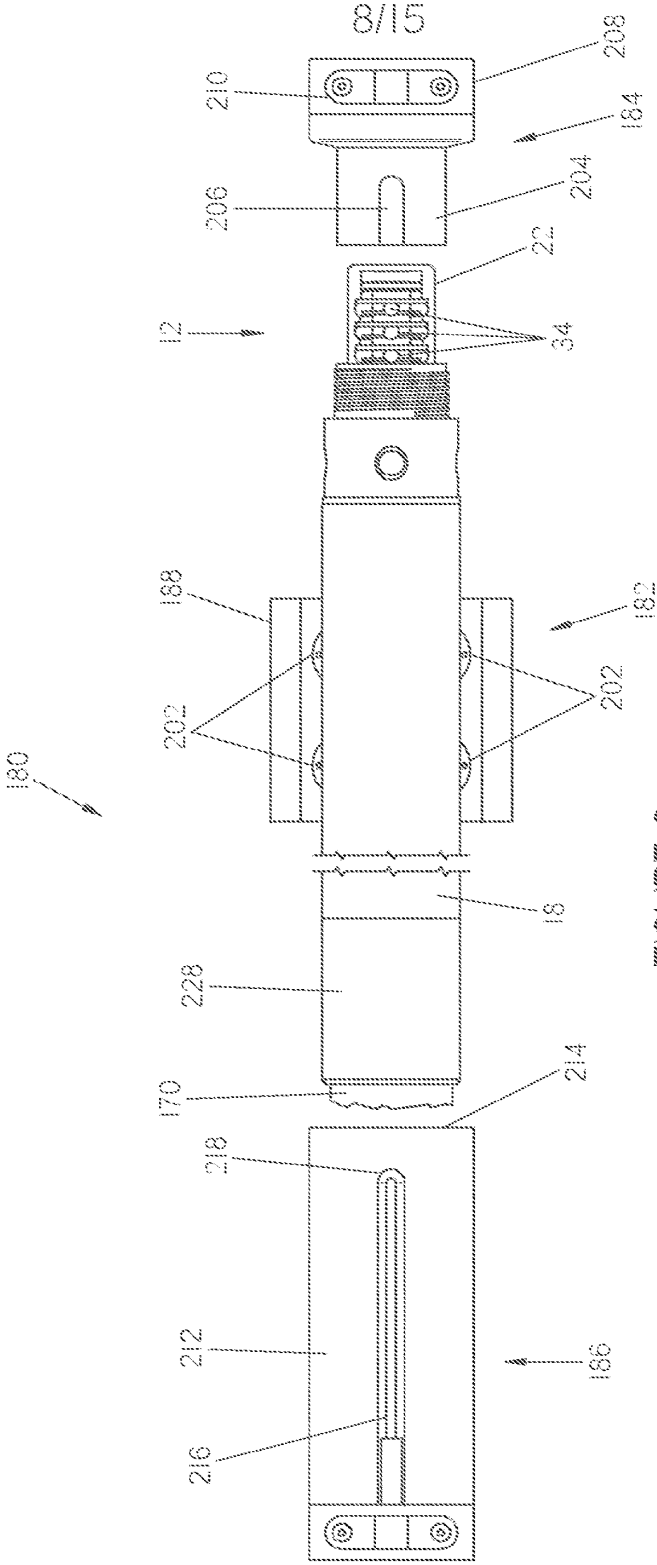

208
210
184
204
206
22
12
34
188
182
202
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180
18
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214
170
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212
186
216

FIGURE 9

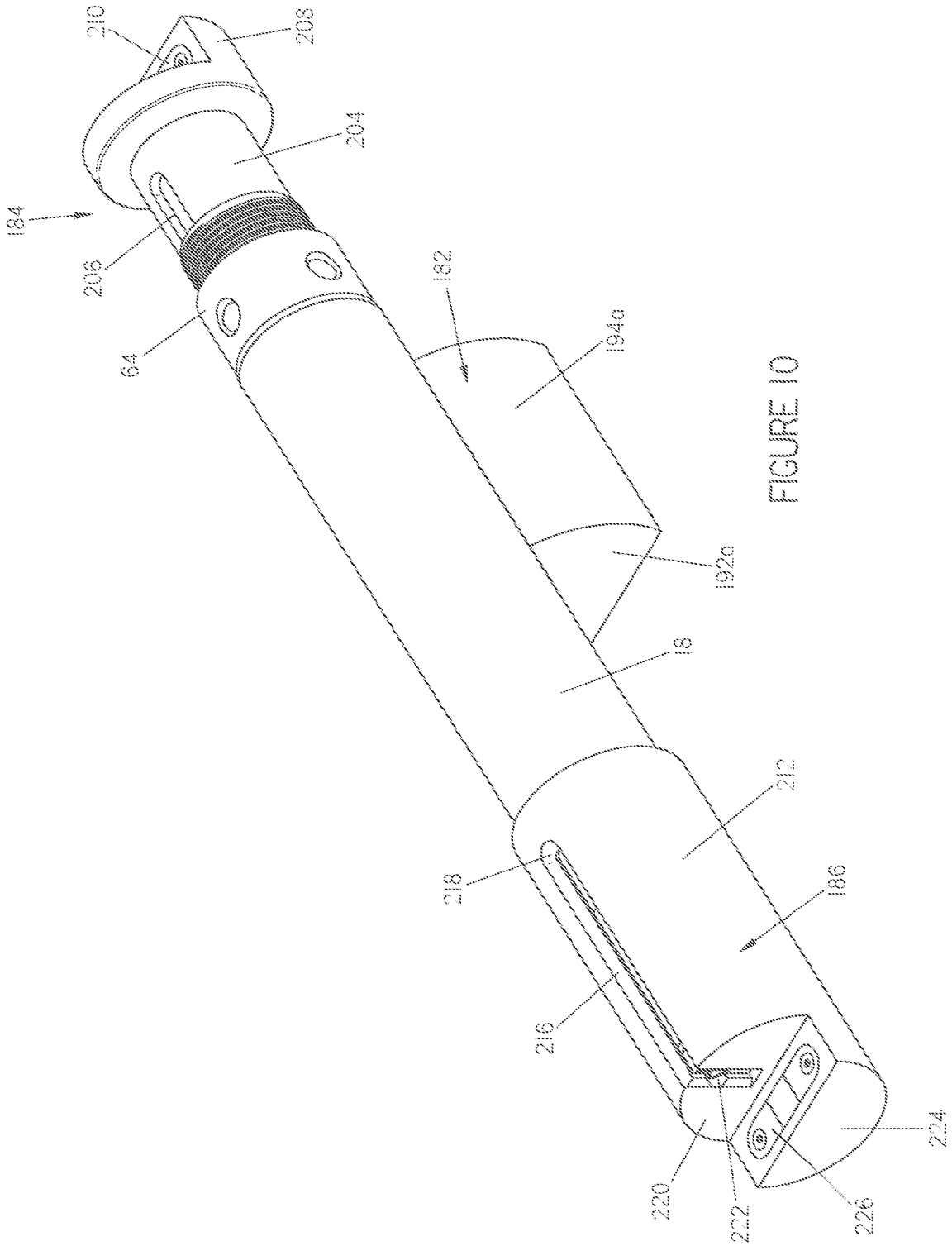

210
208
204
184
206
182
64
194a
192a
18
212
218
186
216
220
222
226
224

FIGURE 10

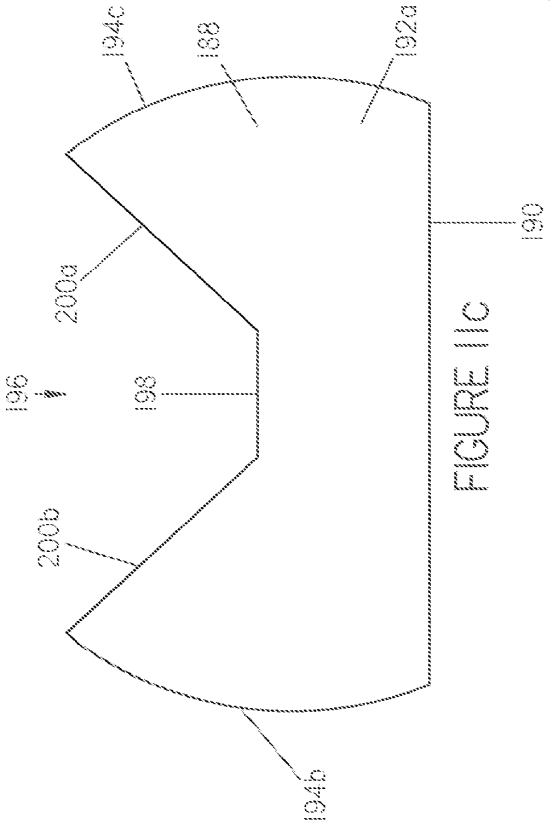


FIGURE IIc

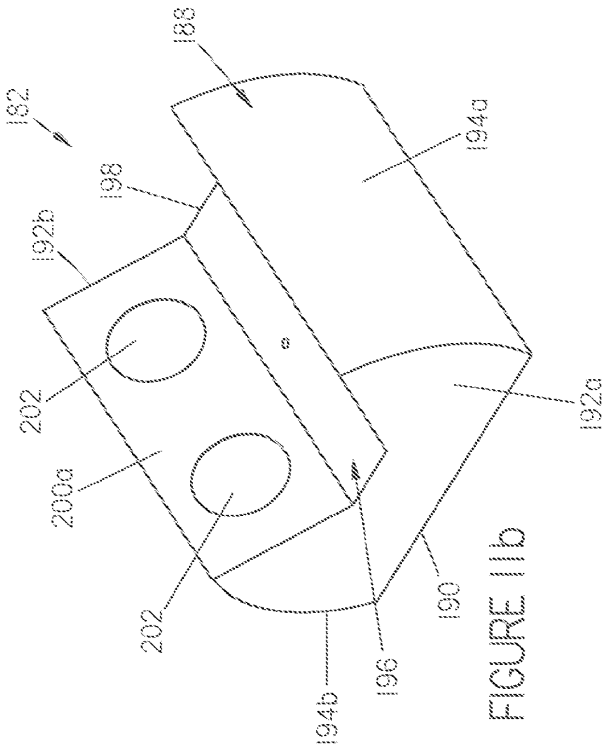


FIGURE IIb

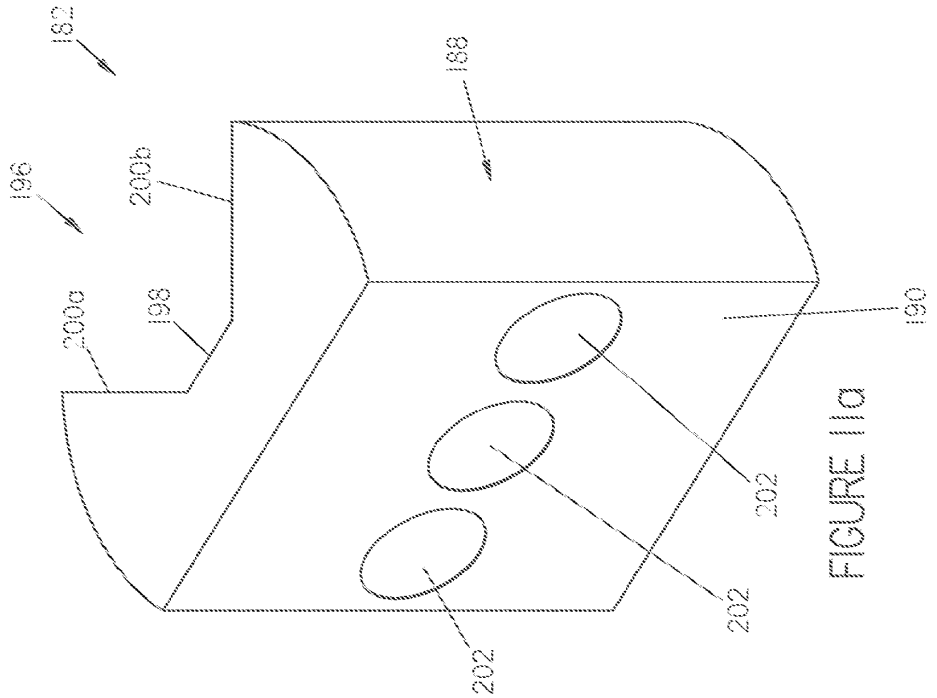


FIGURE IIa

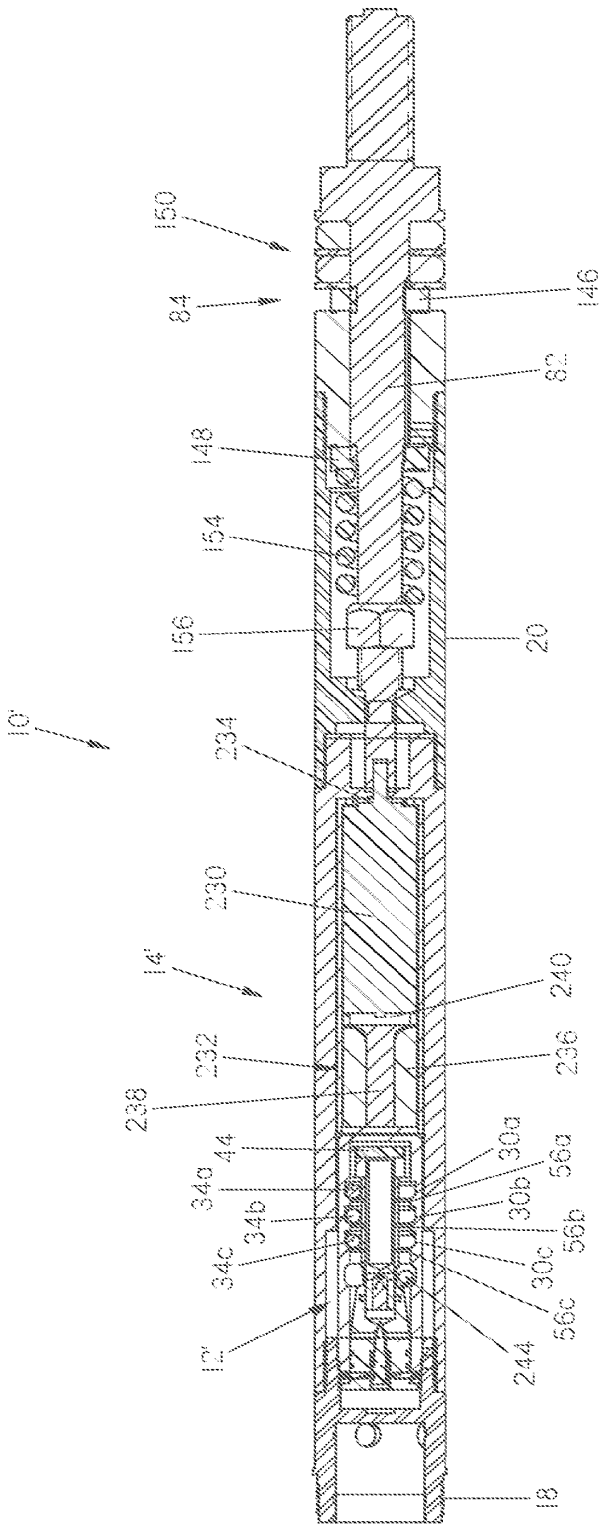

150
84
146
82
148
154
156
20
10'
234
230
14'
240
232
236
238
44
30a
56a
34a
30b
34b
56b
34c
30c
56c
12'
244
18

FIGURE 12

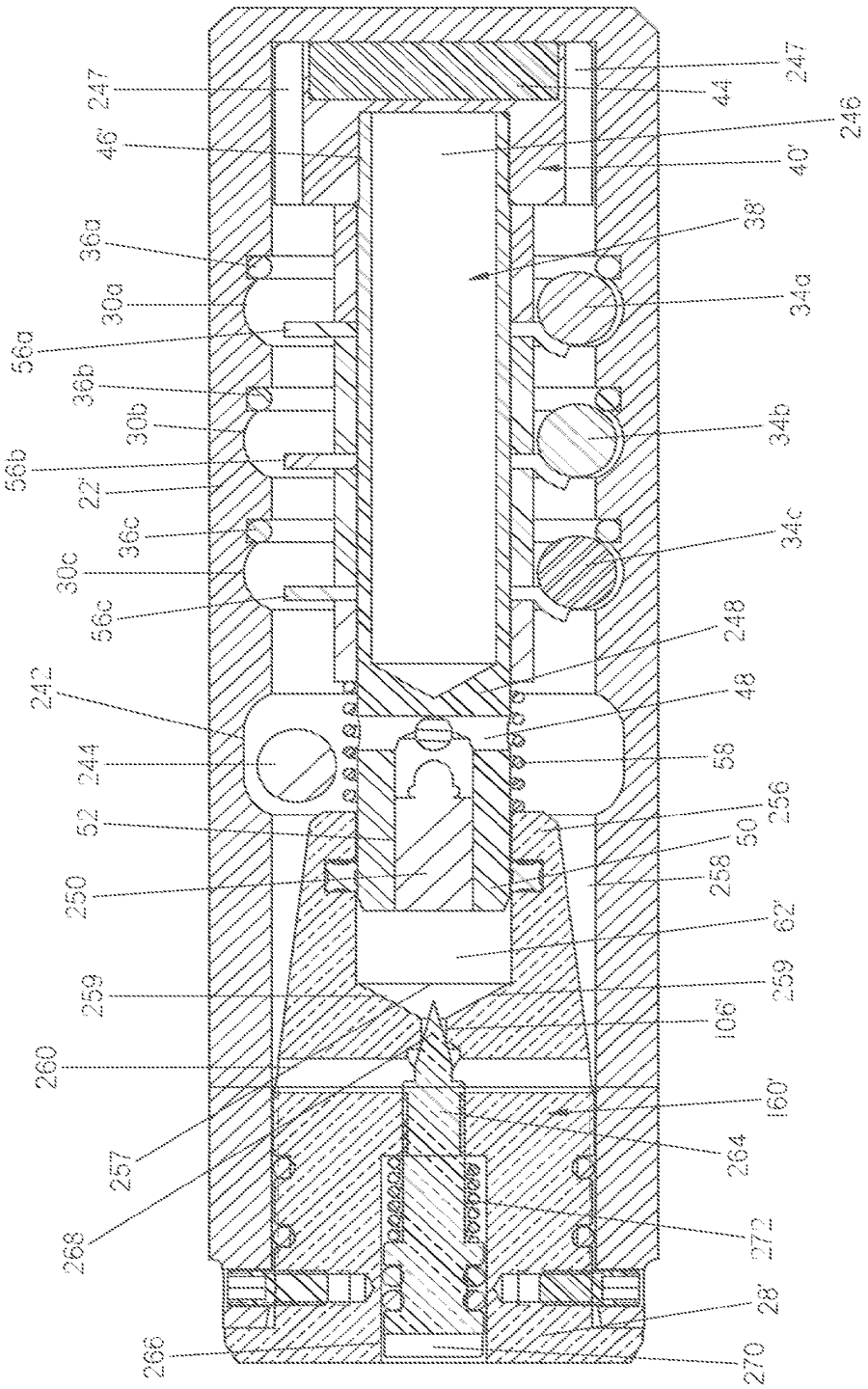

247
46'
36a
30a
56a
36b
30b
56b
22'
36c
30c
56c
242
244
52
250
259
260
257
268
266
247
44
246
40'
38'
34a
34b
34c
248
48
58
256
50
258
62'
259
106'
160'
264
272
28'
270

FIGURE 13

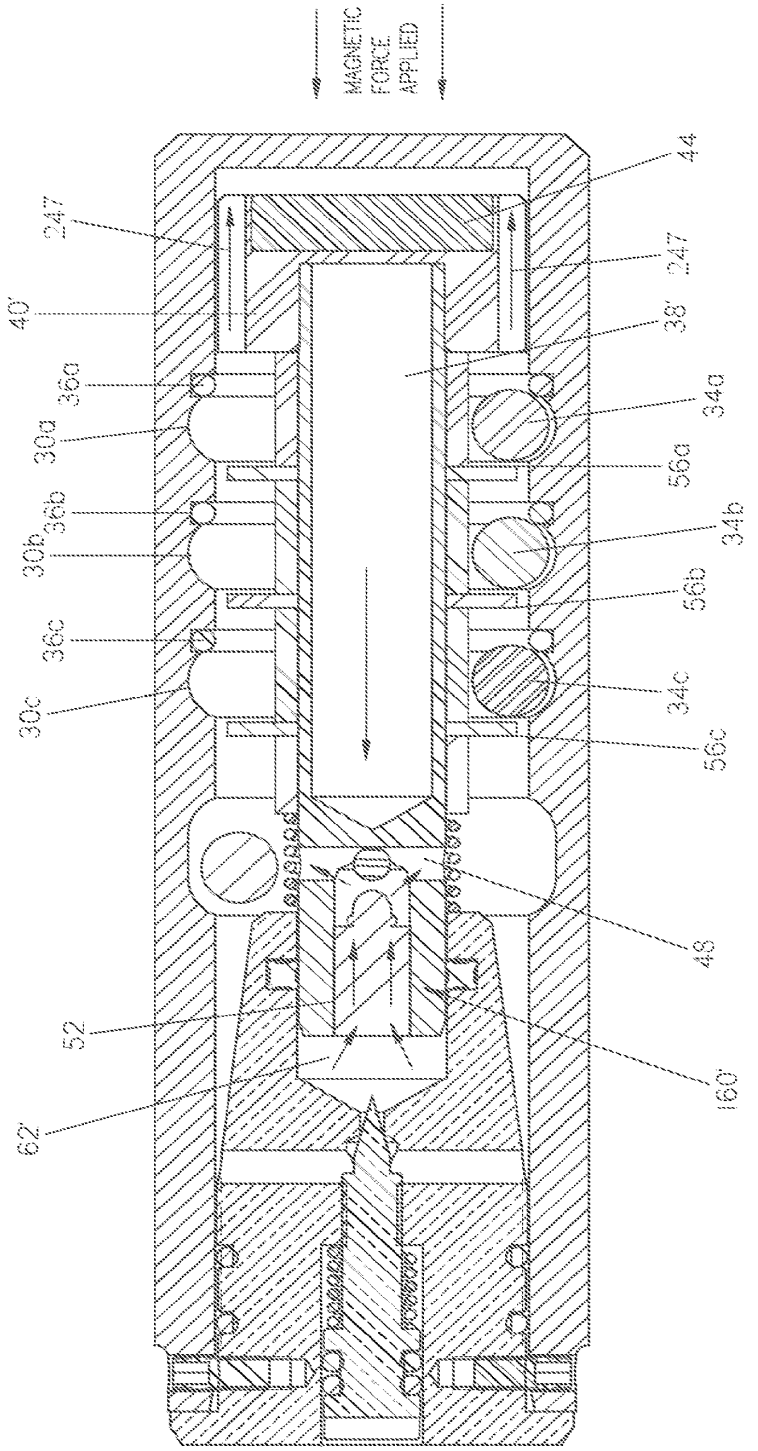

MAGNETIC FORCE APPLIED
44
247
247
40'
38'
36a
34a
30a
56a
36b
34b
30b
56b
36c
34c
30c
56c
48
52
160'
62

FIGURE 14

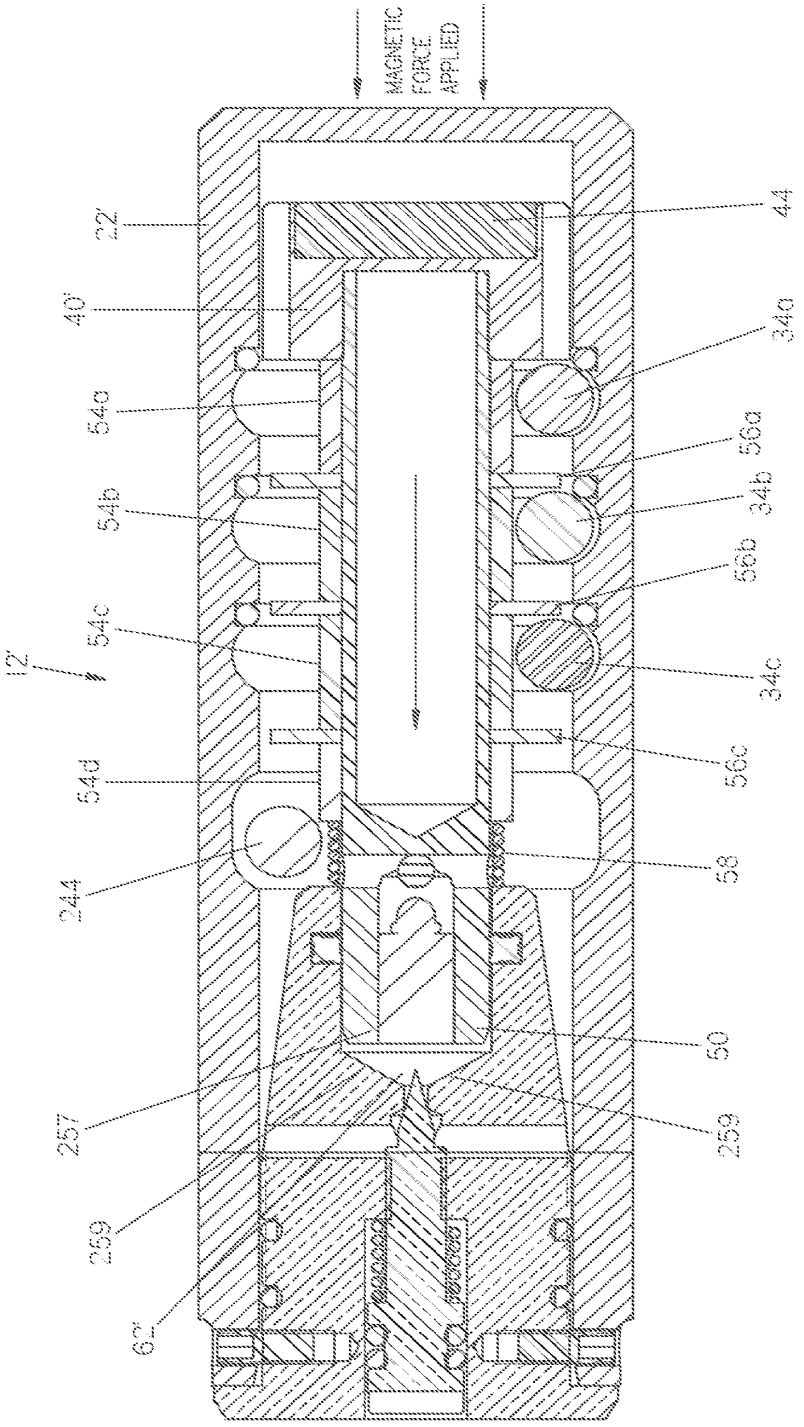

MAGNETIC FORCE APPLIED
22'
44
40'
34a
54a
56a
54b
34b
56b
12'
54c
34c
54d
56c
244
58
50
257
259
259
62'

FIGURE 15

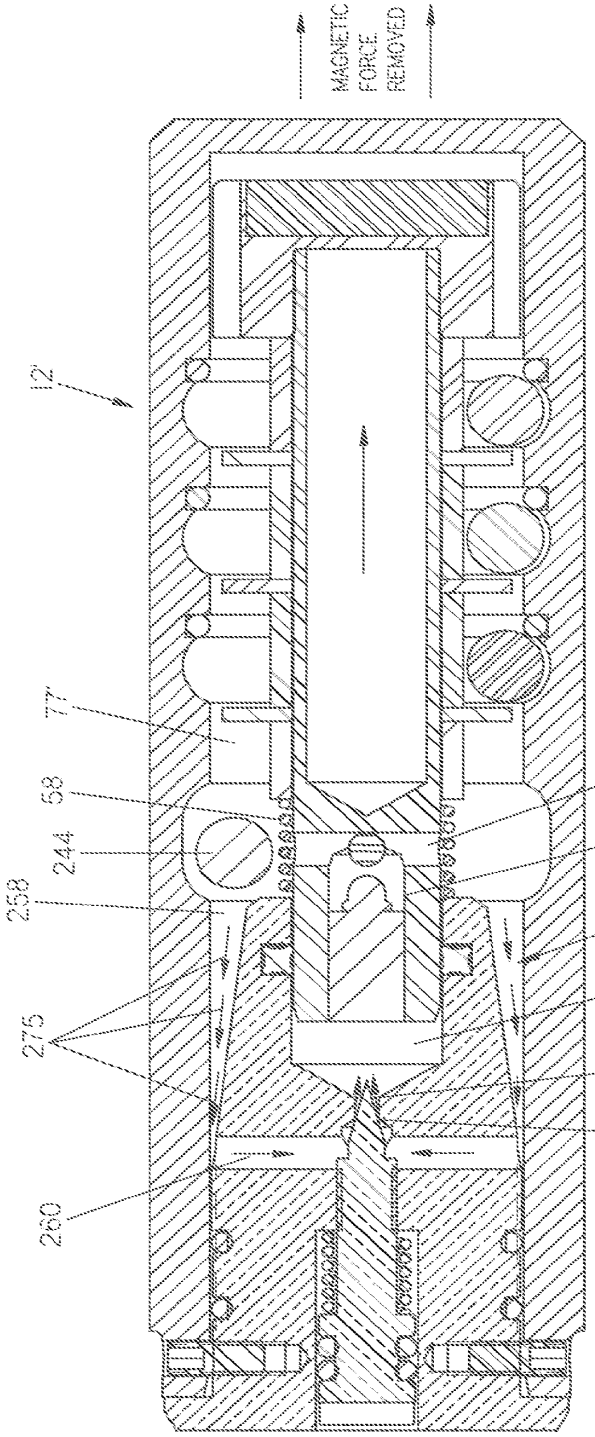

MAGNETIC FORCE REMOVED
12'
77'
58
244
258
275
260
48
52
160'
62'
275
106'

FIGURE 16

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2013/001444

A. CLASSIFICATION OF SUBJECT MATTER

E21B 25/16 (2006.01) E21B 25/00 (2006.01)

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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

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

EPODOC & Derwent WPI: IPC & CPC E21B25 & E21B25/16 with keywords magnet/magnetic, orientation, location, position, rotation, speed, velocity, revolution, rate, rpm, threshold, reference, pre-set, predetermined, given, desired, set, zero, nominated, maximum, minimum, drill, latch, lock, engage, couple, actuate, activate, orientation device, orientator, etc.; Google database with keyword combinations: (rotation or speed) and (activated or actuated or based) and (core) and (orientation or orientating)a nd magnet/magnetic.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

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

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
3 April 2014	03 April 2014

Name and mailing address of the ISA/AU	**Authorised officer**
AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaustralia.gov.au Facsimile No.: +61 2 6283 7999	Jude Fernando AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. 0262832419

Form PCT/ISA/210 (fifth sheet) (July 2009)

INTERNATIONAL SEARCH REPORT C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		International application No. **PCT/AU2013/001444**
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2012/116393 A1 (2IC AUSTRALIA PTY LTD) 07 September 2012 Abstract, page 3 ln 25 - page 4 ln 5; Figs 1a, 1b	1-20
A	US 4499956 A (CAMPBELL et al.) 19 February 1985 Abstract; Figs 1-5	1-20
A	US 4296822 A (ORMSBY) 27 October 1981 Abstract; Figs 1, 9	1-20

Form PCT/ISA/210 (fifth sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2013/001444

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
the subject matter listed in Rule 39 on which, under Article 17(2)(a)(i), an international search is not required to be carried out, including

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See Supplemental Box for Details

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-20

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT	International application No. PCT/AU2013/001444

Supplemental Box

Continuation of: **Box III**

This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

This Authority has found that there are different inventions based on the following features that separate the claims into distinct groups:

- Claims 1-20 are directed to a rotation activated orientation system for a ground dril. The feature of a magnetically operated orientator, a magnetic actuator wherein the rotational speed of the ground drill cases the orientator to switch between a free state and a locked state is specific to this group of claims.

- Claims 21-22 are directed to an orientation device. The feature of a race comprising two clamps, the two clamps being movable between a free position and a locked position is specific to this group of claims.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

When there is no special technical feature common to all the claimed inventions there is no unity of invention.

In the above groups of claims, the identified features may have the potential to make a contribution over the prior art but are not common to all the claimed inventions and therefore cannot provide the required technical relationship. The only feature common to all of the claimed inventions and which provides a technical relationship among them is *an orientator in a locked state* (See Note 1 below, regarding clarity of claims)

However this feature does not make a contribution over the prior art because it is disclosed in:
WO 2012/116393 A1 (2IC AUSTRALIA PTY LTD) 07 September 2012

(See abstract, orientator 14 having a locked state)

Therefore in the light of this document this common feature cannot be a special technical feature. Therefore there is no special technical feature common to all the claimed inventions and the requirements for unity of invention are consequently not satisfied *a posteriori*.

Note 1: Scope of Claim 21 is not clear as it lacks proper antecedent basis to the term 'the orientator'(Page 25 line 17). Furthermore, it does not provide proper antecedent basis to the term 'the locked state' (Page 25 line 17). The claim defines only the clamps having a free and a locked position, not the orientator.
Note that for the purpose of analysis of Lack of Unity, I have considered that the term 'orientator' is synonymous with the predefined term 'orientation element' (Page 25, line 9) and the same having a locked state.

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/AU2013/001444**

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**
WO 2012/116393 A1	07 Sep 2012	WO 2012116393 A1	07 Sep 2012
US 4499956 A	19 Feb 1985	None	
US 4296822 A	27 Oct 1981	None	

End of Annex

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

From the INTERNATIONAL BUREAU

PCT

COMMUNICATION IN CASES FOR WHICH NO OTHER FORM IS APPLICABLE

To:

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Ballard Spahr LLP
999 Peachtree Street
Suite 1000
Atlanta, GA 30309
ÉTATS-UNIS D'AMÉRIQUE

Date of mailing *(day/month/year)* 18 August 2016 (18.08.2016)	
Applicant's or agent's file reference 36362.0150P1	**REPLY DUE** **see paragraph 1 below**
International application No. PCT/US2015/026907	International filing date *(day/month/year)* 21 April 2015 (21.04.2015)
Applicant LONGYEAR TM, INC.	

1. ☐ REPLY DUE within months/days from the above date of mailing
   ☐ NO REPLY DUE, however, see below
   ☒ IMPORTANT COMMUNICATION
   ☐ INFORMATION ONLY

2. COMMUNICATION:

Please find attached a copy of the non-patent literature document uploaded with the third party observation dated 17 August 2016 (17.08.2016).

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Authorized officer
Kan Kai
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Telephone No. +41 22 338 74 02

Third Party Submissions: International patent application PCT/US2015/026907 (to Longyear TM, Inc.)

The following commentary is provided in respect of the claims (***Claims***) published with the above international (PCT) patent application (***Application***) in WO 2015/164394.

Summary

A number of documents (in addition to those cited in the International Search Report (***ISR***) and International Written Opinion established in respect of the Application) are considered to be relevant to the patentability of the Claims of the Application.

It is submitted that the Claims of the Application lack novelty and/or would be obvious to one skilled in the relevant technical art (***Skilled Person***) in view of at least the prior art documents discussed herein and/or knowledge common in the technical field.

The invention

It is understood from the published specification (***Specification***) of the Application that, broadly, the invention described seeks to provide a core barrel head assembly which serves to increase the speed and efficiency of drilling operations.

In one respect, a core barrel head assembly is provided having an integrated sample orientation sub-assembly for use in down hole surveying and sample orientation that minimizes the need to add additional drill string elements. A related method is also described.

In substance, the Specification describes an electronic instrument provided with a core barrel head assembly, and configured to obtain core sample orientation data. As will be clear from the comments below, electronic instruments operable for obtaining core sample orientation data are well known in the technical field – use of electronic core orientation units with what is in effect core barrel head assemblies were also known before the claimed priority date (21 April 2014 - ***Priority Date***) of the Application. Certainly, mechanical orientation units have been used as part of lower head assembly units of core barrel assemblies prior to the Priority Date (not just simply being attached to such assemblies). Document D9 (WO 2007/137356) makes very clear that at least one 'known system utilises an electronic orientation device that is screwed onto a back end of the core tube'.

Accordingly, it is submitted that the concept of integrating an electronic instrument, capable of recording/obtaining core orientation data, with a core barrel head assembly is not new and would certainly not be inventive in view of knowledge persons involved in the relevant technical field would be considered to comprise based on the teachings in the prior art.

The essential features of the invention the subject of the Application, as defined by independent claim 1 of the Claims, are understood as follows:

A core barrel head assembly, comprising:

(i) an elongate tube body defining a selectively sealed interior cavity;

(ii) at least one electronic instrument that is configured to obtain orientation data mounted therein the sealed interior cavity,

(iii) wherein the at least one electronic instrument comprises

(iv) at least one digital and/or electro-mechanical sensors in a core orientation data recording tool

(v) that can be configured to determine a core orientation of a sample core just prior to or after the core break;

(vi) a power source in operable communication with the at least one electronic instrument,

(vii) wherein the power source is mounted therein the interior cavity; and

(viii) communication means to receive and/or transmit core orientation data.

Additional features are defined in each of dependent claims 2 to 33.

Known Prior Art

A number of documents have been identified which address the same or similar problem(s) addressed by the invention the subject of the Application. In addition to the documents cited in the International Search Report (***ITS***) and International Written Opinion established in respect of the Application, a collection of further information is considered to be relevant to the patentability of the Claims of the Application.

As the focus of at least the prior art teachings subject to comment herein seek to address the same or similar problem(s) considered by the Application, it is submitted that the Claims of the Application lack novelty and/or would be obvious to the ***Skilled Person*** in view of at least the cited prior art documents and/or knowledge common in the technical field.

The following listed prior art documents are considered to be relevant to the patentability of the Claims of the Application:

D1 WO 2008/113127 (2IC Australia Pty Ltd)[Ŧ]

D1 seeks to provide a core orientation tool that can provide directional characteristics of a geological core sample extracted from the subsurface.

[Ŧ] Cited in the International Search Report (ITS) and International Written Opinion established in respect of the Application.

Ex.2001 / IPR2023-00642 / Page 583 of 870
Reflex USA LLC v. Longyear TM, Inc. and Globaltech Corporation Pty Ltd.

D1 discloses a core orientation tool (10) for providing an indication of orientation of a core sample (112). The electronic core orientation tool (10) comprises an electronic orientation device (20), which upon receipt of a trigger signal, logs one or more indications of orientation of the tool (10). A trigger system (24) provides trigger signals to the electronic device (20) based on one or both of (a) detecting one or more downhole events and (b) the effluxion of time. The downhole events relate to the action of core breaking and may include detecting: uphole motion of the tool; and, cessation of drilling and commencement of drilling.

D2 WO 2014/053012 (Minnovare Pty Ltd)[†]

D2 discloses a core sample orientation system for determining the relative orientation of a core sample with respect to its surrounding prior to removal from a bore hole.

The system comprises an alignment device and a display device, the alignment device being arranged to engage with a core barrel, the alignment device comprising a protective shroud, at least one sensing means and control electronics, the sensing means comprising at least one set of mutually orthogonal gyroscopes. The sensing means is capable of determining the relative orientation of the alignment device with respect to true north and the relative orientation of a core sample within the core barrel. Control electronics are configured to transmit relative orientation information to the display device.

D3 WO 2007/104103 (2IC Australia Pty Ltd)[†]

D3 discloses a method for orientating a geological core sample extracted from a borehole. The method disclosed comprises: providing a first indication of a directional characteristic of the core or the borehole at the commencement of a core run; providing a second indication of a directional characteristic of the core or the borehole at the end of the core run; and, determining orientation of a core sample extracted from the borehole on the basis of both the first and second directional characteristics.

D4 US 2012/0145461 (Cravatte)[†]

D4 discloses a coring apparatus including an outer core barrel associated with a drill bit; an inner core barrel adapted to accept a core sample; and at least one strain sensor adapted to measure strain (tension, compression) experienced by the inner core barrel. An output of the at least one strain sensor is indicative of entry of the core sample into the inner core barrel.

D5 US 6,732,818 (Gregory)[†]

D5 discloses a device for preserving the orientation of a core. A core barrel is attached to a rotatable orienting rod. A plurality of projections are located on an inner surface of the core barrel. Three projections are grouped together and opposite from a fourth projection. A ratchet assembly is included at an end of the rotatable orienting rod opposite from the core barrel. The ratchet assembly includes a first body, to which the rotatable orienting rod is attached, a plate, a second body, and a biasing mechanism. A turning rod is mounted on the plate, which is located

between the two bodies. The plate and the second body each have teeth which intermesh, but which slip if a clog in the core barrel inhibits rotation of the rotatable orienting rod.

D6 WO 2014/089618 (2IC Australia Pty Ltd)

A rotation activated orientation system (10) for a ground drill is operated by the action of magnetic fields. The system (10) incorporates a magnetically operated orientator (12) having a free state where the orientator (12) provides a substantially instantaneous indication of a position of a reference bearing of a hole being drilled by the ground drill, and a locked state where the orientator maintains the indication. The system (12) also includes a magnetic actuator (14) operatively associated with the magnetically operated orientator (12). When the rotational speed of the ground drill is greater than a threshold speed the magnetic actuator (14) supplies a magnetic field effective to place the orientator (12) in the free state. When the rotational speed of the drill is less than the threshold speed the magnetic actuator (14) does not supply a magnetic field effective to operate the orientator so that the orientator (12) reverts to or remains in the locked state.

D7 US 5,601,152 (Boart Longyear Inc)

D7 discloses a core barrel inner tube assembly including: a latch body mounting latches for movement into a latch seat to removably retain the assembly adjacent to a drill string bit end and to impart rotary movement to the latch body as the drill string is rotated. A spindle subassembly is connected to an axial inner end of the latch body, to in turn, mount a vibrational subassembly for imparting axial reciprocal movement to a core receiving tube as the drill string is rotated to facilitate entry of core into the tube. The vibrational assembly converts rotary motion of the spindle subassembly to axial reciprocal movement of the core receiving tube while the core receiving tube is not being rotated but is moved axially inwardly over the core.

D8 WO 2013/126955 (Globaltech Corporation Pty Ltd)

D8 discloses a method and system of validating orientation of a core obtained by drilling the core from a subsurface body of material. The method disclosed includes: (a) determining that vibration from drilling is below a nominated level, (b) recording data relating to orientation of the core to be retrieved, the data recorded using a downhole core orientation data recording device, (c) separating the core from the subsurface body, and (d) obtaining from the core orientation data recording device an indication of the orientation of the core based on the recorded data obtained when the vibration from drilling was below the nominated level and before the core was separated from the subsurface body.

D9 WO 2007/137356 (2IC Australia Pty Ltd)

D9 discloses a core orientation system (10) comprising an electronic orientation device (12) that connects to a back end (14) of a core tube (16), a core position indicator (***CPI***) 18 adapted for

engagement with the core tube (16) when on the ground, and a remote control unit (22) that communicates between the device (12) and the CPI (18).

The device (12) electronically logs orientation data of a reference point R on the core tube (16) relative to a first datum A at a time when a core sample (24) contained in the core tube (16) is in an insitu orientation. Once the core tube is retrieved and placed in a stable position, the device (12) again logs orientation data of the reference point R to a second datum B. A rotational displacement ϑ from the first datum A to the second datum B is calculated and transferred to the CPI (18) which is then moved about the core tube (16). When the CPI (18) is moved to a position where it is rotated by ϑ from the second datum B, it emits a signal to indicate the position of the first datum A.

D10 – WO 2006/024111 (Australian Mud Company Ltd)

D10 relates to an orientation device for providing an indication of the orientation of a core sample relative to a body of material from which the core has been extracted, and also to a method of core sample orientation identification.

D10 describes a core orientation device (10) for a core drill (12). The device (10) comprises an arrangement (14) for providing signals (16) associated with a physical orientation of the core orientation device (10). The orientation device (10) is accommodated along the length (38) of the inner tube assembly (36) (as shown in Figure 2 of the drawings for D10). In this arrangement the inner tube assembly (36) comprises upper and lower parts (36a, 36b) which, when fitted together, defines a cavity for accommodating the orientation device (10).

D11 – WO 2013/040641 (Imdex Global B.V.)

D11 relates to borehole surveying operations. D11 discloses an inner tube assembly (10) for use in a downhole survey in conjunction with core sampling. The inner tube assembly (10) comprises a body (21) adapted to receive a downhole surveying instrument (35), whereby the downhole surveying instrument can be conveyed along and operated within the borehole.

D12 – WO 2010/094060 (Imdex Technology Australia Pty Ltd)

D12 relates to core sample orientation. D12 discloses a core sample orientation system for providing an indication of the orientation of a core sample relative to the underground environment from which the core sample has been extracted. The core sample orientation system (10) which comprises a first portion (11) and a second portion (12). The first portion (11) comprises a downhole unit adapted to be connected to a core tube of a core drill, and the second portion (12) comprises a control unit. The downhole unit (11) is adapted for cooperation with a core tube for recording data relating to the orientation of the core tube, and the control unit (12) is adapted to cooperate with the downhole unit to receive and process orientation data from the downhole unit and provide an indication of the orientation of a core sample within the core tube at a time prior to separation of the core sample.

D13 – 2IC Ezy-Ori™ Core Barrel Orientation System Operation Manual

D13 is an operation manual distributed with the Ezy-Ori™ core barrel orientation system marketed and sold by 2IC Australia Pty Ltd (***2IC***) as early as May 2013.

D14 – 2IC Ezy-Ori Adapter Assembly Manual

D14 is an assembly notification relevant to the Ezy-Ori™ core barrel orientation system marketed and sold by 2IC from as early as May 2013.

The Claims

The following commentary is submitted in respect of the patentability of the Claims of the Application in view of at least the above listed prior art information.

Independent claim 1

Independent claim 1 is directed to *a core barrel head assembly* comprising:

> *an elongated tube body defining a selectively sealed interior cavity*
>
> *at least one electronic instrument that is configured to obtain orientation data mounted therein the sealed interior cavity, wherein the at least one electronic instrument comprises*
>
> *at least one digital and/or electro-mechanical sensors in a core orientation data recording tool that can be configured to determine a core orientation of a sample core just prior to or after the core break, …*

D1 discloses an inner barrel assembly (11) comprising: a core orientation tool (10) including a body (22) coupled to a core tube cap (18) and a backend assembly (14). Broadly, the tool (10) comprises an electronic core orientation device (20) housed within the body (22) and configured, upon a trigger signal, to log a core orientation of a core sample at least shortly before or during a core breaking event:

> "The tool 10 comprises an electronic core orientation device or system 20 housed within a body 22 that is coupled to and between the core tube cap 18 and the adaptor 16. The electronic core orientation device 20 is configured to log one or more first indications of orientation of the tool (ie, core orientation) upon receiving of a trigger signal. To this end, the tool 10 includes a trigger system 24 that provides the trigger signal upon detecting one or more downhole events associated with the operation of the core drill. These events may particularly relate to the core breaking function of the core drill and/or various sequences of events expected prior to core breakage".

(D1 - page 11, line 30 to page 12, line 5)

D1 shows very clearly, in at least Figure 2 of D1, that the body (22) and therefore the cavity provided therein is of elongate tubular form. In any event, it is submitted that in view of the nature of conventional core drilling processes, the provision of cavities within such apparatus can only be extended in a manner leading to an elongate tubular form.

Accordingly, the forming of an elongate tubular body for defining an interior cavity for holding equipment such as electronic components and/or such devices, is not new. Such configuration would surely be common knowledge in the art and/or would be reached by routine manner if seeking to provide a protective space for housing or carrying sensitive equipment. The Skilled Person would surely appreciate the need for providing a closed or selectively sealable interior cavity (being of elongate tubular form) in view of at least the hostile environment in which such electronic components and/or such devices would need to operate within.

D1 discloses very clearly that embodiments of the tool (10) 'are able to log in situ orientation data relating to the core and the borehole from which the core is extracted at a time shortly before or at core breakage' (D1 – page 12, lines 30 to 33). The term *log* would be clearly understood by the Skilled Person as being an activity, in the context of the embodiments described in D1, of recording measured data – in this instance, the data being orientation data recorded on receipt of a trigger signal.

The device (20) of D1 comprises multiple sensors and transducers for sensing various events and orientation data:

> "The system 20 comprises multiple sensors and transducers for sensing various events and orientation data of the tool 10 and core drill. The sensors may comprise for example accelerometers, gyroscopes, physical switches, magnetometers, vibration sensors, inclinometers, inductive RPM sensors, flow sensors and pressure sensors. Some of the sensors and transducers send information to the trigger system that analyses the information to determine when to provide the trigger signal. Other sensors and transducers, notionally forming an orientation module 26, may be either in an idle state or continually providing data indicative of core and/or bore hole orientation, however these sensors and transducers are not activated and/or the orientation data is not logged until the trigger system 24 provides the trigger signal. It will be appreciated by those skilled in the art that some of the sensors and transducers that are used by the trigger system may also provide orientation data."

(D1 – page 12, lines 7 to 24)

Accordingly, D1 clearly contemplates the use of at least one electronic instrument being configured to obtain orientation data being mounted within a sealed interior cavity (that defined by the body (22)). D1 makes clear that at least one of the electronic instruments could comprise a range of different sensor types (eg. accelerometers, gyroscopes, physical switches,

magnetometers, vibration sensors, inclinometers, inductive RPM sensors, flow sensors and pressure sensors) – many of which could be digital and/or electro-mechanical in nature - configured for at least:

(i) sensing various events and orientation data (or providing an orientation module (26));

(ii) logging (in situ) orientation data relating to the core (sample) at a time shortly before or at core breakage.

… a power source in operable communication with the at least one electronic instrument, where in the power source is mounted therein the interior cavity; and …

As D1 makes very clear that the operation of the tool (10), and thus the electronic core orientation device/system (20), allows for the (in situ) logging of core orientation data and operation of sensors for use in sensing events for issuing a trigger signal, it would be readily understood by the Skilled Person that an associated power source must also be involved.

This interpretation is confirmed by reference D1 (at page 28, lines 9 to 13) to embodiments of the described tool (10) that may perform self-checks regarding the tool's status. Status messages may include one or a combination of low battery power, communications error, and system faults. Accordingly, by the requirement of the operation of electrical sensors and the like within tool (10), it is abundantly clear from the specification *as a whole* that a power source is needed to power the electrical hardware when downhole so as to ensure the intended operation of the tool (10).

In D1, the mounting of a power source means outside of the body (22) would not constitute a practical reality in view of the description of the tool (10) when D1 is read as a whole. It is clear from D1 (with reference to at least Figure 1) that any power source means would, for utility purposes, best be housed at least within the body (22), or some sealed protective means (cavity like arrangement) in view of the hostile environment in which the tool (10) is intended to operate (reliably). Such a feature would come well within the scope of customary practice followed by a person skilled in the technical field.

D8 (WO 2013/126955) acknowledges that battery powered downhole survey equipment (such as probes and core orientation units) are 'known in the art' (see further discussion below). Thus, use of an onboard battery in a hermetically sealed environment (to prevent the ingress of water and contaminants at pressure when downhole), is known in the art.

In any event, use of electronic equipment for the purpose of operation in a remote manner, ie. in a downhole data gathering (*in situ* data logging and physical event monitoring) situation, would ordinarily involve a power source. This is supported by a number of documents.

Use of a power source to power electronic equipment in a core orientation device (10) for use with a core drill is demonstrated in D10 (WO 2006/024111). D10 discloses a device (10) having a housing (44) accommodating an internal chassis (54) which has a cavity (56) for housing electrical components.

The subject core orientation device of D10 (discussed below) includes electronic circuitry on circuit board (60), processing means (22) incorporating an analogue to digital converter (64), a low power microcontroller (66) having timer (68) and non-volatile memory, triaxial accelerometer means (58), and memory (26) coupled to the processing means (22). Use of a power source to power the electronic componentry is clearly contemplated where D10 states (at page 12, lines 25 to 26):

> "As shown in Figure 5, the housing 44 also accommodates a main printed circuit board 60 and an electrical power source 62 in the form of a lithium battery pack."

Use of an onboard power source for powering electronic equipment in a downhole core orientation tool is also clearly disclosed in D12 (WO 2010/094060).

D12 (discussed below) also clearly discloses use of a power supply (provided in the form of a lithium battery pack (95)) to power electrical equipment/sensors/components of a module (83) provided with a downhole unit (11). The module (83) is housed within an elongate tubular cavity (81) defined by a housing (15) of the downhole unit (11).

It is submitted that use of a power source, in the context of the Claims, to power the electronic instrument in a downhole apparatus is known.

… communication means to receive and/or transmit core orientation data.

The device (20) of D1 comprises a transceiver (28) configured to receive or send the orientation data by way of an antenna (30) (D1 - page 11, line 30 - page 12, line 28 and figures 1-2).

> "The orientation system 20 may further comprise a transceiver 28 coupled to an antenna 30 to communicate with a hand-held computer or other like device."
>
> (D1 – page 12, lines 24 to 27)

In an embodiment disclosed in D1, the transceiver (28) in the tool (10) communicates via wireless communication with a hand-held computer which in turn transfers data to a core position indicator.

At the Priority Date, the Skilled Person was well aware of the function of a transceiver – that being to provide a communications means for receiving and/or transmitting data/information, such as for example, core orientation data as in the context of the Claims.

Accordingly, D1, either explicitly and/or implicitly, discloses the substance of at least all of the features of independent claim 1.

D2 – WO 2014/053012

D2 discloses a core orientation apparatus comprising an alignment device ((10) – being of elongate tubular form) arranged to engage with a core barrel (12). The alignment device (10) comprises an outer casing (of impact resistant material) to protect the internal components of the alignment device (10).

The device (10) comprises electrical control equipment to allow the alignment device (10) to determine the true north bearing from its present location. The device (10) is arranged such that, once back at the surface, the core orientation information 'captured by the alignment device (10) prior to removal of the core sample (16) from the drill hole' can be used to allow the core to be rotated such that the orientation of the alignment device (10) relative to the low side of the drill is the same as when the alignment device (10) was in the drill hole.

The alignment device (10) comprises electronic sensors (mutually orthogonal gyroscopes such as Micro Electrical Mechanical System (***MEMS***) devices, or fibre-optic gyroscopes (***FOG***)) arranged to enable the alignment device (10) to determine the device's relative orientation to true north (to allow relative azimuth to be determined).

D2 discloses that the alignment device (10) is accommodated within a protective shroud and is fed down the drill hole after the core barrel has been removed from the drilling assembly. Once the alignment device is in the distal portion of the drilling hole, it is allowed to rest and determine the orientation of the drill hole relative to true north.

The device (10) is disclosed as also having a means of transmitting the orientation information via a wireless or Bluetooth connection. In one embodiment, the orientation information generated by the alignment device (10) is then transmitted to the surface either through a cable which may also be the tether for the alignment device (10) or is transmitted wirelessly once the device is at the surface of the drill hole. In a preferred embodiment, D2 discloses that the orientation information generated by the alignment device (10) is transmitted to the surface either through a cable which may also be the tether for the alignment device or is transmitted wirelessly once the device is at the surface of the drill hole.

The use of electronic equipment in the alignment device (10) in the remote manner described in D2, is surely indicative that a power source means is needed in order to allow the equipment to function as is intended, ie. in order to derive any advantage from the alignment device described. The Skilled Person would completely (without option) appreciate that a power source would be needed in order to operate the device described. Any configuration requiring electrical equipment (and an associated power source) would need to be provided within a protective housing means in view of the hostile environment in which the equipment is intended to operate (reliably) within.

Accordingly, D2, either explicitly and/or implicitly, discloses the substance of at least all of the features of independent claim 1.

D4 – US 2012/0145461

D4 discloses a coring apparatus (10) which includes a number of (electronic) sensors which may comprise: strain sensors, rotation sensors, pressure sensors, vibration sensors, and/or temperature sensors. One or more sensors may be housed within an electronic housing (20). The Skilled Person would surely appreciate that the electronics housing requires the provision of an interior cavity region (being of elongate tubular form) being sufficiently closed/sealed so as to allow the electronics to operate as intended in the (hostile) environment downhole.

Suitable wiring is provided to connect all sensors to an electronics board (32). D4 clearly states that:

> "…electronics board 32 is provided to process all the data received from the sensors a) to e) described above and to transmit it using conventional data transmitting means (such as a radio transmitter (not shown)) back to the surface so that the operator can see the output from the various sensors a) to e) in real time."
>
> (D4 – paragraph [0060])

> "Alternatively, the data transmitting means (not shown) could be omitted and instead all data could be stored on inboard memory provided on the electronics board 32 (in the same way that an airplane black box recorder operates to store data for later analysis)"
>
> (D4 – paragraph [0061])

Thus, D4 clearly contemplates either the transmission of the sensor data back to the surface (using a suitable communication means) in 'real time', or storing of the sensor data on inboard memory for subsequent analysis. In any event, the Skilled Person would appreciate that even for 'real time' transmission purposes, data transmitted would need to be stored on some form of onboard memory prior to transmission.

The sensors in the apparatus of D4 could be configured to determine a core orientation (eg. rotation sensor (26) measuring the relative rotation between inner core barrel (14) and the outer

core barrel (12)). Similarly, at least the vibration sensors could be configured to determine a core sample breakage.

As noted above, use of electronics downhole surely contemplates the use of a power source to power said electronics – this is something the Skilled Person would greatly appreciate on reading D4 as a whole.

Accordingly, D4, either explicitly and/or implicitly, discloses the substance of at least all of the features of independent claim 1.

D8 – WO 2013/126955

D8 relates to a device, system, and method for conducting downhole surveying and determining the orientation of a core sample relative to a body of material from which the core sample has been obtained.

D8 discloses the use of various sensors within a core barrel head assembly:

> "One or more pressure sensors 28,30,32 can be provided to detect pressure, change in pressure and/or pressure differential. These can communicate with the core orientation data recording device and/or an operator at the surface. Once a required pressure value is detected, drilling can cease and the core orientation device can record data relating to the orientation of the core, such as gravitational field strength and direction, and/or magnetic field strength and direction."

(D8 – paragraph [00152])

D8 discloses that digital and/or electro-mechanical sensors (and/or pressure sensors) are used to determine the core orientation prior to core sample breakage and to detect the breakage signal:

> "Digital and/or electro-mechanical sensors, and/or one or more pressure sensors in a core orientation data recording device 20 are used to determine the core orientation just prior to the core break, and to detect the signal of the break of the core from the body of material."

(D8 – paragraph [00153])

In an embodiment shown in figures 3 and 4 of D8, a 'known prior' art inner tube assembly (310) replaces a standard greaser with a two unit system (314,316) utilising a specialised greaser unit (314) and an electronics unit (316) particular to the two unit system. The electronics unit is of elongate tubular form and is sealed to the greaser unit by O-rings, which have a tendency to fail in use and allow liquid into the electronics unit, risking loss of data and/or display failure. The electronics unit (316) is connected to a sample tube (322) for receiving a core sample (324). The electronics unit is arranged to record orientation data every few seconds during core

sampling (D8 – paragraph [00180]). D8 makes clear (at paragraph [00181]) that the electronics unit (316) includes at least an accelerometer (328) and a memory (330) (and timer (332) and an LCD display (318)).

Figures 5A to 8 of D8 refer to a further embodiment of a system (340) which purports to exemplify the principles of the invention described. In this embodiment, a core sample orientation data gathering device (342) (see Figure 7 of D8) is provided as a fully sealed (see paragraph [00192] of D8) cylindrical unit (of elongate tubular form) with screw threads at either end.

> "The core sample orientation data gathering device of the present invention is hermetically sealed against ingress of water or other liquids, even at operative borehole depths and conditions"
>
> (D8 – paragraph [00192])

Once inserted into the drill hole and prepared for operation, the core orientation device will begin normal operation to detect the signature of vibration indicating a core break. Otherwise, pressure changes or levels may be detected to indicate a pre-break condition or period.

D8 discloses that when drilling ceases and the core ready to be broken, the driller will delay a period of time during which an orientation and dip measurement will be taken.

D8 acknowledges that battery powered downhole survey equipment (such as probes and core orientation units) are 'known in the art'. D8 makes clear that the system described may include a power source for the electronics for operational purposes. Indeed one of the objects of the system of D8 is to reduce power consumption in downhole survey tools by seeking to implement a standby, or low power mode, for reducing power consumption to a minimum while vibration is detected to be above a threshold limit.

> "The data gathering device 342,380 of the present invention includes at least one vibration sensor, and preferably at least one of a gravity sensor, magnetic field sensor, accelerometer, inclinometer, and preferably a combination two or more of these devices. These 'sensors' are packaged into the data gathering device which is compatible for connection with downhole tubing, greasers and other instrumentation devices. The data gathering device is powered by an onboard battery, and preferably the data gathering device is hermetically sealed to prevent ingress of water and contaminants at pressure when 'downhole'. The data gathering device forms part of a system in conjunction with the communication device 60, and preferably any other equipment as needed".
>
> (D8 – paragraph [00209])

D8 discloses that the core sample orientation data gathering device (342) includes a transmitter for the purpose of receiving and/or transmitting data (such as a core orientation data). A hand held device (360) is shown in Figure 8 of D8 and configured for wirelessly receiving data or

signals from the core sample orientation data gathering device (see paragraph [00187]). In the embodiment described, data retrieval can be carried out by infra-red communication between the core orientation data receiver or communication device (360)(see paragraph [00188]).

Accordingly, D8, either explicitly and/or implicitly, discloses the substance of at least all of the features of independent claim 1.

D9 – WO 2007/137356

D9 relates to a core orientation system for use with a core sample extracted from the ground.

D9 discloses a core orientation system (10) which comprises an electronic orientation device (12) (of elongate tubular form) adapted for connection with a back end (14) of a core tube (16), a core position indicator (***CPI***) (18) (of substantially elongate tubular form) adapted for demountable engagement with a front end (20) of the core tube (16).

The system further comprises a remote control unit (22) that communicates with both the electronic core orientation device (12) and the CPI (18). D9 discloses that the system (10) further includes a signalling system that emits a sensory signal, the signalling system being incorporated in the CPI (18) or residing (or part of) the remote control unit (22) (see D9 at page 9, line 25 to page 8 to line 4).

The CPI (18) may further comprise a sensor to detect when the marker was moved along the guide (34) and/or inserted in the hole (42) and check that the CPI (18) was at the correct orientation at the time of marking. This can be effected for example by way of a bobbin slidably retained in the slot (38) and into which a marker is inserted to mark the underlying core tube (16) and core sample (24), with say a magnetic sensor mounted in the slat (37) to detect motion of the bobbin; or for the hole (42) by say an optical sensor that can detect the insertion of a marker in the hole (42). The CPI (18) can be programmed or otherwise configured to detect when such motion occurs.

D9 discloses that the electronic orientation device logs (or records) orientation data of the core tube (16). D9 makes clear that:

> "… the electronic orientation device 12 may take the form of any known electronic orientation device used for downhole logging but which is further modified by the provision of a transceiver circuit to enable wireless communication between the device 12 and the remote control unit 22."
>
> (D9 – page 6, lines 25 to 29)

D9 discloses that either one or both of the CPI (18) and the remote control unit (22) may also be configured to store and allow downloading of records of one or more data readings to provide a permanent record for auditing purposes.

D9 discloses that:

> "Just prior to or after breaking of the core sample 24 from the in situ ground, an operator presses the "take reading" button 26 on the remote control unit 22. This activates the timer within the control unit 22 to log the period of time between initiation of the orientation device 12, and the time just before or after core break".
>
> (D9 – page 10, lines 20 to 25)

D9 discloses that the orientation device (12) may perform other self-checks and provide users with status information/messages. Status messages may include one or a combination of: low battery power, communications error, system faults (page 14, lines 9 to 13).

Accordingly, the Skilled Person would clearly appreciate the need for an onboard power source (such as a battery) with either the electronic orientation device (12) and/or the CPI (18) for the various electrical components to be operable as intended. Furthermore, such power source would need to be provided in a manner in which it is not adversely affected by the hostile 'downhole' environment.

D9 discloses that the CPI (18) includes an electronics module (32) which contains transceiver circuits to enable wireless communication with the remote control unit (22); and electronic orientation circuitry which senses the orientation of the CPI (18) relative to a known reference (typically gravity). D9 further contemplates that the electronics module (32) could include the signalling system (see D9, at page 9, lines 1 to 8).

D9 further discloses that, in one mode of operation, an operator may press a button (46) causing operable communication between the remote control unit (22) for interrogating the orientation device (12) and retrieving the orientation data of the core tube at a relevant time period. Accordingly, D9 is clear that a transmitting means for receiving and/or transmitting core orientation data within the system described is clearly contemplated.

Accordingly, D9, either explicitly and/or implicitly, discloses the substance of at least all of the features of independent claim 1.

D11 – WO 2013/040641

D11 relates to borehole surveying operations. In particular the invention described relates to core sampling in borehole surveying operations.

D11 describes an embodiment in which a core drilling operation is performed with a core drill comprising an outer tube assembly (13) in conjunction with an inner tube assembly (10). The inner tube assembly (10) comprises a body (21) having a bottom end section (23) and a top end section (25). The bottom end section (23) incorporates a core inner tube (not shown) to progressively receive a core sample during a core drilling operation in a known manner (D11 – paragraph [00139]).

The body (21) defines an internal compartment (33) adapted to accommodate a downhole survey instrument (35). D11 clearly states that the downhole survey instrument (35) would typically comprise a downhole tool having one or more sensor devices such as orthogonal accelerometers, magnetometers, gyroscopes, MEMS (microelectromechanical) gyro sensors, or any combination thereof. The sensors are used for the purposes in determining orientation data (D11 – paragraph [00142]).

D11 discloses that the body (21) comprises two portions which are adapted to be releasably connected together by a fluid tight seal to define the compartment (33):

> "The body 21 comprises an upper portion 41 and a lower portion 43 adapted to be releasably connected together by a fluid-tight connection 45. The connection 45 may comprise a threaded connection and an associated fluid seal arrangement. The two portions 41, 43 cooperate to define the internal compartment 33 adapted to receive and accommodate the downhole survey instrument 35. The two portions 41, 43 can be separated by disengaging the connection 45 to provide access to the compartment 33 for insertion and removal of the downhole survey instrument 35."
>
> (D11 – page 22, paragraph [0144])

The body (21) and the compartment (33), when so formed, are shown to be of elongate tubular form in at least figure 1.

The downhole survey instrument (35) is onboard the inner tube assembly (10), thereby allowing survey measurements to be taken during the core collection and retrieval process as desired. Thus, orientation data is recorded by the survey instrument (35) during at least the core collection process, ie. recording of orientation data would occur prior to or after the collection (core break) of the core sample (D11 – paragraph [00142]).

As noted above, in the context of providing an electronic unit for use downhole for the purposes of recording orientation data, the Skilled Person would be drawn to using an appropriate power supply means for powering the electronic components and related control circuitry, as is clearly disclosed in a number of the prior documents discussed herein.

D11 discloses that the body (21) may incorporate a communication means (not shown in the drawings) such as an infra-red (IR) port or other telemetry arrangement for communication with the downhole survey instrument to retrieve measurements therefrom (paragraph [00143]).

Accordingly, D11, either explicitly and/or implicitly, discloses the substance of at least all of the features of independent claim 1.

D12 – WO 2010/094060

D12 discloses a core orientation system (10) comprising a first portion (11) and second portion (12), the first portion comprising a downhole unit (11) adapted to be connected to a core tube, and the second portion comprising a control unit.

The downhole unit (11) comprises a cylindrical housing (15) having first, second ends, and a cylindrical side wall (10) extending between both ends. The side wall (19) has an outer periphery (21) configured and dimensioned to accord with the outer periphery of the core tube. The housing (15) of the downhole unit (11) has an internal cavity (81) (of elongate tubular form) which accommodates a module (83) incorporating a triaxial accelerometer means (85), an analogue-to-digital converter (87), a processing means (89) in the form of a low power microcontroller, a memory device (91) providing non-volatile memory, a power supply (92) in form of a lithium battery pack, and a watch dog circuit (93). The function of the downhole unit (11) and its constituent electrical/sensor componentry, is to record data relating to its orientation (and thus the orientation of the core tube to which it is attached) (page 9, lines 16 to 23).

D12 discloses that the module (83) comprises a communications means provided in the form of an IR interface (95). In this manner, when the downhole unit (11) is retrieved from the borehole (along with the core tube and a core sample therein), and the control unit (12) coupled to the downhole unit (11), orientation data records by the downhole unit (11) can be transmitted wirelessly to the control unit (12) through the cooperative operation of an IR interface associated with the control unit (12) and the IR interface (95) provided with the downhole unit (11). The control unit (12) receives and processes orientation data from the downhole unit (11) and provides an indication of the orientation of a core sample within the core tube at a time prior to separation of the core sample from the underground environment from which it was obtained (page 9, lines 23 to 31).

Accordingly, D12, either explicitly and/or implicitly, discloses the substance of at least all of the features of independent claim 1.

In view of the above, it is submitted that independent claim 1 lacks *novelty* and/or would be *obvious* to the Skilled Person in view of at least one or more of the above discussed documents.

In any event, each of the features of the invention defined by independent claim 1, either separately or in the combination claimed, would be common knowledge in the relevant technical field.

The Dependent claims

It is submitted that each of the published dependent claims lack novelty and/or inventive step in view of the prior art of record and/or knowledge considered common in the technical field.

Claim 2

The core barrel head assembly of Claim 1, wherein

the elongate tube body has a threaded proximal end for coupling to a wire line retrieval portion of a head assembly.

D1 discloses that the elongate tube body (22) is coupled to and between the core tube cap (18) and an adapter (16), the adapter having a threaded end (which could be proximal) readily available for coupling to a wire line retrieval portion of a head assembly (see Figure 2 of D1).

The Skilled Person would readily conceive the feature of claim 2 from the disclosure of D1 considering that the core tube cap (18) and the backend assembly (14) have a threaded proximal end (see figure 2).

In any event, it would be reasonable to consider that attachment of a core orientation component to a wire line retrieval system using a threaded portion would be common knowledge in the technical field.

For instance, D3 notes the following:

> "A variety of borehole survey tools are also known that can record the azimuth, inclination and other structural and environmental data, either in the open borehole a sufficient distance from the influence of interference that can be created by the magnetic nature of the drill string or, for example, within the drill string while it is suspended in the completed borehole by the lowering and raising on a wireline of an optically based system known as a Maxibore, which is not affected by either the magnetics of the surrounding rock strata or the metal of the drill string"
>
> (D3 – page 8, lines 18 to 28)

D10 and D11 make clear, in their respective 'Background Art' sections, that wireline systems are typically used as retrieval methods in the technical field:

> "When a core sample is acquired, the core within the inner tube assembly is fractured. The inner tube assembly and the fractured core sample contained therein, are then retrieved from within the drill hole, typically by way of a retrieval cable lowered down the drill hole. Once the inner tube assembly has been brought to ground surface, the core sample can be removed and subjected to the necessary analysis."
>
> (D10 – page 1, lines 14 to 19, D11 – paragraph [0004])

Accordingly, it is submitted that the substance of the feature defined by claim 2 lacks novelty and/or would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 3

The core barrel head assembly of Claim 1, wherein

the elongate tube body has a first interior cavity that extends distally to a base portion of the tube body.

D1 discloses a body (22) having a cavity (that housing/enclosing a gyroscope (34) (see page 16, lines 12-22 and figure 2) which extends distally to a base portion (downhole portion of the body (22)).

D4 discloses a coring apparatus having an electronics housing (20) defining a cavity for housing/enclosing electronic components (sensors, circuit board). The cavity is sized and shaped to hermetically enclose the various electrical components.

D10 discloses an orientation device (10) for a core drill, the orientation device comprising a housing (44) which accommodates an internal chassis (54) having a cavity (56) which accommodates material (57) encasing a triaxial accelerometer means (58). The housing (44) also accommodates a main printed circuit board (60) and an electrical power source (62) in the form of a lithium battery pack. The cavity (56) is of elongate tubular form extending along its longitudinal axis.

D11 discloses the body (21) defining an internal compartment (33) adapted to accommodate a downhole survey instrument (35). The downhole survey instrument (35) would typically comprise a downhole tool having one or more sensor devices such as orthogonal accelerometers, magnetometers, gyroscopes, MEMS (microelectromechanical) gyro sensors, or any combination thereof (D11 – paragraph [00142]). The body comprises an upper portion 41 and a lower portion 43 adapted to be releasably connected together by a fluid-tight connection 45. The two portions 41, 43 cooperate to define the internal compartment (33), said compartment being of elongate tubular form extending along its longitudinal axis.

D12 discloses a downhole unit (11) having a housing (15) which comprises an internal cavity (81) for accommodating electronic sensor equipment and communication means:

> "The housing 15 of the downhole unit 11 has an internal cavity 81 which accommodates a module 83 incorporating a triaxial accelerometer means 85, an analogue-to-digital converter 87, a processing means 89 in the form of low power microcontroller, a memory device 91 providing non-volatile memory, a power supply 92 in the form of a lithium battery pack and a watchdog circuit 93. Further, the module 83 is provided with an IR interface 95. With this arrangement, the downhole unit 11 can record data relating to its orientation (and thus the orientation of the core tube to which it is attached)."
>
> (D12 – page 9, lines 16 to 31)

From Figure 1 D12, the internal cavity (81) is clearly of elongate form.

It is submitted that in view of the nature of conventional core drilling processes, the provision of cavities of elongate tubular form is known, or would readily flow from knowledge common in the technical field.

Accordingly, the forming of an elongate tubular body for defining an interior cavity for holding equipment such as electronic components and/or such devices, is not new and cannot be said to involve an inventive step. Such configuration would surely be common knowledge in the technical art and/or would be reached by routine manner if seeking to provide a protective space for housing or carrying such sensitive equipment for operation in a very hostile environment.

It is submitted that the substance of the feature defined by claim 3 lacks novelty and/or would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 4

The core barrel head assembly of Claim 3, wherein

the selectively sealed interior cavity is spaced from and extends distally from the first interior cavity.

D1 discloses and shows (see Figure 2) that body (22) has a further cavity enclosing the electronic core orientation device (20) (see page 11, lines 30 to 33). This further cavity is spaced from the first cavity (that enclosing the gyroscope (34)) and extends distally from that first cavity.

Accordingly, it is submitted that the substance of the feature defined by claim 4 lacks novelty and/or would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 5

The core barrel head assembly of Claim 4, wherein

a port is defined proximate the base portion of the sealed interior cavity that extends from the exterior surface of the elongate tube body into fluid communication with the first interior cavity.

In substance, the claimed feature defines a port fluidly connecting two cavities. One could interpret this feature as referring to a traditional fluid bypass port used to allow drilling fluid within the drill string to pass through the internal diameter of the empty standard inner core tube out through the ports to the outer diameter of the overall head assembly to allow rapid descent of the entire assembly. In this regard, it is submitted that this is an arrangement which is well known in the technical field.

D6 discloses a downhole orientation system employing such a feature. D6 notes:

> "A high pressure flow path 98 extends from the pump outlet 76 and through the sump block 88 to provide high pressure fluid to a side of the magnets 72/piston 92 distant the orientator 12. The path 98 comprises a bore 100 formed in a body of the magnetic actuator 14 and a bore 102 formed in the sump block 88. The pump block 88 is further provided with an oil sump 104 and bleed path 106. The bleed path 106 extends through a plug 108 of the sump block 88 which fits in to the cavity 74. Further, the bleed path 106 provides fluid communication between sump 104 and a side of the magnets 72/piston 92 distant the orientator 12."
>
> "A bypass flow path 110 provides fluid communication between the cavity 74 and sump 104. The flow path 110 comprises in combination a bore 112 formed in the body of the lower housing 16 and which extends in an axially direction, and circumferential feed groove 114 formed on the inside wall of the cavity 74. A hole 116 formed in the sump block 88 provides fluid communication between the bypass flow path 110 and the sump 104. Oil is returned from the sump 104 to the inlet port 78 via return path 118 which is formed as an axially extending bore in the body of the actuator 14."
>
> (D6 – page 10, line 24 to page 11, lines 2)

In any event, it is submitted that the claimed port arrangement is neither novel nor inventive, as an analogous arrangement has been used with the widely known Ezy-Ori™ core orientation product from 2IC, available since about May 2013 (see D13).

Accordingly, it is submitted that the substance of the feature defined by claim 5 lacks novelty and/or would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical art.

Claim 6

> The core barrel head assembly of Claim 5, wherein
>
> > *a pressure fitting is mounted in the port to allow for selective passage of fluid to and from the exterior surface of the barrel head assembly into communication with the first interior cavity.*

It is submitted that the claimed arrangement is neither novel nor inventive, as an analogous arrangement has been used with the widely known Ezy-Ori™ core barrel orientation product from 2IC Australia Pty Ltd, which has been available since May 2013.

Reference is made to the Ezy-Ori™ core barrel orientation system operation manual (see D13) describing the setup and operation of the system.

In any event, a pressure fitting mounted in a port in a manner to allow for selective passage of fluid to and from cavities connected by the port (ie. the exterior surface of the barrel head assembly and the first interior cavity) would be readily derivable by the Skilled Person in view of at least arrangements known in the technical field.

Accordingly, it is submitted that the substance of the feature defined by claim 6 lacks novelty and/or would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 7

The core barrel head assembly of Claim 1, wherein

the sealed interior cavity is sized and shaped to hermetically enclose at least one of the least one electronic instrument, the power source, and the communication means to receive and/or transmit orientation data.

D1 discloses/shows that the body (22) has another cavity enclosing the electronic core orientation device (20), the electronic core orientation device comprising the multiple sensors and the transceiver (28) (see page 11, line 30 - page 12, line 28 and figure 2).

D4 discloses a coring apparatus having an electronics housing (20) defining a cavity for housing/enclosing electronic components (sensors, circuit board). The cavity is sized and shaped to hermetically enclose the various electrical components.

D8 contemplates the core sample orientation data gathering device (342) being a sealed unit:

"The core sample orientation data gathering device 342 is a fully sealed cylindrical unit with screw threads at either end. …"

(D8 – page 36, paragraph [00184])

D8 discloses that the data gathering device is hermetically sealed:

"… . These 'sensors' are packaged into the data gathering device which is compatible for connection with downhole tubing, greasers and other instrumentation devices. The data gathering device is powered by an onboard battery, and preferably the data gathering device is hermetically sealed to prevent ingress of water and contaminants at pressure when 'downhole'. …"

(D8 – paragraph [00209])

D8 also notes previous efforts to seal core orientation units using 'O'-ring seal arrangements:

"However, the device described in AU 2006100113 has been found to have certain limitations. The orientation unit is connected to the greaser by a screw thread and o-ring

> seal arrangement. In the harsh down hole environment within the drill string, it has been realised that the o-ring seals are not always effective and can let fluid into the space between the orientation unit and the greaser. The display unit allows fluid into the electronics of the orientation, resulting in a risk of fault or failure of the device. Furthermore, the orientation unit must be disassembled from the greaser unit before the display and orientation unit can be viewed, rotated and the required core orientation displayed. Thus, the device of AU 2006100113 requires manual manipulation before any reading can be viewed on the display, if the display and the electronics have survived any ingress of fluid past the o-ring seal."

(D8 - paragraph [0024])

D10 discloses a core orientation device (10) having a housing (44) which accommodates an internal chassis (54) having a cavity (56) which accommodates material (57) encasing a tri-axial accelerometer means (58). The housing (44) also accommodates a main printed circuit board (60) and an electrical power source (62) in the form of a lithium battery pack. Processing means (22) and electronic circuitry is also included. Given the level of sophistication of the processing required, the Skilled Person would readily appreciate the need to seal the electronics housing sufficiently to ensure appropriate and reliable operation of the electronic equipment.

D11 discloses an inner tube assembly (10) having a body (21) which defines an internal compartment (33) adapted to accommodate a downhole survey instrument (35). The downhole survey instrument 35 would typically comprise a downhole tool having one or more sensor devices such as orthogonal accelerometers, magnetometers, gyroscopes, MEMS (microelectromechanical) gyro sensors, or any combination thereof.

D11 discloses that the body (21) comprises two portions which are adapted to be releasably connected together by a fluid tight seal to define the compartment (33):

> "The body 21 comprises an upper portion 41 and a lower portion 43 adapted to be releasably connected together by a fluid-tight connection 45. The connection 45 may comprise a threaded connection and an associated fluid seal arrangement. The two portions 41, 43 cooperate to define the internal compartment 33 adapted to receive and accommodate the downhole survey instrument 35. The two portions 41, 43 can be separated by disengaging the connection 45 to provide access to the compartment 33 for insertion and removal of the downhole survey instrument 35."

(D11 – paragraph [0144])

D12 discloses a core sample orientation system (110) designed for use in a conjunction with a downhole assembly (111) comprising in part a housing (117). D12 discloses that the housing (117) comprises two parts selectively separable to provide access to the compartment (119), in which a downhole unit (11) can be accommodated:

> "The housing 117 comprises two parts, being lower body part 125 and an upper cap part 127. The two parts 125, 127 cooperate to define the compartment 119 for accommodating the downhole unit 11. The parts 125, 127 are selectively separable to provide access to the compartment 119. In the arrangement illustrated in Figure 15, the two parts 125, 127 are shown in the separated condition.
>
> … A sealing means 139 is provided to effect fluid-tight sealing engagement between the two parts 125, 127. In the arrangement illustrated, the sealing means 139 comprises O-rings on the spigot 133."
>
> (D12 – page 14, lines 4 to 15)

Accordingly, it is submitted that the substance of the feature defined by claim 7 lacks novelty and/or would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 8

The core barrel head assembly of Claim 1, wherein

> *the sealed interior cavity is sized and shaped to hermetically enclose the least one electronic instrument and the power source.*

Reference is made to the comments outlined in relation to the feature the subject of Claim 7.

Accordingly, it is submitted that the substance of the feature defined by claim 8 lacks novelty and/or would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 9

The core barrel head assembly of Claim 1, further comprising

> *a plurality of windows defined in the elongate tube body that extend from the exterior surface of the elongate tube body into optical communication with the sealed interior cavity proximate a closed proximal end of the sealed interior cavity.*

D8 discloses the use of various sensors in an embodiment of a data gathering device (342) operable with a drill assembly (10). D8 (see Figure 9, 10a, and 10b) discloses the use of an optical communication means:

> "As shown in figure 9, the indicator window end 344 of the core sample orientation data gathering device 342 includes a window 372. The indicator lights can be seen through this window at least when illuminated. In this embodiment, two lights, red and green LEDs are shown. The left hand 374 (red) LED illuminates to indicate to a user to rotate

the device 342 anti-clockwise. The right hand 76 (green) LED illuminates to indicate to a user to rotate the device 342 anti-clockwise. When correct core sample orientation is achieved, both LEDs might illuminate, such as steady or flashing red and green, or another illuminated indication might be given, such as a white light (steady or flashing)."

(D8 – paragraph [00190])

D8 also clearly discloses use of window(s) behind which can be one or more light emitters (LEDs) which serve to provide an optical communication means:

"Obtaining core orientation is made easier by only requiring two colours lights to indicate one or other direction of rotation to establish correct core orientation prior to marking. The indicators form part of the sealed device and can be low power consumption LED lights. Alternatively, flashing lights may be used. For example, a certain frequency or number of flashes for one direction and another frequency or number of flashes for the other direction of rotation. A steady light could be given when correct orientation is achieved."

(D8 – paragraph [00194])

"The data gathering device then provides visual indications of which direction to rotate the core sample to indicate the 'downside' of the core. As discussed earlier in this specification, light indicators, such as the flashing coloured LEDs, and the described method of use, can be employed to indicate to the user which direction to rotate the barrel to the required 'downside'. For such use, a user rotates the barrel until the flashing stops and a solid ON LED indicates that the barrel is in the 'downside' position."

(D8 – paragraph [00222])

D8 discloses the use of apertures through which light from emitters can be observed:

"According to an alternative embodiment of the present invention shown in figures 10a and 10b, a data gathering device 380 houses the light emitters 374,376. Light from these emitters (e.g. LEDs) passes through the window 372 (shown in figure 9). Reference arrow A refers to the drill bit end direction, and reference arrow B refers to the backend assembly direction. An optical adapter 382 is provided at the end 342 of the device and which adapter extends into the greaser unit 346 when connected thereto. The optical adapter has a reflective material. The greaser unit 346 has apertures 384 that allow light therethrough. Light from the emitters is directed onto at least one reflector 386 of the adapter. The emitted and reflected light can be observed through the apertures 384 in the greaser. …"

(D8 – paragraph [00197])

D8 discloses that LED indicators are provided at a closed proximal end of the sealed interior:

> "... . LED indicators are provided at one end 344, the greaser end, that are used in determining correct orientation of the core sample once the core and the device are recovered back a the surface. Figure 9 shows an example of the indicator end 344 of the core sample orientation data gathering device 342."
>
> (D8 – paragraph [00185])

It is submitted that optical communication in the form contemplated by claim 9 is not novel nor inventive for core orientation devices in view of at least the documents discussed herein.

Reference is also made to the widely known Ezy-Mark™ and Ezy-Ori™ core orientation products from 2IC (see D13), which have been available since before the Priority Date. Both products incorporated a visual (optical) observation system using a plurality of balls and their relative position to each other being observable through a clear plastic orientation ball housing (window).

It is submitted that the substance of the feature defined by claim 9 lacks novelty and/or would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 10

The core barrel head assembly of Claim 9, further comprising

an orientation indicator module comprising a plurality of light emitters.

Reference is made to the comments above in relation to claim 9.

Accordingly, it is submitted that the substance of the feature defined by claim 10 lacks novelty and/or would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 11

The core barrel head assembly of Claim 10, wherein

the orientation indicator module is sized and shaped to sealingly close the sealed interior cavity from any intrusion of pressurized fluid into the sealed interior cavity via the plurality of windows.

D8 discloses that the data gathering device (342) (includes at least one vibration sensor, and preferably at least one of a gravity sensor, magnetic field sensor, accelerometer, inclinometer, and preferably a combination two or more of these devices) is fully sealed:

> "The core sample orientation data gathering device 342 is a fully sealed cylindrical unit with screw threads at either end. A first end 344 connects to a standard length and size greaser unit 346 and a second end 348 connects to a core sample tube 350. ..."
>
> (D8 – paragraph [00184])

D8 discloses that the data gathering device is hermetically sealed so as to prevent the intrusion of pressurized fluid (this clearly includes intrusion from at least window (372)):

> "... . These 'sensors' are packaged into the data gathering device which is compatible for connection with downhole tubing, greasers and other instrumentation devices. The data gathering device is powered by an onboard battery, and preferably the data gathering device is hermetically sealed to prevent ingress of water and contaminants at pressure when 'downhole'. ..."
>
> (D8 – paragraph [00209])

Accordingly, it is submitted that the substance of the feature defined by claim 11 lacks novelty and/or would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 12

> The core barrel head assembly of Claim 10, wherein
>
> > *the orientation indicator module is configured to orient or otherwise position the plurality of light emitters so that each light emitter underlies one window.*

Reference is made to the comments above in relation to claims 7 to 11.

D8 discloses that light from light emitters (374, 376) can be observed by way of apertures (384). The Skilled Person would readily appreciate that this can occur when the cylindrical unit housing apertures (346) are in an appropriate position relative the emitters:

> "According to an alternative embodiment of the present invention shown in figures 10a and 10b, a data gathering device 380 houses the light emitters 374,376. Light from these emitters (e.g. LEDs) passes through the window 372 (shown in figure 9). Reference arrow A refers to the drill bit end direction, and reference arrow B refers to the backend assembly direction. An optical adapter 382 is provided at the end 342 of the device and which adapter extends into the greaser unit 346 when connected thereto. The optical adapter has a reflective material. The greaser unit 346 has apertures 384 that allow light therethrough. Light from the emitters is directed onto at least one reflector 386 of the adapter. The emitted and reflected light can be observed through the apertures 384 in the greaser. ..."

(D8 – paragraph [00197])

Accordingly, it is submitted that the substance of the feature defined by claim 12 lacks novelty and/or would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 13

The core barrel head assembly of Claim 10, wherein the

> *orientation indicator module further comprises a first sealing means for preventing any pressurized fluid from entering the sealed interior cavity from the plurality of windows defined in the elongate tube body.*

Reference is made to the comments above in relation to claims 7 to 12.

Reference is also made to comments above regarding sealing of the interior cavity. Specifically, D8 discloses that the data gathering device (342) is fully sealed:

> "The core sample orientation data gathering device 342 is a fully sealed cylindrical unit with screw threads at either end. A first end 344 connects to a standard length and size greaser unit 346 and a second end 348 connects to a core sample tube 350. ..."

(D8 – paragraph [00184])

D8 also discloses that the data gathering device is hermetically sealed so as to prevent the intrusion of pressurized fluid (this clearly includes intrusion from at least window (372)):

> "... . These 'sensors' are packaged into the data gathering device which is compatible for connection with downhole tubing, greasers and other instrumentation devices. The data gathering device is powered by an onboard battery, and preferably the data gathering device is hermetically sealed to prevent ingress of water and contaminants at pressure when 'downhole'. ..."

(D8 – paragraph [00209])

D8 therefore clearly indicates that at least one sealing means would be needed to establish the hermetic seal.

Accordingly, it is submitted that the substance of the feature defined by claim 13 lacks novelty and/or would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 14

The core barrel head assembly of Claim 13, wherein

> *the first sealing means comprises at least one O-ring seal that is mounted on an exterior portion of the orientation indicator module and that is configured to seal between an exterior portion of the orientation indicator module and a portion of an interior surface of the sealed interior cavity*.

D8 acknowledges previous efforts to seal core orientation units using 'O'-ring seal arrangements:

> "However, the device described in AU 2006100113 has been found to have certain limitations. The orientation unit is connected to the greaser by a screw thread and o-ring seal arrangement. In the harsh down hole environment within the drill string, it has been realised that the o-ring seals are not always effective and can let fluid into the space between the orientation unit and the greaser. The display unit allows fluid into the electronics of the orientation, resulting in a risk of fault or failure of the device. Furthermore, the orientation unit must be disassembled from the greaser unit before the display and orientation unit can be viewed, rotated and the required core orientation displayed. Thus, the device of AU 2006100113 requires manual manipulation before any reading can be viewed on the display, if the display and the electronics have survived any ingress of fluid past the o-ring seal."

(D8 – page 6, paragraph [0024])

D12 discloses the use of an O-ring seal between co-operating portions to establish an appropriate seal:

> "The housing 117 comprises two parts, being lower body part 125 and an upper cap part 127. The two parts 125, 127 cooperate to define the compartment 119 for accommodating the downhole unit 11. The parts 125, 127 are selectively separable to provide access to the compartment 119. In the arrangement illustrated in Figure 15, the two parts 125, 127 are shown in the separated condition.
>
> … . A sealing means 139 is provided to effect fluid-tight sealing engagement between the two parts 125, 127. In the arrangement illustrated, the sealing means 139 comprises O-rings on the spigot 133."

(D12 – page 14, lines 4 to 15)

In any event, the Skilled Person would readily appreciate the use of O-ring seals for creating/providing a hermetic seal of the type contemplated in claim 14.

Accordingly, it is submitted that the substance of the feature defined by claim 14 lacks novelty and/or would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 15

The core barrel head assembly of Claim 14, wherein the

sealed interior cavity can comprised at least one orienting slot defined therein.

Reference is made to comments above regarding sealing of the interior cavity.

It is submitted that the provision of a 'slot' for positional or orientation purposes, in the context of the claimed invention and the relevant technical field, would be well known to the Skilled Person. Such feature would surely constitute a readily derivable *workshop variation* in view of at least arrangements known to the Skilled Person, or arrangements readily derivable thereby, in the technical field.

Accordingly, it is submitted that the substance of the feature defined by claim 15 would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 16

The core barrel head assembly of Claim 14, wherein

a desired position of the orientation indicator module is maintained relative to at least one O-ring seal.

As noted herein, O-ring seals in technology of this type for establishing hermetic seals are known.

It is submitted that maintaining a desired relative position between a component and an O-ring seal for (presumably) maintaining a (hermetic) seal, in the context of the relevant technical field, would be well known to the Skilled Person. Such feature would surely constitute a readily derivable *workshop variation* in view of at least arrangements known to the Skilled Person, or arrangements readily derivable thereby, in the technical field.

Accordingly, it is submitted that the substance of the feature defined by claim 16 lacks novelty and/or would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 17

The core barrel head assembly of Claim 1, wherein

the sealed interior cavity extends distally to an open threaded distal end of the elongate tube body.

The elongate tubular cavity shown in at least Figure 2 of D1 is clearly shown extending distally toward an open threaded distal end of the elongate tube body (22).

D11 discloses that respective portions (273, 275), each defining an internal cavity, and which cooperate to define a sealed cavity, comprise threaded portions at open distal ends thereof:

> "The compartment 261 is incorporated in the upper portion 263. The upper portion 263 comprises two sections, being a top section 273 and a bottom section 275 adapted to be releasably connected together by a fluid-tight connection 277. The connection 277 may comprise a threaded connection and an associated fluid seal arrangement. The two sections 273, 275 are selectively separable to provide access to the compartment 261."
>
> (D11 – paragraph [00223])

Accordingly, it is submitted that the substance of the feature defined by claim 17 lacks novelty and/or would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 18

The core barrel head assembly of Claim 18 [17], further comprising

a seal coupler that is configured to be sealingly received in the open threaded distal end of the elongate tube body.

Reference is made to comments herein regarding sealing of the interior cavity.

It is submitted that the provision of a seal coupler for establishing a seal, in the context of the relevant technical field, would be well known to the Skilled Person. Such feature would surely constitute a readily derivable workshop variation in view of at least arrangements known in the technical field.

Accordingly, it is submitted that the substance of the feature defined by claim 18 lacks novelty and/or would be obvious to the Skilled Person in view of one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 19

The core barrel head assembly of Claim 18, further comprises

a second sealing means for preventing any pressurized fluid from entering the sealed interior cavity.

Reference is made to comments herein regarding sealing of the interior cavity.

It is submitted that the provision of one or more sealing means or sealing elements, in the context of the relevant technical field, would be well known to the Skilled Person. Such feature would surely constitute a readily derivable workshop variation in view of at least arrangements known in the technical field.

Accordingly, it is submitted that the substance of the feature defined by claim 19 lacks novelty and/or would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 20

The core barrel head assembly of Claim 19, wherein the

second sealing means comprises at least one O-ring seal that is mounted on a portion of the seal coupler and that is configured to seal between a portion of the seal coupler and a portion of an interior surface of the open distal end of the elongate tube body.

Reference is made to comments herein regarding sealing of the interior cavity.

As noted above, O-ring seals are widely known in the present technical field, as well as in other technical fields, for the purpose of establishing a fluid/hermetic seal between components.

It is submitted that the provision of O-ring elements, in the context of the relevant technical field, for fluid sealing purposes would be well known to the Skilled Person. Such feature would surely constitute a readily derivable workshop variation in view of at least arrangements known in the technical field.

Accordingly, it is submitted that the substance of the feature defined by claim 20 lacks novelty and/or would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 21

The core barrel head assembly of Claim 18, further comprising

a check valve assembly configured to affect a hermetical seal of the sealed interior cavity and to provide fluid control for wire line operation.

It is submitted that the claimed check valve assembly for use in affecting a hermetic/fluid seal and/or for providing fluid control for wireline operation (or other retrieval methods) is neither novel nor inventive, as a check valve assembly has been used with the widely known Ezy-Ori™ core orientation product from 2IC, which has been available since May 2013. This product incorporated a check valve arrangement for use in establishing a hermetic/fluid seal for operable use in at least one retrieval method.

Reference is made to the Ezy-Ori™ core barrel orientation system operation manual (see D13) describing the setup and operation of the system.

In any event, a check valve assembly arrangement configured so as to affect a hermetic seal of a sealed cavity would be readily derivable by the Skilled Person in view of at least arrangements known in the technical field.

Accordingly, it is submitted that the substance of the feature defined by claim 21 lacks novelty and/or would be obvious to the Skilled Person in view of one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 22

The core barrel head assembly of Claim 21, wherein

the check valve assembly comprises a coupled proximal end assembly and a distally tapered seat that defines an interior chamber for operative receipt of a check ball.

It is submitted that the claimed check valve assembly for use to affect hermetic/fluid seal and/or for providing fluid control for wireline operation (or other retrieval methods) is neither novel nor inventive, as a check valve assembly has been used with the widely known Ezy-Ori™ core barrel orientation product from 2IC, which has been available prior to the Priority Date. This product incorporated a check valve arrangement which comprised a cavity for accommodating a check ball (see D13 describing the setup and operation of the system).

In any event, a check valve assembly arrangement configured so as to accommodate a check ball would be readily derivable by the Skilled Person in view of at least arrangements known in the technical field.

Accordingly, it is submitted that the substance of the feature defined by claim 22 lacks novelty and/or would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 23

The core barrel head assembly of Claim 22, wherein

the proximal end assembly defines a female threaded coupling that is configured to be threadably coupled to male threads defined on an exterior surface of a distal end of the elongate tube body.

The Skilled Person would readily appreciate the co-operability of female and male thread arrangements in order to provide a threaded coupling arrangement.

It is submitted that such coupling arrangements are known in view of use with the widely known Ezy-Ori™ core orientation product from 2IC, which has been available prior to the Priority Date. This product incorporated a check valve arrangement which comprised a cavity for accommodating a check ball (see D13 describing the setup and operation of the system).

In any event, in the context of the claimed invention and the relevant technical field, thread coupling arrangements would be readily derivable by the Skilled Person in view of at least arrangements known in the technical field.

Accordingly, it is submitted that the substance of the feature defined by claim 23 lacks novelty and/or would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 24

The core barrel head assembly of Claim 23, wherein, when

the proximal end assembly is threadably coupled to the distal end of the elongate tube body, the seal coupler is driven into a sealed position therein the sealed interior cavity to affect complete hermeticity.

The Skilled Person would readily appreciate the co-operability of female and male thread arrangements in order to provide a threaded coupling arrangement, or arrangements in which a form of co-operability is required in order to establish a hermetic type seal. Reference is made to the arrangement shown in D11 discussed herein, in which two housing threadedly engage to define a cavity having a fluid tight fit.

It is submitted that such coupling arrangements are known in view of use with the widely known Ezy-Ori™ core orientation product from 2IC, which has been available prior to the Priority Date. This product incorporated a threaded coupling arrangement.

Reference is made to the Ezy-Ori™ core barrel orientation system operation manual (D13) describing the setup and operation of the system.

In any event, on the context of the technical art, thread coupling arrangements for establishing fluid/hermetic type seals would be readily derivable by the Skilled Person in view of arrangements know in the technical field.

Accordingly, it is submitted that the substance of the feature defined by claim 24 lacks novelty and/or would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 25

The core barrel head assembly of Claim 22, wherein

the interior chamber of the check valve assembly extends to a distal end of the check valve assembly, and

wherein the check valve assembly further defines at least one port that extends from an exterior surface of the check valve assembly and is in fluid communication with the interior chamber of the check valve assembly.

Reference is made to comments advanced in relation to the claims 21, 22, 25, and 27 herein.

In any event, the specific configurations of the side walls of an interior chamber configured to accommodate a check ball of a check valve for appropriate operation would be readily derivable by the Skilled Person in view of at least arrangements known in the technical field.

Accordingly, it is submitted that the substance of the feature defined by claim 26 lacks novelty and/or would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 26

The core barrel head assembly of Claim 25, wherein

the interior chamber has a distally tapered seat that is adapted to selectively receive the check ball that is sized to selectively block the distally tapered seat.

Reference is made to comments advanced in relation to the claims 21, 22, 25, and 27 herein.

In any event, the specific configurations of the side walls of an interior chamber configured to accommodate a check ball of a check valve for appropriate operation would be readily derivable by the Skilled Person in view of at least arrangements known in the technical field.

Accordingly, it is submitted that the substance of the feature defined by claim 26 lacks novelty and/or would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 27

The core barrel head assembly of Claim 26,

wherein the interior chamber is

sized and

shaped to allow the check ball to selectively move axially between

an open position, in which

the check ball is spaced proximally away from the surface of the tapered seat so that

pressurized fluid can move through the distal end of the check valve assembly and

subsequently through the interior chamber to exit out of the at least one port, and

a closed position, in which

the check ball is pressurized against the surface of the tapered seat so that pressurized fluid cannot move through the check valve assembly.

It is submitted that the claimed check valve arrangement is neither novel nor inventive, as the substance of the claimed feature describes the general operation of check valve assemblies when operable with a check ball. It is submitted that the usual structure and operation of a check valve assembly using a check ball is as follows:

(i) having an interior chamber sized to accommodate a check ball valve;

(ii) allowing the check ball to move between an open and a closed position;

(iii) the open position being one in which pressurized fluid is allowed to flow along a desired fluid path; and

(iv) the closed position being one in which the check ball ceases fluid flow by way of the pressure exerted thereon by the fluid flow.

A check valve assembly has been used with the widely known Ezy-Ori™ core barrel orientation system from 2IC, which has been available since before the Priority Date. This product incorporated a check valve arrangement which was arranged to operate in the conventional manner.

In any event, the specific configurations of a check valve being used with a check ball would be readily derivable by the Skilled Person in view of at least conventional arrangements known in the technical field.

Accordingly, it is submitted that the substance of the feature defined by claim 27 lacks novelty and/or would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 28

The core barrel head assembly of Claim 1, wherein

an exterior surface of the elongate tube body defines a plurality of female planar stops proximate the mid-body portion.

D1 clearly shows (see Figure 2) a 'female planar stop' feature provided intermediate portions (16) and (18):

"The tool 10 comprises an electronic core orientation device or system 20 housed within a body 22 that is coupled to and between the core tube cap 18 and the adaptor 16."

(D1 – page 11, lines 30 to 33)

Reference is made to the Ezy-Ori ™ core barrel orientation system known widely in the industry prior to the Priority Date. Reference is made to D13 at page 11, section 4.3.4, where a 'female planar stop' feature is shown.

Accordingly, it is submitted that the substance of the feature defined by claim 28 lacks novelty and/or would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 29

The core barrel head assembly of Claim 1, wherein

the at least one electronic instrument is programmed to obtain orientation data when the at least one electronic instrument senses no relative movement of the at least one electronic instrument.

D1 discloses that a trigger signal may be provided when cessation of drilling is detected:

> "The trigger signal may be one of a plurality of trigger signals provided upon detection of different downhole events. That is a trigger signal may be provided when commencement of drill is detected, another when cessation of drilling is detected and another when an uphole motion of the tool 10 or drill is detected. Thus logging (recording) of data will commence prior to the breaking of the core. Additionally different orientation indications may be logged at different trigger signals. For example dip may be logged at when the trigger system detects drilling has stopped (e.g. detecting no rotation of the core drill following previously detecting the commencement of drilling; and core orientation may be logged upon the trigger system detecting a core lifter case gripping the core just prior to the core break."
>
> (page 14, lines 7-21).

D8 discloses use of one or more sensors in a data gathering device (342, 380), the sensors including at least one vibration sensor, and preferably at least one of a gravity sensor, magnetic field sensor, accelerometer, inclinometer, and preferably a combination two or more of these devices. These 'sensors' are packaged into the data gathering device which is compatible for connection with downhole tubing, greasers and other instrumentation devices. The data gathering device is powered by an onboard battery, and preferably the data gathering device is hermetically sealed to prevent ingress of water and contaminants at pressure when 'downhole'. The data gathering device forms part of a system in conjunction with the communication device (60), and preferably any other equipment as needed. (D8 – paragraph [00209])

In one aspect of the operation disclosed in D8, the data gathering device (342, 380) is used downhole to check and determine whether vibration (which might be occurring) is due to drilling. The device also checks whether there is a valid communication from a communication device. The device goes back to a standby mode until vibration is not detected above a threshold (preferably zero). If no vibration is detected for a desired period the data gathering device determines that drilling has stopped, the device activates ('wakes up' from its standby or 'sleep' mode) and begins recording data (see D8 – paragraph [00211]).

D9 discloses that information logged either side of a core breakage can be assessed to provide an alert to a user of any unacceptable variation:

> "More particularly, in terms of error checking the data logged by the orientation device 12 may be analysed, either by the device 12 itself while in the hole, or by the remote control unit 22, or indeed by a separate device, using statistical measures of its accuracy. The logged data may be analysed to identify the presence of any movement during the logging of orientation data. This may include linear and/or rotational direction of motion, which is itself logged and provided to a user. These self checks may be beneficial to identify service requirements. In particular the indication of movement during logging may be beneficial in identifying improper operation of the orientation device and thus flag the need for training or retraining of operators. For example multiple logged orientation

data on either side, in a time line sense, of a specific individual or averaged data point used as the orientation data at the time of core break, can be analysed to ascertain whether there was any appreciable motion (ie change in logged orientation) immediately before or after the core break when the core orientation data was being logged. Thus data in a time period adjacent of a core break (and in particular before the core break) can be analysed to detect linear/rotational motion of the core tube 12. If this motion is outside of an acceptable range the system 10 can log that information and the signaling system can emit a sensory signal to alert a user of that variation."

(page 7, line 30 to page 8, line 19)

Accordingly, it is submitted that the substance of the feature defined by claim 29 lacks novelty and/or would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 30

The core barrel head assembly of Claim 29, wherein

the at least one electronic instrument is programmed to obtain orientation data when the at least one electronic instrument senses no vibrations.

Reference is made to the comments outlined above in relation to claim 29.

In practice, it is likely never going to be the case where 'no' vibration is detected. Thus, testing against an acceptable threshold which reasonably reflects a 'no vibration' case is most probable.

Accordingly, it is submitted that the substance of the feature defined by claim 30 lacks novelty and/or would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 31

The core barrel head assembly of Claim 30, wherein

the at least one electronic instrument does not take any orientation measurements if vibrations are sensed by the at least one electronic instrument.

Reference is made to comments noted above in relation to claim 29 and claim 30.

Accordingly, it is submitted that the substance of the feature defined by claim 31 lacks novelty and/or would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 32

The core barrel head assembly of Claim 29, wherein

> *the at least one electronic instrument is programmed to not obtain orientation data when the at least one electronic instrument determines that the core barrel head assembly is in motion while descending down or ascending up the hole and during drilling*.

Reference is made to comments above in relation to claims 29 to 31.

It is submitted that descending or ascending movement of the drill head assembly would cause vibrations. The substance of the features would be testing to see whether such movement is above an acceptable threshold level. The substance of this process is clearly known from at least D8.

Accordingly, it is submitted that the substance of the feature defined by claim 32 lacks novelty and/or would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical field.

Claim 33

The core barrel head assembly of Claim 1, wherein

> *the at least one electronic instrument is programmed to obtain orientation data based on a predetermined time interval scheme*.

D1 discloses that the logging of orientation data by the electronic core orientation device (20) may occur for a predetermined period of time (see page 26, lines 5-18). The following is informative:

> "… . The electronic orientation device 20 can then log data relating to the orientation of a tool 10, the borehole in which it resides, and/or the core 112. The logging of information by the electronic device 20 may occur at a predetermined frequency for a predetermined period of time. For example the electronic orientation device/system 20 may log orientation data every 10 seconds for a two minute period after receipt of the initial trigger signal."
>
> (D1 – page 26, lines 10 to 18)

D9 acknowledged prior efforts which involve recordal of orientation data based on a predetermined time interval scheme:

> "Other systems are known that electronically record information or data relating to the core orientation at the commencement or end of a core run rather than physically mark or take impressions of the core sample. One known system utilises an electronic

orientation device that is screwed onto a back end of the core tube, a stopwatch, and a marking jig. … . The device records readings of core orientation at fixed time intervals. …"

(D9 – page 1, lines 26 to 37)

"The orientation device may be pre-programmed, or programmable via the remote control unit 22, to take orientation readings at predetermined time intervals. For example orientation readings may be taken every 1, 2 or 5 seconds. In a further embodiment multiple successive readings may be taken over a small time interval or pulse and repeated over a longer duty cycle."

(D9 – page 7, lines 1 to 7)

Accordingly, it is submitted that the substance of the feature defined by claim 33 lacks novelty and/or would be obvious to the Skilled Person in view of at least one or more of the documents discussed herein, and/or knowledge common in the technical field.

ATTORNEY DOCKET NO. 36362.0150U2-
PATENT
VIA EFS-WEB

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	)	
	)	
DRENTH et al.	)	Art Unit: 3676
	)	
Application No.: 14/692,484	)	Examiner: Wills III, Michael R.
	)	
Filing Date: April 21, 2015	)	Confirmation No.: 3851
	)	
FOR: **CORE BARREL HEAD ASSEMBLY WITH AN INTEGRATED SAMPLE ORIENTATION TOOL AND SYSTEM FOR USING SAME**	)	

RESPONSE TO NON-FINAL OFFICE ACTION

MAIL STOP AMENDMENT
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Ballard Spahr LLP
Customer Number 23859

October 18, 2017

Commissioner:

In response to the Office Action dated August 18, 2017, please amend the above-referenced application as set forth below and consider the Remarks that follow.

Amendments to the Claims are reflected on the listing of claims which begins on page 2 of this Amendment.

Remarks begin on page 8 of this Amendment.

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Reflex USA LLC v. Longyear TM, Inc. and Globaltech Corporation Pty Ltd.

AMENDMENTS TO THE CLAIMS

The following listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1. (Currently Amended) A core barrel head assembly, comprising:

an elongate tube body defining a first interior cavity and a selectively sealed interior cavity spaced distally from the first interior cavity, wherein the elongate tube body has a threaded proximal end for coupling to a wire line retrieval portion of a head assembly, wherein the first interior cavity extends distally from the threaded proximal end to a base portion of the elongate tube body, and wherein the elongate tube body further defines a port positioned proximate the base portion and extending from the exterior surface of the elongate tube body into fluid communication with the first interior cavity;

a plurality of windows defined in the elongate tube body that extend from the exterior surface of the elongate tube body into optical communication with the sealed interior cavity proximate a closed proximal end of the sealed interior cavity;

at least one electronic instrument that is configured to obtain orientation data mounted therein the sealed interior cavity, wherein the at least one electronic instrument comprises at least one digital and/or electro-mechanical sensors in a core orientation data recording tool that can be configured to determine a core orientation of a sample core just prior to or after the core break;

a power source in operable communication with the at least one electronic instrument, wherein the power source is mounted therein the interior cavity; and

communication means to receive and/or transmit core orientation data,

wherein the sealed interior cavity is sized and shaped to hermetically enclose the at least one electronic instrument and the power source.

Claims 2-5 are cancelled.

6. (Previously Presented) The core barrel head assembly of Claim 1, wherein a pressure fitting is mounted in the port to allow for selective passage of fluid to and from the exterior surface of the barrel head assembly into communication with the first interior cavity.

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Reflex USA LLC v. Longyear TM, Inc. and Globaltech Corporation Pty Ltd.

7. (Previously Presented) The core barrel head assembly of Claim 1, wherein the sealed interior cavity is sized and shaped to hermetically enclose the communication means to receive and/or transmit orientation data.

Claims 8-9 are cancelled.

10. (Original) The core barrel head assembly of Claim [[9]] 1, further comprising an orientation indicator module comprising a plurality of light emitters.

11. (Original) The core barrel head assembly of Claim 10, wherein the orientation indicator module is sized and shaped to sealingly close the sealed interior cavity from any intrusion of pressurized fluid into the sealed interior cavity via the plurality of windows.

12. (Original) The core barrel head assembly of Claim 10, wherein the orientation indicator module is configured to orient or otherwise position the plurality of light emitters so that each light emitter underlies one window.

13. (Original) The core barrel head assembly of Claim 10, wherein the orientation indicator module further comprises a first sealing means for preventing any pressurized fluid from entering the sealed interior cavity from the plurality of windows defined in the elongate tube body.

14. (Original) The core barrel head assembly of Claim 13, wherein the first sealing means comprises at least one O-ring seal that is mounted on an exterior portion of the orientation indicator module and that is configured to seal between an exterior portion of the orientation indicator module and a portion of an interior surface of the sealed interior cavity.

15. (Original) The core barrel head assembly of Claim 14, wherein the sealed interior cavity can comprised at least one orienting slot defined therein.

16. (Original) The core barrel head assembly of Claim 14, wherein a desired position of the orientation indicator module is maintained relative to at least one O-ring seal.

17. (Original) The core barrel head assembly of Claim 1, wherein the sealed interior cavity extends distally to an open threaded distal end of the elongate tube body.

18. (Previously Presented) The core barrel head assembly of Claim 17, further comprising a seal coupler that is configured to be sealingly received in the open threaded distal end of the elongate tube body.

19. (Previously Presented) The core barrel head assembly of Claim 18, further comprising a second sealing means for preventing any pressurized fluid from entering the sealed interior cavity.

20. (Original) The core barrel head assembly of Claim 19, wherein the second sealing means comprises at least one O-ring seal that is mounted on a portion of the seal coupler and that is configured to seal between a portion of the seal coupler and a portion of an interior surface of the open distal end of the elongate tube body.

21. (Original) The core barrel head assembly of Claim 18, further comprising a check valve assembly configured to affect a hermetical seal of the sealed interior cavity and to provide fluid control for wire line operation.

22. (Original) The core barrel head assembly of Claim 21, wherein the check valve assembly comprises a coupled proximal end assembly and a distally tapered seat that defines an interior chamber for operative receipt of a check ball.

23. (Original) The core barrel head assembly of Claim 22, wherein the proximal end assembly defines a female threaded coupling that is configured to be threadably coupled to male threads defined on an exterior surface of a distal end of the elongate tube body.

24. (Original) The core barrel head assembly of Claim 23, wherein, when the proximal end assembly is threadably coupled to the distal end of the elongate tube body, the seal coupler is driven into a sealed position therein the sealed interior cavity to affect complete hermeticity.

25. (Original) The core barrel head assembly of Claim 22, wherein the interior chamber of the check valve assembly extends to a distal end of the check valve assembly, and wherein the check valve assembly further defines at least one port that extends from an exterior surface of the check valve assembly and is in fluid communication with the interior chamber of the check valve assembly.

26. (Original) The core barrel head assembly of Claim 25, wherein the interior chamber has a distally tapered seat that is adapted to selectively receive the check ball that is sized to selectively block the distally tapered seat.

27. (Original) The core barrel head assembly of Claim 26, wherein the interior chamber is sized and shaped to allow the check ball to selectively move axially between an open position, in which the check ball is spaced proximally away from the surface of the tapered seat so that pressurized fluid can move through the distal end of the check valve assembly

and subsequently through the interior chamber to exit out of the at least one port, and a closed position, in which the check ball is pressurized against the surface of the tapered seat so that pressurized fluid cannot move through the check valve assembly.

28. (Original) The core barrel head assembly of Claim 1, wherein an exterior surface of the elongate tube body defines a plurality of female planar stops proximate the mid-body portion.

29. (Original) The core barrel head assembly of Claim 1, wherein the at least one electronic instrument is programmed to obtain orientation data when the at least one electronic instrument senses no relative movement of the at least one electronic instrument.

30. (Original) The core barrel head assembly of Claim 29, wherein the at least one electronic instrument is programmed to obtain orientation data when the at least one electronic instrument senses no vibrations.

31. (Original) The core barrel head assembly of Claim 30, wherein the at least one electronic instrument does not take any orientation measurements if vibrations are sensed by the at least one electronic instrument.

32. (Original) The core barrel head assembly of Claim 29, wherein the at least one electronic instrument is programmed to not obtain orientation data when the at least one electronic instrument determines that the core barrel head assembly is in motion while descending down or ascending up the hole and during drilling.

33. (Original) The core barrel head assembly of Claim 1, wherein the at least one electronic instrument is programmed to obtain orientation data based on a predetermined time interval scheme.

34. (Previously Presented) A core barrel head assembly, comprising:

an elongate tube body defining a first interior cavity and a selectively sealed interior cavity spaced distally from the first interior cavity, wherein the elongate tube body has a threaded proximal end for coupling to a wire line retrieval portion of a head assembly, wherein the first interior cavity extends distally from the threaded proximal end to a base portion of the elongate tube body, and wherein the elongate tube body further defines a port positioned proximate the base portion and extending from the exterior surface of the elongate tube body into fluid communication with the first interior cavity;

at least one electronic instrument that is configured to obtain orientation data mounted therein the sealed interior cavity, wherein the at least one electronic instrument comprises at

least one digital and/or electro-mechanical sensors in a core orientation data recording tool that can be configured to determine a core orientation of a sample core just prior to or after the core break;

a power source in operable communication with the at least one electronic instrument, wherein the power source is mounted therein the interior cavity; and

communication means to receive and/or transmit core orientation data,

wherein the sealed interior cavity is sized and shaped to hermetically enclose the at least one electronic instrument and the power source, and

wherein a pressure fitting is mounted in the port to allow for selective passage of fluid to and from the exterior surface of the barrel head assembly into communication with the first interior cavity.

35. (Previously Presented) The core barrel head assembly of claim 34, further comprising a plurality of windows defined in the elongate tube body that extend from the exterior surface of the elongate tube body into optical communication with the sealed interior cavity proximate a closed proximal end of the sealed interior cavity

36. (Previously Presented) The core barrel head assembly of claim 34, wherein the sealed interior cavity extends distally to an open threaded distal end of the elongate tube body.

37. (Previously Presented) The core barrel head assembly of Claim 36, further comprising a seal coupler that is configured to be sealingly received in the open threaded distal end of the elongate tube body.

38. (Previously Presented) The core barrel head assembly of Claim 34, wherein the at least one electronic instrument is programmed to obtain orientation data when the at least one electronic instrument senses no relative movement of the at least one electronic instrument.

39. (New) A core barrel head assembly, comprising:

an elongate tube body defining a first interior cavity and a selectively sealed interior cavity spaced distally from the first interior cavity, wherein the elongate tube body has a threaded proximal end for coupling to a wire line retrieval portion of a head assembly, wherein the first interior cavity extends distally from the threaded proximal end to a base portion of the elongate tube body, and wherein the elongate tube body further defines a port positioned proximate the base portion and extending from the exterior surface of the elongate tube body into fluid communication with the first interior cavity, wherein the sealed interior cavity extends distally to an open threaded distal end of the elongate tube body;

a seal coupler that is configured to be sealingly received in the open threaded distal end of the elongate tube body;

at least one electronic instrument that is configured to obtain orientation data mounted therein the sealed interior cavity, wherein the at least one electronic instrument comprises at least one digital and/or electro-mechanical sensors in a core orientation data recording tool that can be configured to determine a core orientation of a sample core just prior to or after the core break;

a power source in operable communication with the at least one electronic instrument, wherein the power source is mounted therein the interior cavity; and

communication means to receive and/or transmit core orientation data,

wherein the sealed interior cavity is sized and shaped to hermetically enclose the at least one electronic instrument and the power source.

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REMARKS

Claims 1, 6, 7, and 9-38 are pending. As set forth herein, Applicants have amended claim 1. Claim 9 has been canceled without prejudice, and new claim 39 has been added. Therefore, after entry of this amendment, claims 1, 6-7, and 10-39 will be under consideration. No new matter has been added by these amendments.

Allowable Subject Matter

Applicants would like to thank the Examiner for the indication that claims 34-38 are allowed and that claims 6, 9-16 and 18-27 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Rejections Under 35 U.S.C. § 103

Claims 1, 7, 17, and 28-33 were rejected under 35 U.S.C. § 103 as being unpatentable over International Patent Application Publication No. WO 2008/113127 to Beach ("Beach") in view of U.S. Patent No. 4,955,438 to Juergens ("Juergens").

As set forth herein, independent claim 1 has been amended to incorporate the limitations of dependent claim 9, which was indicated as being directed to allowable subject matter. Therefore, Applicant respectfully submits that independent claim 1, as amended, and its dependent claims are nonobvious over the cited references. Accordingly, Applicant respectfully requests that the rejections of claims 1, 7, 17, and 28-33 and the objections to claims 6, 9-16, and 18-27 be withdrawn.

New Claim 39

New claim 39 includes the limitations of previously presented claim 18, which was indicated as being directed to allowable subject matter. More particularly, new claim 39 is an independent claim that includes, in combination, the limitations of previously presented claims 1, 17, and 18. Accordingly, Applicant respectfully submits that new independent claim 39 is in condition for allowance.

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CONCLUSION

In view of the above amendments and/or remarks, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue. The Examiner is invited and encouraged to contact directly the undersigned is such contact may enhance the efficient prosecution of this application to issue.

No fee(s) are believed due; however, the Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 14-0629.

Respectfully submitted,

Electronic signature: /Joseph P. Anderson, III/
Joseph P. Anderson, III
Registration No.: 59,245
BALLARD SPAHR LLP
Correspondence Customer Number: 23859

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Electronic Acknowledgement Receipt

EFS ID:	30695127
Application Number:	14692484
International Application Number:	
Confirmation Number:	3851
Title of Invention:	Core Barrel Head Assembly With An Integrated Sample Orientation Tool And System For Using Same
First Named Inventor/Applicant Name:	CHRISTOPHER L. DRENTH
Customer Number:	23859
Filer:	Joseph P. Anderson
Filer Authorized By:	
Attorney Docket Number:	36362.0150U2-
Receipt Date:	18-OCT-2017
Filing Date:	21-APR-2015
Time Stamp:	16:51:33
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		36362_0150U2_Response_to_NonFinal_Office_Action.pdf	102798 0589edf812e3fc33566c53ea3ff55c1c3630dcea	yes	9

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
	Claims	2	7
	Applicant Arguments/Remarks Made in an Amendment	8	9
Warnings:			
Information:			
	Total Files Size (in bytes):	102798	

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

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 14/692,484	Filing Date 04/21/2015	☐ To be Mailed

ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT 10/18/2017

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 33	Minus	** 33	= 0	X $80 =	0
Independent (37 CFR 1.16(h))	* 3	Minus	***3	= 0	X $420 =	0
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	0

AMENDMENT

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LIE
DEBORAH SCOTT

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**
If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/692,484	04/21/2015	CHRISTOPHER L. DRENTH	36362.0150U2-	3851

23859 7590 08/18/2017

Ballard Spahr LLP
SUITE 1000
999 PEACHTREE STREET
ATLANTA, GA 30309-3915

EXAMINER	
WILLS III, MICHAEL R	

ART UNIT	PAPER NUMBER
3676	

NOTIFICATION DATE	DELIVERY MODE
08/18/2017	ELECTRONIC

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

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

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

USpatentmail@ballardspahr.com

Office Action Summary	Application No. 14/692,484	Applicant(s) DRENTH ET AL.	
	Examiner MICHAEL WILLS III	Art Unit 3676	AIA (First Inventor to File) Status Yes

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

Period for Reply

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

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

Status

1)☒ Responsive to communication(s) filed on *April 21, 2015*.

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

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

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

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

Disposition of Claims*

5)☒ Claim(s) *1,6,7 and 9-38* is/are pending in the application.

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

6)☒ Claim(s) *34-38* is/are allowed.

7)☒ Claim(s) *1,7,17 and 28-33* is/are rejected.

8)☒ Claim(s) *1,6,9-16 and 18-27* is/are objected to.

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

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

Application Papers

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

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

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

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

Priority under 35 U.S.C. § 119

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

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

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

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

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

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

Attachment(s)

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

2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

DETAILED ACTION

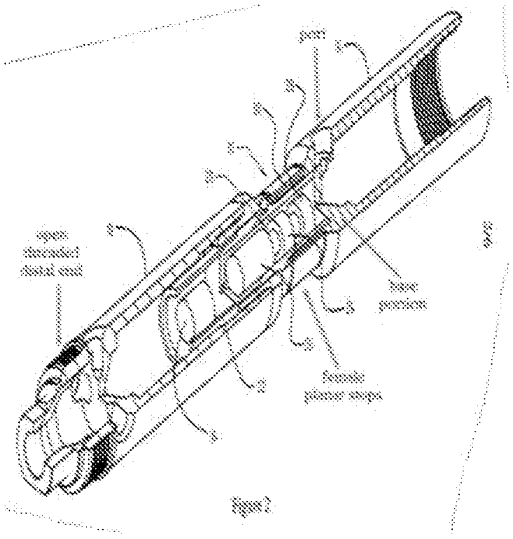
1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Claim Rejections - 35 USC § 103

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

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

3. **Claims 1, 7, 17 and 28-33 are rejected under 35 U.S.C. 103 as being unpatentable over Beach et al. WO 2008/113127 (Beach) in view of Juergens et al. US Patent 4,955,438 (Juergens).**



4. Regarding claim 1, Beach discloses a core barrel head assembly, comprising: an elongate tube body **(18, 16)** defining a first interior cavity **(16)** and a selectively sealed interior cavity **(18)** spaced distally from the first interior cavity, wherein the elongate tube body has a threaded

proximal end for coupling to a wire line retrieval portion of a head assembly **(Fig. 2)**, wherein the first interior cavity extends distally from the threaded proximal end to a base portion **(illustrated in Fig. 2 above)**, of the elongate tube body, and wherein the elongate tube body further defines a port **(illustrated in Fig. 2 above)** positioned proximate the base portion and extending from the exterior surface of the elongate tube body into fluid communication with the first interior cavity; at least one electronic instrument **(20)** that is configured to obtain orientation data mounted therein the sealed interior cavity **(pg. 11, lines 33-36)**, wherein the at least one electronic instrument comprises at least one digital and/or electro-mechanical sensors **(pg. 12, lines 7-21)** in a core orientation data recording tool that can be configured to determine a core orientation of a sample core just prior to or after the core break **(pg. 12, lines 9-36)**; a power source in operable communication with the at least one electronic instrument **(pg. 12, lines 9-13)**; and communication means **(28, 30)** to receive and/or transmit core orientation data **(pg. 12, lines 25-28)**. **(Fig. 2)**.

The elongated tube in Beach has two sections, which are the adapter **(16)** and the core tube cap **(18)**. Applicant discloses the elongated tube as an integral tube versus two separate tubes. Additionally, Beach teaches the core orientation tool **(10)** is battery powered. **(pg. 12, lines 9-13)**. Beach does not disclose the power source is mounted therein the interior cavity, wherein the sealed interior cavity is sized and shaped to hermetically enclose the at least one electronic instrument and the power source.

Nonetheless, it would have been considered obvious to one of ordinary skill in the art, at the time the invention was made, to have made the elongated tube separable or modular, rather than unitary or integral, as it has been held that constructing a formerly integral structure as

various discrete elements involves only routine skill in the art. *Nerwin v. Erlichman*, 168 USPQ 177, 179; *In re Fridolph*, 309 F.2d 509, 50 CCPA 745; *In re Larson*, 52 C.C.P.A. 930, 340 F.2d 965, 144 USPQ 347 (CCPA 1965).

Furthermore, Juergens discloses a core drilling tool with a core pipe **(20)** that houses a measuring unit **(10)** that includes a power supply source unit **(33)**. **(col. 3, lines 50-52, Figs. 2-3)**.

Thus it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Beach so that the battery is in the enclosed tube with the electronic instrument as taught by Juergens for the purpose of providing power to the downhole components. This would achieve the predictable result of proving energy to the downhole components of the tool without the need of a wireline.

5. Regarding claim 7, Beach discloses the sealed interior cavity **(18)** is sized and shaped to hermetically enclose the communication means **(28)** to receive and/or transmit orientation data. **(Fig. 2)**.

6. Regarding claim 17, Beach discloses the sealed interior cavity extends distally to an open threaded distal end of the elongate tube body. **(Fig. 2 above)**.

7. Regarding claim 28, Beach discloses an exterior surface of the elongate tube body **(18, 16)** defines a plurality of female planar stops proximate the mid-body portion. **(Fig. 2 above)**.

8. Regarding claim 29, Beach discloses the at least one electronic instrument **(34)** is programmed to obtain orientation data when the at least one electronic instrument senses no relative movement of the at least one electronic instrument. **(pg. 17, lines 4-12)**. The gyroscope (34) tracks changes in orientation of the tool after drilling has stopped meaning there is no movement or vibrations.

9. Regarding claim 30, Beach discloses the at least one electronic instrument **(34)** is programmed to obtain orientation data when the at least one electronic instrument senses no vibrations. **(pg. 17, lines 4-12)**. The gyroscope **(34)** tracks changes in orientation of the tool after drilling has stopped meaning there is no movement or vibrations. Vibrations would occur during drilling.

10. Regarding claim 31, Beach discloses the at least one electronic instrument **(34)** does not take any orientation measurements if vibrations are sensed by the at least one electronic instrument. **(pg. 17, lines 4-12)**.

11. Regarding claim 32, Beach discloses the at least one electronic instrument **(34)** is programmed to not obtain orientation data when the at least one electronic instrument determines that the core barrel head assembly is in motion while descending down or ascending up the hole and during drilling. **(pg. 17, lines 4-7)**.

12. Regarding claim 33, Beach discloses the at least one electronic instrument is programmed to obtain orientation data based on a predetermined time interval scheme. **(pg. 19, lines 11-23)**.

Allowable Subject Matter

13. Claims 34-38 are allowed.

14. Claims 6, 9-16 and 18-27 objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

15. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. See Notice of References Cited.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MICHAEL WILLS III whose telephone number is (571)272-5521. The examiner can normally be reached on 8:30am-5:00pm.

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

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Waseem Moorad can be reached on (571) 270/3436. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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

/MICHAEL WILLS III/
Primary Examiner, Art Unit 3676

Notice of References Cited	Application/Control No. 14/692,484	Applicant(s)/Patent Under Reexamination DRENTH ET AL.	
	Examiner MICHAEL WILLS III	Art Unit 3676	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-4,955,438 A	09-1990	Juergens; Rainer	E21B25/02	166/64
*	B	US-7,296,638 B2	11-2007	Beach; Andrew	E21B25/16	175/244
	C	US-				
	D	US-				
	E	US-				
	F	US-				
	G	US-				
	H	US-				
	I	US-				
	J	US-				
	K	US-				
	L	US-				
	M	US-				

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
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	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

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BIB DATA SHEET

CONFIRMATION NO. 3851

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
14/692,484	04/21/2015 RULE	175	3676	36362.0150U2-

APPLICANTS

LONGYEAR TM, INC., South Jordan, UT;
GLOBALTECH CORPORATION PTY LTD, CANNING VALE, AUSTRALIA;

INVENTORS

CHRISTOPHER L. DRENTH, Ontario, CANADA;
GORDON STEWART, Claremont, AUSTRALIA;
KHALED HEJLEH, Peppermint Grove, AUSTRALIA;

**** CONTINUING DATA ***************************

This appln claims benefit of 61/982,052 04/21/2014

**** FOREIGN APPLICATIONS ***************************

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ****

05/01/2015

Foreign Priority claimed ☐ Yes ☑ No 35 USC 119(a-d) conditions met ☐ Yes ☑ No Verified and Acknowledged /MICHAEL R WILLS III/ Examiner's Signature	☐ Met after Allowance Initials	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
		CANADA	12	33	1

ADDRESS

Ballard Spahr LLP
SUITE 1000
999 PEACHTREE STREET
ATLANTA, GA 30309-3915
UNITED STATES

TITLE

Core Barrel Head Assembly With An Integrated Sample Orientation Tool And System For Using Same

FILING FEE RECEIVED		
2780	FEES: Authority has been given in Paper No._____ to charge/credit DEPOSIT ACCOUNT No._____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

BIB (Rev. 05/07).

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14692484	DRENTH ET AL.
	Examiner	Art Unit
	MICHAEL WILLS III	3676

CPC- SEARCHED		
Symbol	Date	Examiner
E21B25/16,	8/12/17	MW

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner

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

SEARCH NOTES		
Search Notes	Date	Examiner
Invetor Name Search	8/12/17	MW
Forward/Backward Search	8/12/17	MW
See East Search History	8/12/17	MW
texted searched classes E21B17/028, E21B47/09	8/12/17	MW

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner

PTO/SB/08a (07-09)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 2

Complete if Known	
Application Number	14/692,484
Filing Date	April 21, 2015
First Named Inventor	Christopher L. Drenth
Art Unit	3676
Examiner Name	T. S. Bomar
Attorney Docket Number	36362.0150U2-

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (*if known*)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	A*	US-6,732,818	05-11-2004	Gregory	
	B*	US-2012/0145461-A1	06-14-2012	Cravatte	

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3] Number[4] Kind Code[5] (*if known*)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages Or Relevant Figures Appear	T[6]
	A	WO-2007/104103-A1	09-20-2007	2ic Australia Pty Ltd.		
	B	WO-2008/113127-A1	09-25-2008	2ic Australia Pty Ltd.		
	C	WO-2014/053012-A1	04-10-2014	Minnovare Pty Ltd.		

Examiner Signature	/MICHAEL R WILLS III/	Date Considered	08/10/2017

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. * CITE NO.: Those application(s) which are marked with an single asterisk (*) next to the Cite No. are not supplied (under 37 CFR 1.98(a)(2)(iii)) because that application was filed after June 30, 2003 or is available in the IFW. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5]Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

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Dated: 10/14/2015 Signature: /Joseph P. Anderson, III/ (Joseph P. Anderson, III)

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /M.R.W/

PTO/SB/08b (07-09)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

	Complete if Known
Application Number	14/692,484
Filing Date	April 21, 2015
First Named Inventor	Christopher L. Drenth
Art Unit	3676
Examiner Name	T. S. Bomar
Sheet 2 of 2	Attorney Docket Number 36362.0150U2-

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]
	A	International Search Report and Written Opinion issued by the International Searching Authority on July 24, 2015 for international application PCT/US2015/026907, filed on April 21, 2015 (Applicant - Longyear TM, Inc. // Inventor - Drenth, et al.) (Attorney Docket No. 36362.0150P1-) (13 pages).	

Examiner Signature	/MICHAEL R WILLS III/	Date Considered	08/10/2017

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[1] Applicant's unique citation designation number (optional). [2] Applicant is to place a check mark here if English language Translation is attached.

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	2	("20120145461" | "6732818").PN.	US-PGPUB; USPAT; USOCR	ADJ	ON	2017/08/12 14:07
L2	0	("2012/0145461").URPN.	USPAT	ADJ	ON	2017/08/12 14:07
L3	20	("1701724" | "1773915" | "2120240" | "2489566" | "2974739" | "3059707" | "3148740" | "3207239" | "4128134" | "4558749" | "4883131").PN. OR ("6732818").URPN.	US-PGPUB; USPAT; USOCR	ADJ	ON	2017/08/12 14:07
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L7	9	L6 and window and core$3 and orientat$3	US-PGPUB; USPAT; USOCR	ADJ	ON	2017/08/12 14:09
L8	69	L6 and core$3 and orientat$3	US-PGPUB; USPAT; USOCR	ADJ	ON	2017/08/12 14:09
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Ex.2001 / IPR2023-00642 / Page 647 of 870
Reflex USA LLC v. Longyear TM, Inc. and Globaltech Corporation Pty Ltd.

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L17	0	("2015/0136488").URPN.	USPAT	ADJ	ON	2017/08/12 14:11
L20	0	("2015/0029035").URPN.	USPAT	ADJ	ON	2017/08/12 14:11
S1	1	"14692484"	US-PGPUB; USPAT; USOCR	ADJ	ON	2017/06/16 07:57
S2	79	(("DRENTH") near3 ("CHRISTOPHER")).INV.	US-PGPUB; USPAT; USOCR	ADJ	ON	2017/08/10 12:08
S3	145	(("STEWART") near3 ("GORDON")).INV.	US-PGPUB; USPAT; USOCR	ADJ	ON	2017/08/10 12:21
S4	47	(("STEWART") near3 ("GORDON")).INV.	EPO; JPO; DERWENT	ADJ	ON	2017/08/10 12:21
S5	7	(("HEJLEH") near3 ("KHALED")).INV.	US-PGPUB; USPAT; USOCR	ADJ	ON	2017/08/10 14:08
S6	2	("20120145461" | "6732818").PN.	US-PGPUB; USPAT; USOCR	ADJ	ON	2017/08/10 15:04
S7	201	(E21B25/16).cpc.	US-PGPUB; USPAT; USOCR	ADJ	ON	2017/08/10 15:07
S8	440855	(power source or battery) and (body or housing)and (instrument or sensor)	US-PGPUB; USPAT; USOCR	ADJ	ON	2017/08/10 16:21
S9	0	WO "2008113127"	US-PGPUB; USPAT; USOCR	ADJ	ON	2017/08/11 10:41
S10	3	"2008113127"	US-PGPUB; USPAT; USOCR; DERWENT	ADJ	ON	2017/08/11 10:41
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S12	48	S11 and (battery or power source)	US-PGPUB; USPAT;	ADJ	ON	2017/08/11 11:12

Ex.2001 / IPR2023-00642 / Page 648 of 870
Reflex USA LLC v. Longyear TM, Inc. and Globaltech Corporation Pty Ltd.

			USOCR			
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S15	3	S13 and (battery or power source or power supply)	US-PGPUB; USPAT; USOCR	ADJ	ON	2017/08/11 11:19
S16	48	S11 and (battery or power source or power supply)	US-PGPUB; USPAT; USOCR	ADJ	ON	2017/08/11 11:19
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S19	921	702/2.ccls.	US-PGPUB; USPAT; USOCR	ADJ	ON	2017/08/11 11:46
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S23	606	E21B$.cpc. and window and core$3 and orientat$3 and (battery or power source or power supply)	US-PGPUB; USPAT; USOCR	ADJ	ON	2017/08/11 11:48
S24	263	E21B$.cpc. and window and core$3 and orientat$3 and (battery or power source or power supply) and wireline	US-PGPUB; USPAT; USOCR	ADJ	ON	2017/08/11 11:54
S25	300	E21B$.cpc. and window and core$3 and orientat$3 and (battery or power source or power supply) and (wireline or wire line)	US-PGPUB; USPAT; USOCR	ADJ	ON	2017/08/11 11:54
S26	346	E21B$.cpc. and window and cor$3 and orientat$3 and (battery or power source or power supply) and (wireline or wire line)	US-PGPUB; USPAT; USOCR	ADJ	ON	2017/08/11 12:07
S27	1730	window and cor$3 and orientat$3 and (battery or power source or power supply) and (wireline or wire line)	US-PGPUB; USPAT;	ADJ	ON	2017/08/11 12:08

Ex.2001 / IPR2023-00642 / Page 649 of 870
Reflex USA LLC v. Longyear TM, Inc. and Globaltech Corporation Pty Ltd.

			USOCR			
S28	114	S27 AND ((E21B17/028 OR E21B47/09 OR E21B25/16).CPC.)	US-PGPUB; USPAT; USOCR	ADJ	ON	2017/08/11 12:20

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Ex.2001 / IPR2023-00642 / Page 650 of 870
Reflex USA LLC v. Longyear TM, Inc. and Globaltech Corporation Pty Ltd.

ATTORNEY DOCKET NO. 36362.0150U2-
PATENT
VIA EFS-WEB

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	)	
	)	
DRENTH et al.	)	Art Unit: 3676
	)	
Application No.: 14/692,484	)	Examiner: Waseem Moorad
	)	
Filing Date: April 21, 2015	)	Confirmation No.: 3851
	)	
FOR: **CORE BARREL HEAD ASSEMBLY WITH AN INTEGRATED SAMPLE ORIENTATION TOOL AND SYSTEM FOR USING SAME**	)	

PRELIMINARY AMENDMENT

MAIL STOP AMENDMENT
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Ballard Spahr LLP
Customer Number 23859

February 28, 2017

Commissioner:

Prior to issuance of an Office Action on the merits, please amend the above-reference application as set forth below and consider the Remarks that follow.

Amendments to the Claims are reflected on the listing of claims which begins on page 2 of this Amendment.

Remarks begin on page 7 of this Amendment.

Electronic Acknowledgement Receipt

EFS ID:	28487483
Application Number:	14692484
International Application Number:	
Confirmation Number:	3851
Title of Invention:	Core Barrel Head Assembly With An Integrated Sample Orientation Tool And System For Using Same
First Named Inventor/Applicant Name:	CHRISTOPHER L. DRENTH
Customer Number:	23859
Filer:	Joseph P. Anderson
Filer Authorized By:	
Attorney Docket Number:	36362.0150U2-
Receipt Date:	28-FEB-2017
Filing Date:	21-APR-2015
Time Stamp:	16:36:41
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		36362_0150U2_Preliminary_Amendment.pdf	93404 7e9a92c8bdbad1f6eefede312ffff3369bc6aa73	yes	7

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Applicant Arguments/Remarks Made in an Amendment	7	7
	Claims	2	6
	Preliminary Amendment	1	1

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New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

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

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

REMARKS

Claims 1-33 are pending. Applicants have amended claims 1, 6-7, and 18-19, canceled claims 2-5 and 8, and added new claims 34-38. Therefore, after entry of this preliminary amendment, claims 1, 6-7, and 9-38 will be under consideration. No new matter has been added by these amendments.

Applicants await an Office Action on the merits.

No fee(s) are believed due; however, the Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 14-0629.

Respectfully submitted,

Electronic signature: /Joseph P. Anderson, III/
Joseph P. Anderson, III
Registration No.: 59,245
BALLARD SPAHR LLP
Correspondence Customer Number: 23859

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Reflex USA LLC v. Longyear TM, Inc. and Globaltech Corporation Pty Ltd.

AMENDMENTS TO THE CLAIMS

The following listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1. (Currently Amended) A core barrel head assembly, comprising:

an elongate tube body defining a first interior cavity and a selectively sealed interior cavity spaced distally from the first interior cavity, wherein the elongate tube body has a threaded proximal end for coupling to a wire line retrieval portion of a head assembly, wherein the first interior cavity extends distally from the threaded proximal end to a base portion of the elongate tube body, and wherein the elongate tube body further defines a port positioned proximate the base portion and extending from the exterior surface of the elongate tube body into fluid communication with the first interior cavity;

at least one electronic instrument that is configured to obtain orientation data mounted therein the sealed interior cavity, wherein the at least one electronic instrument comprises at least one digital and/or electro-mechanical sensors in a core orientation data recording tool that can be configured to determine a core orientation of a sample core just prior to or after the core break;

a power source in operable communication with the at least one electronic instrument, wherein the power source is mounted therein the interior cavity; and

communication means to receive and/or transmit core orientation data,

wherein the sealed interior cavity is sized and shaped to hermetically enclose the at least one electronic instrument and the power source.

Claims 2-5 are cancelled.

6. (Currently Amended) The core barrel head assembly of Claim [[5]] 1, wherein a pressure fitting is mounted in the port to allow for selective passage of fluid to and from the exterior surface of the barrel head assembly into communication with the first interior cavity.

7. (Currently Amended) The core barrel head assembly of Claim 1, wherein the sealed interior cavity is sized and shaped to hermetically enclose ~~at least one of the least one electronic instrument, the power source , and~~ the communication means to receive and/or transmit orientation data.

Claim 8 is cancelled.

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Reflex USA LLC v. Longyear TM, Inc. and Globaltech Corporation Pty Ltd.

9. (Original) The core barrel head assembly of Claim 1, further comprising a plurality of windows defined in the elongate tube body that extend from the exterior surface of the elongate tube body into optical communication with the sealed interior cavity proximate a closed proximal end of the sealed interior cavity.

10. (Original) The core barrel head assembly of Claim 9, further comprising an orientation indicator module comprising a plurality of light emitters.

11. (Original) The core barrel head assembly of Claim 10, wherein the orientation indicator module is sized and shaped to sealingly close the sealed interior cavity from any intrusion of pressurized fluid into the sealed interior cavity via the plurality of windows.

12. (Original) The core barrel head assembly of Claim 10, wherein the orientation indicator module is configured to orient or otherwise position the plurality of light emitters so that each light emitter underlies one window.

13. (Original) The core barrel head assembly of Claim 10, wherein the orientation indicator module further comprises a first sealing means for preventing any pressurized fluid from entering the sealed interior cavity from the plurality of windows defined in the elongate tube body.

14. (Original) The core barrel head assembly of Claim 13, wherein the first sealing means comprises at least one O-ring seal that is mounted on an exterior portion of the orientation indicator module and that is configured to seal between an exterior portion of the orientation indicator module and a portion of an interior surface of the sealed interior cavity.

15. (Original) The core barrel head assembly of Claim 14, wherein the sealed interior cavity can comprised at least one orienting slot defined therein.

16. (Original) The core barrel head assembly of Claim 14, wherein a desired position of the orientation indicator module is maintained relative to at least one O-ring seal.

17. (Original) The core barrel head assembly of Claim 1, wherein the sealed interior cavity extends distally to an open threaded distal end of the elongate tube body.

18. (Currently Amended) The core barrel head assembly of Claim [[18]] 17, further comprising a seal coupler that is configured to be sealingly received in the open threaded distal end of the elongate tube body.

19. (Currently Amended) The core barrel head assembly of Claim 18, further ~~comprises~~ comprising a second sealing means for preventing any pressurized fluid from entering the sealed interior cavity.

20. (Original) The core barrel head assembly of Claim 19, wherein the second sealing means comprises at least one O-ring seal that is mounted on a portion of the seal coupler and that is configured to seal between a portion of the seal coupler and a portion of an interior surface of the open distal end of the elongate tube body.

21. (Original) The core barrel head assembly of Claim 18, further comprising a check valve assembly configured to affect a hermetical seal of the sealed interior cavity and to provide fluid control for wire line operation.

22. (Original) The core barrel head assembly of Claim 21, wherein the check valve assembly comprises a coupled proximal end assembly and a distally tapered seat that defines an interior chamber for operative receipt of a check ball.

23. (Original) The core barrel head assembly of Claim 22, wherein the proximal end assembly defines a female threaded coupling that is configured to be threadably coupled to male threads defined on an exterior surface of a distal end of the elongate tube body.

24. (Original) The core barrel head assembly of Claim 23, wherein, when the proximal end assembly is threadably coupled to the distal end of the elongate tube body, the seal coupler is driven into a sealed position therein the sealed interior cavity to affect complete hermeticity.

25. (Original) The core barrel head assembly of Claim 22, wherein the interior chamber of the check valve assembly extends to a distal end of the check valve assembly, and wherein the check valve assembly further defines at least one port that extends from an exterior surface of the check valve assembly and is in fluid communication with the interior chamber of the check valve assembly.

26. (Original) The core barrel head assembly of Claim 25, wherein the interior chamber has a distally tapered seat that is adapted to selectively receive the check ball that is sized to selectively block the distally tapered seat.

27. (Original) The core barrel head assembly of Claim 26, wherein the interior chamber is sized and shaped to allow the check ball to selectively move axially between an open position, in which the check ball is spaced proximally away from the surface of the tapered seat so that pressurized fluid can move through the distal end of the check valve assembly and subsequently through the interior chamber to exit out of the at least one port, and a closed position, in which the check ball is pressurized against the surface of the tapered seat so that pressurized fluid cannot move through the check valve assembly.

28. (Original) The core barrel head assembly of Claim 1, wherein an exterior surface of the elongate tube body defines a plurality of female planar stops proximate the mid-body portion.

29. (Original) The core barrel head assembly of Claim 1, wherein the at least one electronic instrument is programmed to obtain orientation data when the at least one electronic instrument senses no relative movement of the at least one electronic instrument.

30. (Original) The core barrel head assembly of Claim 29, wherein the at least one electronic instrument is programmed to obtain orientation data when the at least one electronic instrument senses no vibrations.

31. (Original) The core barrel head assembly of Claim 30, wherein the at least one electronic instrument does not take any orientation measurements if vibrations are sensed by the at least one electronic instrument.

32. (Original) The core barrel head assembly of Claim 29, wherein the at least one electronic instrument is programmed to not obtain orientation data when the at least one electronic instrument determines that the core barrel head assembly is in motion while descending down or ascending up the hole and during drilling.

33. (Original) The core barrel head assembly of Claim 1, wherein the at least one electronic instrument is programmed to obtain orientation data based on a predetermined time interval scheme.

34. (New) A core barrel head assembly, comprising:

an elongate tube body defining a first interior cavity and a selectively sealed interior cavity spaced distally from the first interior cavity, wherein the elongate tube body has a threaded proximal end for coupling to a wire line retrieval portion of a head assembly, wherein the first interior cavity extends distally from the threaded proximal end to a base portion of the elongate tube body, and wherein the elongate tube body further defines a port positioned proximate the base portion and extending from the exterior surface of the elongate tube body into fluid communication with the first interior cavity;

at least one electronic instrument that is configured to obtain orientation data mounted therein the sealed interior cavity, wherein the at least one electronic instrument comprises at least one digital and/or electro-mechanical sensors in a core orientation data recording tool that can be configured to determine a core orientation of a sample core just prior to or after the core break;

a power source in operable communication with the at least one electronic instrument, wherein the power source is mounted therein the interior cavity; and

communication means to receive and/or transmit core orientation data,

wherein the sealed interior cavity is sized and shaped to hermetically enclose the at least one electronic instrument and the power source, and

wherein a pressure fitting is mounted in the port to allow for selective passage of fluid to and from the exterior surface of the barrel head assembly into communication with the first interior cavity.

35. (New) The core barrel head assembly of claim 34, further comprising a plurality of windows defined in the elongate tube body that extend from the exterior surface of the elongate tube body into optical communication with the sealed interior cavity proximate a closed proximal end of the sealed interior cavity

36. (New) The core barrel head assembly of claim 34, wherein the sealed interior cavity extends distally to an open threaded distal end of the elongate tube body.

37. (New) The core barrel head assembly of Claim 36, further comprising a seal coupler that is configured to be sealingly received in the open threaded distal end of the elongate tube body.

38. (New) The core barrel head assembly of Claim 34, wherein the at least one electronic instrument is programmed to obtain orientation data when the at least one electronic instrument senses no relative movement of the at least one electronic instrument.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 14/692,484	Filing Date 04/21/2015	☐ To be Mailed

ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT 02/28/2017

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 33	Minus	** 33	= 0	X $80 =	0
Independent (37 CFR 1.16(h))	* 2	Minus	***3	= 0	X $420 =	0
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	0

AMENDMENT

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LIE
/DORIS KING/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**
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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/692,484	04/21/2015	CHRISTOPHER L. DRENTH	36362.0150U2-

CONFIRMATION NO. 3851

23859
Ballard Spahr LLP
SUITE 1000
999 PEACHTREE STREET
ATLANTA, GA 30309-3915

POA ACCEPTANCE LETTER

OC000000078632435

Date Mailed: 11/13/2015

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 11/09/2015.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/hsarwari/

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
14/692,484	04/21/2015	3676	2780	36362.0150U2-	33	1

CONFIRMATION NO. 3851

CORRECTED FILING RECEIPT

23859
Ballard Spahr LLP
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999 PEACHTREE STREET
ATLANTA, GA 30309-3915



Date Mailed: 11/13/2015

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Inventor(s)

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Applicant(s)

LONGYEAR TM, INC., South Jordan, UT;
GLOBALTECH CORPORATION PTY LTD, CANNING VALE, AUSTRALIA;

Power of Attorney: The patent practitioners associated with Customer Number 23859

Domestic Priority data as claimed by applicant

This appln claims benefit of 61/982,052 04/21/2014

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

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The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 14/692,484**
Projected Publication Date: Not Applicable
Non-Publication Request: No

Early Publication Request: No
Title

Core Barrel Head Assembly With An Integrated Sample Orientation Tool And System For Using Same

Preliminary Class

175

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

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I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:

☐ Practitioners associated with Customer Number: 23859

OR

■ Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignments documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

■ The address associated with Customer Number:

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Firm or Individual Name			
Address			
City		State	Zip
Country			
Telephone		Email	

Assignee Name and Address: GLOBALTECH CORPORATION PTY LTD
ABN 18 087 281 418 of 1/48
Vinnicombe Drive
Canning Vale, Australia 6155

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be Filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of The practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record
The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature	Digitally signed by Khaled Hejleh		Date
Name	Date: 2015.09.10 10:42:35 +08'00'		Telephone
Title	Managing Director		

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PTO/AIA/96 (08-12)
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STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: LONGYEAR TM, INC. / GLOBALTECH CORPORATION PTY LTD

Application No./Patent No.: 14/692,484 Filed/Issue Date: April 21, 2015

Titled: Core Barrel Head Assembly With An Integrated Sample Orientation Tool And System For Using Same

GLOBALTECH CORPORATION PTY LTD, a Corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☐ The assignee of the entire right, title, and interest.

2. ☑ An assignee of less than the entire right, title, and interest (check applicable box):

   ☑ The extent (by percentage) of its ownership interest is 50 %. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☑ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel 036328, Frame 0298, or for which a copy thereof is attached.

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

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This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/AIA/96 (08-12)
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STATEMENT UNDER 37 CFR 3.73(c)

3. From: _____ To: _____

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Reel _____, Frame _____, or for which a copy thereof is attached.

4. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

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☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☐ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Joseph P. Anderson, III/	November 9, 2015
Signature	Date
Joseph P. Anderson, III	59,245
Printed or Typed Name	Title or Registration Number

Electronic Acknowledgement Receipt

EFS ID:	24021525
Application Number:	14692484
International Application Number:	
Confirmation Number:	3851
Title of Invention:	Core Barrel Head Assembly With An Integrated Sample Orientation Tool And System For Using Same
First Named Inventor/Applicant Name:	CHRISTOPHER L. DRENTH
Customer Number:	23859
Filer:	Joseph P. Anderson
Filer Authorized By:	
Attorney Docket Number:	36362.0150U2-
Receipt Date:	09-NOV-2015
Filing Date:	21-APR-2015
Time Stamp:	17:02:27
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Power of Attorney	36362_0150U2_Power_of_Attorney.PDF	1884865 14ec13386b9c166bd0a254beb001a9b54959f235	no	3
Warnings:					
Information:					

Total Files Size (in bytes):	1884865

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

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

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

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

ATTORNEY DOCKET NO. 36362.0150U2-
PATENT
VIA EFS-WEB

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	)	
	)	
DRENTH et al.	)	Art Unit: 3672
	)	
Application No.: 14/692,484	)	Examiner: Unassigned
	)	
Filing Date: April 21, 2015	)	Confirmation No.: 3851
	)	
FOR: **CORE BARREL HEAD ASSEMBLY WITH AN INTEGRATED SAMPLE ORIENTATION TOOL AND SYSTEM FOR USING SAME**	)	

TRANSMITTAL OF CORRECTED APPLICATION DATA SHEET and REQUEST FOR CORRECTED FILING RECEIPT

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

Ballard Spahr LLP
Customer Number 23859

November 9, 2015

Commissioner:

Submitted herewith is a new Application Data Sheet for the above-referenced application, which includes a corrected "Mailing Address Information for Applicant" section. The corrected "Mailing Address Information for Applicant" section is intended to replace the "Mailing Address Information for Applicant" section of the original Application Data Sheet (filed April 21, 2015). The new Application Data Sheet is submitted to include the correct name of theApplicant's city, South Jordan, which was inadvertently listed incorrectly on the original Application Data Sheet. The change to the "Mailing Address Information for Applicant" section is annotated with the document, which shows the name of the Applicant as:

LONGYEAR TM, INC.
10808 South River Front Parkway
Suite 400
South Jordan, UT 84095

Moreover, the new Application Data Sheet also lists a new co-applicant in the "Mailing Address Information for Applicant" section. The additional co-applicant was inadvertently left off of the original Application Data Sheet (filed April 21, 2015). The change to the "Mailing Address Information for Applicant" section is annotated within the document, which shows the name of the new co-applicant as:

GLOBALTECH CORPORATION PTY LTD
ABN 18 087 281 418 OF 1/48
Vinnicombe Drive
Canning Vale, AU 6155

Ex.2001 / IPR2023-00642 / Page 670 of 870
Reflex USA LLC v. Longyear TM, Inc. and Globaltech Corporation Pty Ltd.

Other sections of the Application Data Sheet remain unchanged.

In view of the revisions to the "Mailing Address Information for Applicant" section of the Application Data Sheet, Applicant requests preparation of an Updated Filing Receipt.

No fee is due; however, the Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. 14-0629.

Dated: November 9, 2015

Respectfully submitted,

Electronic signature: /Joseph P. Anderson, III/
Joseph P. Anderson, III
Registration No.: 59,245
BALLARD SPAHR LLP
Correspondence Customer Number: 23859

(678) 420-9300 Phone
(678) 420-9301 Fax

In accordance with 37 C.F.R. § 1.8, I certify that this correspondence is being transmitted to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 via the USPTO's EFS-Web Electronic Filing System on November 9, 2015
/Joseph P. Anderson, III/
Joseph P. Anderson, III – Reg. No. 59, 245

Ex.2001 / IPR2023-00642 / Page 671 of 870
Reflex USA LLC v. Longyear TM, Inc. and Globaltech Corporation Pty Ltd.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	36362.0150U2-
	Application Number	
Title of Invention	Core Barrel Head Assembly With An Integrated Sample Orientation Tool And System For Using Same	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	CHRISTOPHER	L.	DRENTH	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Ontario	Country of Residence [i]	CA

Mailing Address of Inventor:

Address 1	2311 Hoover Court		
Address 2			
City	Burlington	State/Province	ON
Postal Code	L7P 4V2	Country [i]	CA

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	GORDON		STEWART	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Claremont	Country of Residence [i]	AU

Mailing Address of Inventor:

Address 1	18 Airle Street		
Address 2			
City	Claremont	State/Province	
Postal Code	6010	Country [i]	AU

Inventor 3 Remove

Legal Name

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	36362.0150U2-
	Application Number	
Title of Invention	Core Barrel Head Assembly With An Integrated Sample Orientation Tool And System For Using Same	

Prefix	Given Name	Middle Name	Family Name	Suffix
	KHALED		HEJLEH	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Peppermint Grove	Country of Residence [i]	AU

Mailing Address of Inventor:

Address 1	34A Leake Street		
Address 2			
City	Peppermint Grove	**State/Province**	
Postal Code	6011	**Country** [i]	AU

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	23859		
Email Address	uspatentmail@ballardspahr.com	Add Email	Remove Email

Application Information:

Title of the Invention	Core Barrel Head Assembly With An Integrated Sample Orientation Tool And System For Using Same		
Attorney Docket Number	36362.0150U2-	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)		**Suggested Figure for Publication (if any)**	

Filing By Reference :

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	36362.0150U2-
	Application Number	
Title of Invention	Core Barrel Head Assembly With An Integrated Sample Orientation Tool And System For Using Same	

Publication Information:

☐	Request Early Publication (Fee required at time of Request 37 CFR 1.219)
☐	**Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	23859		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the application number blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	Claims benefit of provisional	61982052	2014-04-21

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(d). When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(h)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

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Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	36362.0150U2-
	Application Number	
Title of Invention	Core Barrel Head Assembly With An Integrated Sample Orientation Tool And System For Using Same	

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Authorization to Permit Access:

☒ Authorization to Permit Access to the Instant Application by the Participating Offices

If checked, the undersigned hereby grants the USPTO authority to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the instant patent application is filed access to the instant patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the instant patent application is filed to have access to the instant patent application.

In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the instant patent application with respect to: 1) the instant patent application-as-filed; 2) any foreign application to which the instant patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the instant patent application; and 3) any U.S. application-as-filed from which benefit is sought in the instant patent application.

In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date o f filing this Authorization.

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	36362.0150U2-
	Application Number	
Title of Invention	Core Barrel Head Assembly With An Integrated Sample Orientation Tool And System For Using Same	

Applicant 1

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

(●) Assignee	( ) Legal Representative under 35 U.S.C. 117	( ) Joint Inventor
( ) Person to whom the inventor is obligated to assign.	( ) Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor :

If the Applicant is an Organization check here. ☒

Organization Name	LONGYEAR TM, INC.		
Mailing Address Information For Applicant:			
Address 1	10808 South River Front Parkway		
Address 2	Suite 400		
City	~~Salt Lake City~~ South Jordan	**State/Province**	UT
Country	US	Postal Code	84095
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button.

Applicant 2

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

(●) Assignee	( ) Legal Representative under 35 U.S.C. 117	( ) Joint Inventor
( ) Person to whom the inventor is obligated to assign.	( ) Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor :

PTO/AIA/14 (12-13)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	36362.0150U2-
	Application Number	
Title of Invention	Core Barrel Head Assembly With An Integrated Sample Orientation Tool And System For Using Same	

If the Applicant is an Organization check here. ☒			
Organization Name	GLOBALTECH CORPORATION PTY LTD		
Mailing Address Information For Applicant:			
Address 1	ABN 18 087 281 418 OF 1/48		
Address 2	VINNICOMBE DRIVE		
City	CANNING VALE	**State/Province**	
Country i	AU	Postal Code	6155
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button.

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not subsitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication . An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	36362.0150U2-
	Application Number	
Title of Invention	Core Barrel Head Assembly With An Integrated Sample Orientation Tool And System For Using Same	

Signature:

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications.					
Signature	/Joseph P. Anderson, III/			Date (YYYY-MM-DD)	2015-11-09
First Name	Joseph	Last Name	Anderson	Registration Number	59245
Additional Signature may be generated within this form by selecting the Add button.					

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Electronic Acknowledgement Receipt

EFS ID:	24021485
Application Number:	14692484
International Application Number:	
Confirmation Number:	3851
Title of Invention:	Core Barrel Head Assembly With An Integrated Sample Orientation Tool And System For Using Same
First Named Inventor/Applicant Name:	CHRISTOPHER L. DRENTH
Customer Number:	23859
Filer:	Joseph P. Anderson
Filer Authorized By:	
Attorney Docket Number:	36362.0150U2-
Receipt Date:	09-NOV-2015
Filing Date:	21-APR-2015
Time Stamp:	17:01:23
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Miscellaneous Incoming Letter	36362_0150U2_Transmittal_of_Corrected_Application_Data_Sheet.pdf	83170 2e4423910bb407446e3364f1213eb2e5b8ea8b31	no	2

Warnings:	
Information:	

2	Application Data Sheet	36362_0150U2_Application_Data_Sheet.PDF	5003006 40002bead04a55290810c818daac9b64fc0a946f	no	7

Warnings:	
Information:	
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Total Files Size (in bytes):	5086176

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New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

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

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

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/692,484	04/21/2015	CHRISTOPHER L. DRENTH	36362.0150U2-

CONFIRMATION NO. 3851

23859
Ballard Spahr LLP
SUITE 1000
999 PEACHTREE STREET
ATLANTA, GA 30309-3915

PUBLICATION NOTICE

OC000000078208091

Title: Core Barrel Head Assembly With An Integrated Sample Orientation Tool And System For Using Same

Publication No.US-2015-0300162-A1
Publication Date:10/22/2015

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Office of Public Records. The Office of Public Records can be reached by telephone at (703) 308-9726 or (800) 972-6382, by facsimile at (703) 305-8759, by mail addressed to the United States Patent and Trademark Office, Office of Public Records, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently http://pair.uspto.gov/. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

Ex.2001 / IPR2023-00642 / Page 681 of 870
Reflex USA LLC v. Longyear TM, Inc. and Globaltech Corporation Pty Ltd.

PTO/SB/08a (07-09)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 2

Complete if Known	
Application Number	14/692,484
Filing Date	April 21, 2015
First Named Inventor	Christopher L. Drenth
Art Unit	3676
Examiner Name	T. S. Bomar
Attorney Docket Number	36362.0150U2-

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	A*	US-6,732,818	05-11-2004	Gregory	
	B*	US-2012/0145461-A1	06-14-2012	Cravatte	

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3]-Number[4]-Kind Code[5] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages Or Relevant Figures Appear	T[6]
	A	WO-2007/104103-A1	09-20-2007	2ic Australia Pty Ltd.		
	B	WO-2008/113127-A1	09-25-2008	2ic Australia Pty Ltd.		
	C	WO-2014/053012-A1	04-10-2014	Minnovare Pty Ltd.		

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. * CITE NO.: Those application(s) which are marked with an single asterisk (*) next to the Cite No. are not supplied (under 37 CFR 1.98(a)(2)(iii)) because that application was filed after June 30, 2003 or is available in the IFW. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at **www.uspto.gov** or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5]Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

I hereby certify that this paper (along with any paper referred to as being attached or enclosed) is being transmitted via the Office electronic filing system in accordance with 37 CFR § 1.6(a)(4).

Dated: 10/14/2015 Signature: /Joseph P. Anderson, III/ (Joseph P. Anderson, III)

PTO/SB/08b (07-09)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet	2	of	2	Attorney Docket Number	36362.0150U2-

Complete if Known	
Application Number	14/692,484
Filing Date	April 21, 2015
First Named Inventor	Christopher L. Drenth
Art Unit	3676
Examiner Name	T. S. Bomar

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]
	A	International Search Report and Written Opinion issued by the International Searching Authority on July 24, 2015 for international application PCT/US2015/026907, filed on April 21, 2015 (Applicant - Longyear TM, Inc. // Inventor - Drenth, et al.) (Attorney Docket No. 36362.0150P1-) (13 pages).	

Examiner Signature		Date Considered	

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

[1] Applicant's unique citation designation number (optional). [2] Applicant is to place a check mark here if English language Translation is attached.

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To:
BALLARD SPAHR LLP

999 PEACHTREE STREET SUITE 1000 ATLANTA GA
30309 USA

PCT

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

(PCT Rule 44.1)

Date of mailing *(day/month/year)*	24 July 2015 (24.07.2015)
Applicant's or agent's file reference 36362.0150P1	**FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. **PCT/US2015/026907**	International filing date *(day/month/year)* **21 April 2015 (21.04.2015)**
Applicant **LONGYEAR TM, INC.**	

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

Filing of amendments and statement under Article 19:

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

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

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

For more detailed instructions, see *PCT Applicant's Guide*, International Phase, paragraphs 9.004 . 9-011.

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

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

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

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

4. **Reminders**

The applicant may submit comments on an informal basis on the written opinion of the International Searching Authority to the International Bureau. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established. Following the expiration of 30 months from the priority date, these comments will also be made available to the public.

Shortly after the expiration of **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90*bis*.1 and 90*bis*.3).

Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for entry into the national phase before those designated Offices. In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months. For details about the applicable time limits, Office by Office, see www.wipo.int/pct/en/texts/time_limits.html and the *PCT Applicant's Guide*, National Chapters.

Within **19 months** from the priority date, the applicant may request that a supplementary international search be carried out by an International Searching Authority, that offers this service (Rule 45*bis*.1). The procedure for requesting supplementary international search is described in the *PCT Applicant's Guide*, International Phase, paragraphs 8.006-8.032.

Name and mailing address of the ISA/KR International Application Division Korean Intellectual Property Office 189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan City, 302-701, Republic of Korea	Authorized officer COMMISSIONER
Facsimile No. 82-42-472-7140	Telephone No. 82-42-481-5875

Form PCT/ISA/220 (July 2014)

* Attention

Copies of the documents cited in the international search report can be searched in the following Korean Intellectual Property Office English website for six months(expire date : **2016.01.24**) from the date of mailing of the international search report.

http://www.kipo.go.kr/en/ => PCT Services => PCT Services

ID : PCT international application number
PW : **Q6QA9DQ6**

Inquiries related to PCT International Search Report or Written Opinion prepared by KIPO as an International Searching Authority can be answered not only by KIPO but also through IPKC (Intellectual Property Korea Center), located in Vienna, VA, which functions as a PCT Help Desk for PCT applicants.

Homepage: http://www.ipkcenter.com

Email: ipkc@ipkcenter.com

Notes to Form PCT/ISA/220 (July 2014)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:
BALLARD SPAHR LLP

999 PEACHTREE STREET SUITE 1000 ATLANTA GA
30309 USA

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

Date of mailing *(day/month/year)*	**24 July 2015 (24.07.2015)**
Applicant's or agent's file reference 36362.0150P1	**FOR FURTHER ACTION** See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2015/026907	**21 April 2015 (21.04.2015)**	21 April 2014 (21.04.2014)

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

E21B 10/02(2006.01)i, E21B 49/02(2006.01)i

Applicant

LONGYEAR TM, INC.

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

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.
For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/KR	Date of completion of this opinion	Authorized officer
International Application Division Korean Intellectual Property Office 189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan City, 302-701, Republic of Korea Facsimile No. +82-42-472-7140	24 July 2015 (24.07.2015)	HWANG, Chan Yoon Telephone No. +82-42-481-3347

Form PCT/ISA/237 (cover sheet) (January 2015)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2015/026907

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of :

   ☒ the international application in the language in which it was filed

   ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

   a. ☐ forming part of the international application as filed:
      ☐ in the form of an Annex C/ST.25 text file.
      ☐ on paper or in the form of an image file.

   b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

   c. ☐ furnished subsequent to the international filing date for the purposes of international search only:
      ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).
      ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

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

5. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2015/026907

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

1. Statement

Novelty (N)	Claims	1-33	YES
	Claims	NONE	NO
Inventive step (IS)	Claims	5-6,9-16,18-27	YES
	Claims	1-4,7-8,17,28-33	NO
Industrial applicability (IA)	Claims	1-33	YES
	Claims	NONE	NO

2. Citations and explanations :

Reference is made to the following documents:

D1: WO 2008-113127 A1 (2IC AUSTRALIA PTY LTD. et al.) 25 September 2008
D2: WO 2014-053012 A1 (MINNOVARE PTY LTD.) 10 April 2014
D3: WO 2007-104103 A1 (2IC AUSTRALIA PTY LTD. et al.) 20 September 2007
D4: US 2012-0145461 A1 (CRAVATTE, PHILLIPE) 14 June 2012
D5: US 6732818 B2 (GREGORY, FRANK) 11 May 2004

1. Novelty and Inventive Step

1.1 Independent Claim 1

D1, which is considered to be the closest prior art to the subject matter of claim 1, discloses an inner barrel assembly (11) comprising: a core orientation tool (10) including a body (22) and coupled to a core tube cap (18) and a backend assembly (14); an electronic core orientation device (20) housed within the body (22) and configured, upon a trigger signal, to log a core orientation of a core sample at least shortly before and during a core breaking action, the device (20) comprising multiple sensors; and a transceiver (28) configured to receive or send the orientation data (see page 11, line 30 - page 12, line 28 and figures 1-2). Claim 1 differs from D1 in that a core barrel head assembly comprises a power source in operable communication with at least one electronic instrument, wherein the power source is mounted therein an interior cavity. However, this feature comes within the scope of the customary practice followed by a person skilled in the art. Accordingly, claim 1 would have been obvious over D1. Therefore, claim 1 does not involve an inventive step under PCT Article 33(3).

Continued on Supplemental Box

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2015/026907

Box No. VIII Certain observations on the international application

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

Claim 18 refers to itself and does not clearly define the matter for which protection is sought (PCT Article 6).
(Note: This written opinion has been established on the assumption that claim 18 is dependent on claim 17.)

Supplemental Box

In case **the space in any of the preceding boxes is not sufficient.**
Continuation of : Box No. V

1.2 Dependent Claims 2-33

The additional feature of claim 2, characterized in that an elongate tube body has a threaded proximal end for coupling to a wire line retrieval portion of a head assembly, would be easily conceived from the disclosure of D1 considering that the core tube cap (18) and the backend assembly (14) have a threaded proximal end (see figure 2). Accordingly, claim 2 would have been obvious over D1. Therefore, claim 2 does not involve an inventive step under PCT Article 33(3).

The additional feature of claim 3 is identical to the feature of D1 in that the body (22) has a cavity enclosing a gyroscope (34) (see page 16, lines 12-22 and figure 2). Accordingly, claim 3 would have been obvious over D1. Therefore, claim 3 does not involve an inventive step under PCT Article 33(3).

The additional feature of claim 4 is identical to the feature of D1 in that the body (22) has another cavity enclosing the electronic core orientation device (20) (see page 11, lines 30-33 and figure 2). Accordingly, claim 4 would have been obvious over D1. Therefore, claim 4 does not involve an inventive step under PCT Article 33(3).

The additional feature of claim 5, characterized in that a port is defined proximate **to** a base portion of the sealed interior cavity that extends from an exterior surface of the elongate tube body into fluid communication with a first interior cavity, is not disclosed in any of the prior art documents, nor is it obvious to a person skilled in the art by the documents. Therefore, claim 5 is novel and involves an inventive step under PCT Article 33(2) and (3).

Claim 6 is dependent on claim 5. Therefore, claim 6 meets the requirements of PCT Article 33(2) and (3).

The additional feature of claim 7 is identical to the feature of D1 in that the body (22) has another cavity enclosing the electronic core orientation device (20), the electronic core orientation device comprising the multiple sensors and the transceiver (28) (see page 11, line 30 - page 12, line 28 and figure 2). Accordingly, claim 7 would have been obvious over D1. Therefore, claim 7 does not involve an inventive step under PCT Article 33(3).

Continued on The Next Page

Supplemental Box

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

The additional feature of claim 8, characterized in that the sealed interior cavity is sized and shaped to hermetically enclose the at least one electronic instrument and the power source, comes within the scope of the customary practice followed by a person skilled in the art. Accordingly, claim 8 would have been obvious over D1. Therefore, claim 8 does not involve an inventive step under PCT Article 33(3).

The additional feature of claim 9, concerning a plurality of windows defined in the elongate tube body that extend from the exterior surface of the elongate tube body into optical communication with the sealed interior cavity proximate a closed proximal end of the sealed interior cavity, is not disclosed in any of the prior art documents, nor is it obvious to a person skilled in the art by the documents. Therefore, claim 9 is novel and involves an inventive step under PCT Article 33(2) and (3).

Claims 10-16 are directly or indirectly dependent on claim 9. Therefore, claims 10-16 meet the requirements of PCT Article 33(2) and (3).

The additional feature of claim 17 is identical to the feature of D1 in that the body (22) extends distally to the threaded proximal end of the core tube cap (18) (see figure 2). Accordingly, claim 17 would have been obvious over D1. Therefore, claim 17 does not involve an inventive step under PCT Article 33(3).

The additional feature of claim 18, concerning a seal coupler that is configured to be sealingly received in the open threaded distal end of the elongate tube body, is not disclosed in any of the prior art documents, nor is it obvious to a person skilled in the art by the documents. Therefore, claim 18 is novel and involves an inventive step under PCT Article 33(2) and (3).
(Note: This written opinion has been established on the assumption that claim 18 is dependent on claim 17.)

Claims 19-27 are directly or indirectly dependent on claim 18. Therefore, claims 19-27 meet the requirements of PCT Article 33(2) and (3).

Continued on The Next Page

Supplemental Box

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

The additional feature of claim 28, characterized in that an exterior surface of the elongate tube body defines a plurality of female planar stops proximate the mid body portion, is merely a design change of the body (22) of the core orientation tool (10) in D1 (see page 11, lines 30-33 and figure 2). Accordingly, claim 28 would have been obvious over D1. Therefore, claim 28 does not involve an inventive step under PCT Article 33(3).

The additional feature of claim 29 is identical to the feature of D1 in that the trigger signal may be provided when cessation of drilling is detected (see page 14, lines 7-21). Accordingly, claim 29 would have been obvious over D1. Therefore, claim 29 does not involve an inventive step under PCT Article 33(3).

The additional feature of claim 30 is identical to the feature of D1 in that the trigger signal may be provided when cessation of drilling is detected (see page 14, lines 7-21). Accordingly, claim 30 would have been obvious over D1. Therefore, claim 30 does not involve an inventive step under PCT Article 33(3).

The additional feature of claim 31 is identical to the feature of D1 in that the trigger signal may be provided when cessation of drilling is detected (see page 14, lines 7-21). Accordingly, claim 31 would have been obvious over D1. Therefore, claim 31 does not involve an inventive step under PCT Article 33(3).

The additional feature of claim 32, characterized in that at least one electronic instrument is programmed not to obtain orientation data when the at least one electronic instrument determines that the core barrel head assembly is in motion while descending down or ascending up the hole and during drilling, would be easily conceived from the disclosure of D1 considering that the trigger signal may be provided when cessation of drilling is detected (see page 14, lines 7-21). Accordingly, claim 32 would have been obvious over D1. Therefore, claim 32 does not involve an inventive step under PCT Article 33(3).

The additional feature of claim 33 is identical to the feature of D1 in that the orientation data by the electronic core orientation device (20) may occur for a predetermined period of time (see page 26, lines 5-18). Accordingly, claim 33 would have been obvious over D1. Therefore, claim 33 does not involve an inventive step under PCT Article 33(3).

Continued on The Next Page

Supplemental Box

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

2. Industrial Applicability

Claims 1-33 are industrially applicable under PCT Article 33(4).

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 36362.0150P1	**FOR FURTHER ACTION**	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. **PCT/US2015/026907**	International filing date *(day/month/year)* **21 April 2015 (21.04.2015)**	(Earliest) Priority Date *(day/month/year)* 21 April 2014 (21.04.2014)
Applicant **LONGYEAR TM, INC.**		

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

This international search report consists of a total of **3** sheets.

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

1. **Basis of the report**
   a. With regard to the **language**, the international search was carried out on the basis of :
      ☒ the international application in the language in which it was filed
      ☐ a translation of the international application into _____ , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))
   b. ☐ This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).
   c. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.
2. ☐ **Certain claims were found unsearchable** (See Box No. II)
3. ☐ **Unity of invention is lacking** (See Box No. III)
4. With regard to the **title,**
   ☒ the text is approved as submitted by the applicant.
   ☐ the text has been established by this Authority to read as follows:
5. With regard to the **abstract,**
   ☒ the text is approved as submitted by the applicant.
   ☐ the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.
6. With regard to the drawings,
   a. the figure of the **drawings** to be published with the abstract is Figure No. **1**
      ☒ as suggested by the applicant.
      ☐ as selected by this Authority, because the applicant failed to suggest a figure.
      ☐ as selected by this Authority, because this figure better characterizes the invention.
   b. ☐ none of the figures is to be published with the abstract.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/026907

A. CLASSIFICATION OF SUBJECT MATTER

E21B 10/02(2006.01)i, E21B 49/02(2006.01)i

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)
E21B 10/02; E21B 49/02; E21B 25/16; E21B 25/00; E21B 49/00

Documentation 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 models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & keywords: core barrel, core sample, orientation, electronic instrument, port, window, light emitter, seal coupler

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2008-113127 A1 (2IC AUSTRALIA PTY LTD. et al.) 25 September 2008 See page 11, line 30 - page 12, line 28; page 14, lines 7-21; page 16, lines 12-22; page 26, lines 5-18 and figures 1-2.	1-4,7-8,17,28-33
A		5-6,9-16,18-27
A	WO 2014-053012 A1 (MINNOVARE PTY LTD.) 10 April 2014 See paragraph [0035] and figure 1.	1-33
A	WO 2007-104103 A1 (2IC AUSTRALIA PTY LTD. et al.) 20 September 2007 See page 6, line 16 - page 7, line 12 and figure 1.	1-33
A	US 2012-0145461 A1 (CRAVATTE, PHILLIPE) 14 June 2012 See paragraphs [0047]-[0058] and figures 1-3.	1-33
A	US 6732818 B2 (GREGORY, FRANK) 11 May 2004 See abstract and claim 1.	1-33

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

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 July 2015 (24.07.2015)	**24 July 2015 (24.07.2015)**

Name and mailing address of the ISA/KR
International Application Division
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan City, 302-701, Republic of Korea
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Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2015/026907

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(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
20 September 2007 (20.09.2007)

PCT

(10) International Publication Number
WO 2007/104103 A1

(51) International Patent Classification:
E21B 25/16 (2006.01)

(21) International Application Number:
PCT/AU2007/000315

(22) International Filing Date: 13 March 2007 (13.03.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2006901298 14 March 2006 (14.03.2006) AU

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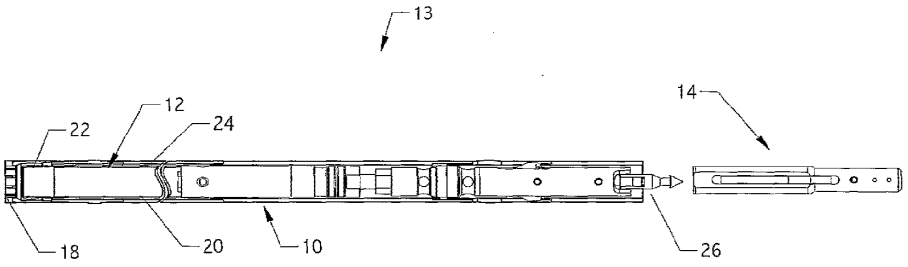
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV. SY, 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, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD OF ORIENTATING A CORE SAMPLE



(57) Abstract: A method for orientating a geological core sample extracted from a borehole comprising: providing a first indication of a directional characteristic of the core or the borehole at the commencement of a core run; providing a second indication of a directional characteristic of the core or the borehole at the end of the core run; and, determining orientation of a core sample extracted from the borehole on the basis of both the first and second directional characteristics.

WO 2007/104103 A1

METHOD OF ORIENTATING A CORE SAMPLE

Field of the Invention

The present invention relates to the orientation of a geological core sample to provide an indication of the orientation of the core sample relative to the strata from which it is cut.

Background of the Invention

Geological core sampling is used to enable geological surveying of the ground for various purposes including exploration, mine development and civil construction. Analysis of the core sample provides valuable information including information relating to the composition of the strata from which the core is cut as well as the physical structure of the strata. However, unless one is able to correctly and accurately determine the orientation of the core sample relative to a known value (e.g., gravity, buoyancy and/or the azimuth and inclination of the borehole), the value of this information is substantially diminished.

Many different types of systems have been developed to enable orientation of a core sample relative to gravity or buoyancy, and separate systems have been developed to provide the azimuth and inclination of the bore hole itself, as well as other potentially relevant structural and environmental data. Some systems operate by taking a reading, or marking a core, to determine the gravitational bottom side of the core sample at the commencement of the core run (i.e. just prior to commencement of the cutting of a core sample), and rely on physical contact between an orientation tool or marker and a toe of the hole from which the core is cut. Such systems include, for example, the use of a scribe or a pencil for marking the core, a

VAN RUTH type system that uses slidable pins to provide a profile record of the core face, or a resilient pad that takes an impression of the core face.

Other systems operate at the end of a core run; that is, once the core has been physically detached from the surrounding strata. Such systems include, for example, the BALLMARK system described in International Publication No. WO 00/75480.

Other systems rely on electronic tools to record the gravitational top or bottom side of a device located in an inner core tube prior to or just after a core run and then relate that reading back to a core.

Yet another system digitally scans the entire length of an open borehole after it has been completed and the drill pipe removed from the borehole. This digital scan is related to a known point set by the operator at the commencement of the scan and orientation of the strata is achieved. This can be related back to the core sample removed by correlating and matching the core sample with the hole depth. This method, however, is time-consuming and unreliable due to the difficulty of matching hole depth registered by the scanner to the core sample.

Systems have also been developed that will either magnetically, or by the use of accelerometers, gyroscopes, a compass or even optics, determine the azimuth and inclination of a borehole independent of the coring process. However, each of these products stop or significantly interfere with the core production process.

It is to be understood that, if any prior art publication is referred to herein, such reference does not constitute an admission that the publication forms a part of the

common general knowledge in the art, in Australia or any other country.

In the claims of this application and in the description of the invention, except where the context requires otherwise due to express language or necessary implication, the words "comprise" or variations such as "comprises" or "comprising" are used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the invention.

Summary of the Invention

According to the present invention, there is provided a method for orientating a geological core sample extracted from a borehole comprising:

providing a first indication of a directional characteristic of the core or the borehole at the commencement of a core run;

providing a second indication of a directional characteristic of the core or the borehole at the end of the core run; and,

determining orientation of a core sample extracted from the borehole on the basis of both the first and second directional characteristics.

In one embodiment, one of the first and second directional characteristics may comprise (a) an indication of core orientation, or (b) an indication of borehole azimuth and/or inclination, as well as other relevant structural and environmental data of the core sample or borehole. In any particular embodiment the first and second directional characteristics need not be the same. For example both could be indications or data relating to core orientation or both could be an indication or data relating to the

bore hole, or one may relate to core orientation and one to borehole azimuth and/or inclination.

The method may further comprise correlating borehole azimuth and/or inclination, as well as the other relevant structural and environmental data of the core sample or the borehole with orientation data collected to the physical core sample.

An embodiment of the method allows the provision of the correlated borehole survey data, as well as core orientation data every core run to facilitate correction and/or deviation of a borehole while it is being drilled.

The method may further comprise providing a first directional characteristic measuring, recording or marking device; providing a second directional characteristic measuring, recording or marking device; and operating each device to provide respective indications of directional characteristics of either a core sample or bore hole at substantially the same time. Thus, two separate first indications and/or two separate second indications can be obtained. A comparison may then be made between the two separate indications taken at substantially the same time to provide an audit on the accuracy of the tools or devices. The tools or devices may either be both mechanical, both electronic or one mechanical and one electronic. For example, if the directional indications provided by the separate devices are within an acceptable tolerance range (e.g. up to 5°), a high level of confidence is provided that each of the mechanical and electronic devices is providing reliable indications of directional characteristics. However, if the devices give readings that differ by more than an acceptable range, potential errors in the indications of orientation can be flagged on site to enable corrective action. This method is particularly useful to be employed, say, at the beginning

of each day to ensure that mechanical and/or electronic tools or devices used in the system are providing reliable readings. For example, looking specifically at core orientation, one may initially use both a mechanical and electronic device to obtain two separate core orientation readings and then make a comparison of the readings. Assuming there is relative concordance between the readings, the mechanical device may then be decoupled and the orientation method for the rest of the day completed with either or both of the devices.

According to another aspect of the present invention, there is provided a method of orientating a geological core sample comprising:

providing a mechanical gravity based orientation device and an electronic based orientation device;

disposing both devices down a borehole; and,

operating both devices to take separate orientation readings at substantially the same time.

According to a further aspect of the present invention, there is provided a method of orientating a core sample comprising:

obtaining first and second separate indications of a directional characteristic of a core sample or corresponding borehole from which the core sample is cut, the first and second separate indications either (a) captured at substantially the same time at the commencement of a core run or at the end of a core run by respective separate tools or devices or (b) captured at different times, one at the commencement of a core run and a second at the end of the core run, using either separate or the same tool or device.

In any embodiment the method comprises providing the first and/or second indications during a core run.

Brief Description of the Drawings

An embodiment of the present invention will now be described by way of example only with reference to the accompanying drawings in which:

Figure 1 is a schematic representation of a standard core barrel assembly and overshot used for core drilling; and,

Figure 2 is a table representing different combinations of orientation and borehole survey devices that may be used in various embodiments of the present method.

Detailed Description of Preferred Embodiments

Figure 1 is a schematic representation of a outer core barrel 10 and inner core barrel assembly 12 for a drill string 13 together with an overshot 14, which is used for lowering and retrieving the inner core barrel assembly 12 through the drill string 13. While specific features of the outer core barrel 10, inner core barrel assembly 12 and overshot 14 vary from manufacturer to manufacturer, the general form of these components is the same. Further, the specific form of these components is not critical to embodiments of the invention.

The outer core barrel 10 comprises a outer tube 24 screwed to a downhole end of the drill string 13. A core bit 18 is attached to the downhole end of the outer tube 24. The inner core barrel assembly 12 is typically latched to the outer core barrel 10 and includes an inner core tube 20 that receives a core being cut by the core drill. A core lifter case 22 is located at a downhole end of the inner core tube 20 which is seated within the outer tube 24 of the core barrel assembly 10. An uphole end of the inner core barrel assembly 12 comprises a head assembly/back end and a spear point 26 that can be engaged by the overshot

14 to allow lowering of the core barrel assembly 12 through, and retrieving the core barrel assembly 12 from, the drill string.

Many different types of core orientation devices and borehole survey tools are already known. These include devices that mark a core face or record a core face profile. The simplest form of a core orientator is a pencil or scribe that extends through the bit 18 and physically marks the toe of the hole into which the drill is lowered. The toe forms the core face of a core sample being cut by the drill.

A well known device for recording the profile of a core face is the VAN RUTH profiler, which comprises a plurality of pins that are able to slide along their length. The VAN RUTH orientator initially extends through the core bit 18. When the drill is lowered onto the toe of the hole, the pins slide axially upon contact with the toe to provide a profile record of the core face. Typically, such a device has a weighted bearing to provide a gravitational reference point or a metal ball enclosed in a race that is clamped in a bottom side position when contact with the toe of the hole is enacted.

Another type of known device is the BALLMARK system, which incorporates a washer and free rolling ball in the core barrel assembly. Prior to a core break, the ball is able to move freely under the influence of gravity and will therefore lie at the bottom or low side of an angled hole. During a core break, the ball and washer are pressed together so that the ball indents the washer. The washer is keyed to the core barrel. Thus, the indentation made by the ball on the washer can be transposed to the core to provide an indication of the orientation of the core.

The above device may be broadly referred to as a mechanical device as they rely upon moving mechanical part or mechanical contact to record or log directional or orientation characteristics.

Electronic core orientation devices are also known that do not rely upon the weight of the drill string on the toe of the hole nor the force required during a core break to provide indications of core orientation. Typically in these systems, electronic devices provide a constant read out or record of the gravitational bottom side of the device. A drill rig operator then logs the time the core run is finished and the reading taken at that time is then transposed to the core inside the inner core tube once it has been removed from the borehole by the drill rig operator.

A variety of borehole survey tools are also known that can record the azimuth, inclination and other structural and environmental data, either in the open borehole a sufficient distance from the influence of interference that can be created by the magnetic nature of the drill string or, for example, within the drill string while it is suspended in the completed borehole by the lowering and raising on a wireline of an optically based system known as a Maxibore, which is not affected by either the magnetics of the surrounding rock strata or the metal of the drill string.

Irrespective of which core orientation or borehole survey system is used, ultimately a Geologist or other suitably trained and skilled personnel will use the information provided by each system to physically mark a core sample with a line indicative of the orientation of the core sample, and/or graphically or mathematically represent the borehole path that the sample was obtained from and

correlate all other structural and environmental data collected to these known physical values.

Some embodiments of the present invention rely not on taking a single reading of a directional characteristic of a core or corresponding borehole at either the beginning or end of a core run, but rather taking two or more separate readings of such directional characteristic, at least one at the commencement of the core run and at least one at the end of the core run. As a consequence, a core sample is able to be marked at opposite ends with a mark indicative of the lowest point of the core, or otherwise have its orientation characterised by data logged at the beginning and end of a core run.

Throughout this specification the expression "directional characteristic of a core or borehole" is used to denote either: (a) an indication of core orientation or corresponding core orientation data; or (b) an indication of the azimuth and/or inclination of a borehole from which the core is cut.

When the core is physically marked, respective lines can then be drawn on the core sample from those points parallel to a central axis of the core sample. If the lines overlie each other or are closely adjacent, a Geologist or other suitably trained and skilled personnel is able to assume that the orientation provided by the overlaid or closely adjacent lines is correct. However, in the event that the lines are spaced by more than the predetermined minimum distance or angle, a Geologist or other suitably trained and skilled personnel is able to conclude that one of the readings of core orientation taken is incorrect.

To determine whether the incorrect reading is that taken at the commencement of the core run or at the end of the

core run, the Geologist or other suitably trained and skilled personnel can refer to adjacent core samples. In this regard, the orientation of adjacent core samples should be continuous; that is, the orientation indicated at the commencement of a core run should be continuous with the orientation indicated at the end of the previous core run. If no error is detected in the orientation of the previous core sample, and no error is detected in the orientation of a subsequent core sample, then it is expected that there will be either a misalignment between the orientation indication at the end of the core run of a previous core sample with the indication of orientation at the commencement at the present core sample or a misalignment with the orientation reading at the end of the core run of the present core sample and the indication of orientation at the commencement of a core run of the next core sample. This mismatch is likely to be clearly visible or discernable, allowing the Geologist or other suitably trained and skilled personnel to disregard that particular orientation indication.

In order to provide directional characteristics of a core or borehole at both the commencement and end of a core run either at least two devices for obtaining such directional characteristics are required or a single device can be used, but operated both at the beginning and end of the core run. This may comprise one or more core orientation devices, one or more borehole survey tools, or a combination thereof.

Borehole survey tools provide information relative to the azimuth, inclination and/or other structural and environmental data of a borehole that may be required during the core production process and allow the correlation of such data to the physical core sample and the core orientation data at the completion of each core run. Various borehole survey tools could be deployed

downhole either at the commencement of the drilling process or at its completion when the core sample contained in the inner core tube is retrieved via the overshot and the wireline, and then, if necessary, deviating the borehole path to ensure that the maximum value of such data is achieved at all times.

The table in Figure 2 provides a non-exhaustive matrix of combinations of orientation devices and borehole survey tools (referred to collectively as "tool" or "tools") that may be used to provide the directional characteristics of the core or borehole at the beginning and end of each core run. The table also indicates the possible location of the tools.

In the table, the location "in front of bit" indicates that a tool is initially disposed downhole of the drill bit 18. During use, this tool will, however, be pushed into the core barrel assembly 12.

The reference to "lifter" in the table indicates that a tool is located adjacent the core lifter case 22.

The reference to "tube back end/head assembly" means that the tool could be included at an uphole end of the inner core tube 20, or in an adaptor between the inner core tube 20 and the spear head assembly 26, or in a custom-made head assembly.

The location "overshot" in the table is reference to a tool being located in or adjacent to the overshot 14. It would be appreciated that the overshot is tripped at the beginning and end of every core run for the purposes of lowering an empty inner core barrel assembly 12 into the drill string 13 at the commencement of the core run, or alternatively withdrawing a core barrel assembly 12 with a cut core at the end of the core run. Thus, any tool

disposed in or carried with the overshot may be operated at any one or both of the beginning or end of the core run.

The table also makes reference to particular types of tools which are explained below.

Profile record: this refers to a tool that marks a core face and/or records a core face. Examples of such devices include the above-mentioned VAN RUTH type system, clay or plasticine pads, scribe or pencil for physically marking the core face. In use the profile record would be aligned, keyed or synchronized with a further tool or device which records or measures orientation and/or azimuth indications or data.

Profile with Ori: this refers to a device that records a core face profile correlated to an orientation reading. Such a tool is exemplified by Applicant's **EZY-MARK** (TM orientation system described in International Publication No. WO 2005/078232).

Profile with Ori+Az: this refers to a device that records core face profile correlated to an orientation reading together with the taking of a borehole azimuth reading. Such a device, for example, could constitute the above-mentioned **EZY-MARK** orientation system coupled with an azimuth measurement and reading device.

Ori reading: this refers to an orientation tool that takes a reading of core orientation such as for example the BALLMARK system mentioned above.

Ori reading+Az: this refers to an orientation tool which includes an azimuth module for taking a reading of the azimuth of the hole.

Az: this refers to an azimuth tool *per se* to provide readings of the azimuth of a borehole. The azimuth tool may be magnetic, gravitational, optical or inertial (gyro).

The specific location of a tool is not necessarily indicative of the timing of providing corresponding orientation data. Thus, having a tool "in front of the bit" does not necessarily mean that the tool is operated only at the commencement of a core run. For example, placement of the tool "profile with Ori+Az" at the location "in front of the bit" can provide both the first and second indications of core orientation. In particular, the "profile with Ori" component can provide profile and orientation data at the commencement of the core run, constituting the first indication of orientation of the core. The azimuth component of the tool may also be operated at the commencement of the core run so as to tie the azimuth reading at the commencement of the core run with the recorded profile and orientation data, but significantly the tool can also be operated at the end of the core run to provide an azimuth reading of the borehole, thus providing the second indication of core orientation at the end of the core run.

In addition, it is to be appreciated that the tools are coupled with the core barrel assembly 12 or the overshot 14 and thus tripped through the drill string at the beginning and end of every core run. There is no requirement to trip the drill string *per se*, which of course is a much more difficult and time-consuming operation. It will be also noted in the enclosed table that in some instances only one tool is required to provide both the first indication of core or borehole orientation at the commencement of the core run and the second indication of core or borehole orientation at the end of the core run. For example, combination C in the

table shows the existence of an azimuth tool only at the location "in front of bit". The azimuth tool, however, may be operated to provide azimuth information of the borehole at both the commencement and end of the core run. Similarly, combination J indicates a tool providing profile with orientation data located at the lifter. This device may provide a profile of the core at the commencement of the core run together with orientation of the core at the commencement of the core run and orientation at the end of the core run.

In the above-described embodiment, separate directional characteristics are taken at the commencement and end of a core run. However, in a further variation multiple directional characteristics relating to the core and/or borehole may be taken at substantially the same time at the commencement or end of a core run, particularly for the purposes of auditing the tools used for obtaining core orientation data. As mentioned above, the tools used to obtain core and/or hole orientation data may be mechanical, electronic or optical devices. Electronic orientation devices are becoming popular in some sectors of the market. Many of these devices rely on a drill rig operator operating a timing device so that the reading from the electronic device can be taken at the time corresponding to either the commencement or end of the core run. However, when the electronic device is used by itself, there is an assumption that the device is providing accurate orientation information. While errors in orientation data obtained from such electronic devices can be detected, this can only be done by comparison with other data collected by Geologist or other suitably trained and skilled personnel which is analysed off-site, days or weeks after the drilling has been completed. The present embodiment proposes a system to enable auditing, particularly of such electronic devices, on site so that errors in readings can be detected within one to two core

runs after the core run that may have provided a faulty reading.

To this end, the present embodiment proposes the use of both a mechanical gravity-based orientation tools such as the BALLMARK system or the EZY-MARK system, together with an electronic orientation device such as the ACE system manufactured by Australian Mud Company Pty Ltd. For example, with reference to Figures 1 and 2, both the mechanical and electronic orientation tools may be provided adjacent the lifter 22 or the head assembly 26. The mechanical tool will be operated by a physical action of the core drill, e.g. lowering of the core drill on to the toe of the hole, or during a core break. The electronic tool typically will provide readings for the entire time it is in a bore hole and a timer is operated to flag or mark the reading at a point in time corresponding to time of operation of the mechanical device.

It will be appreciated that once a core run has been completed, both the mechanical and electronic devices are returned to the surface with the core barrel assembly 12. A Geologist or other suitably trained and skilled personnel is then able to compare the orientation data from the mechanical tool with that of the electronic tool. Provided the readings are within a desired tolerance range, for example 5°, it is assumed that both tools are providing reliable orientation information. However, if the readings from the two tools differ by more than the desired tolerance range, then it is assumed that one or both is not providing an accurate orientation reading. Further tests may then be conducted to ascertain which device is providing faulty readings. However, if the mechanical device is one that itself provides self error checking such as the EZI-MARK system (which includes a

plurality of balls in separate races), identification of the tool in error may be simplified.

If it is determined that both devices are operating reliably, future core runs during the day may be conducted with only the mechanical tool or only the electronic tool. It will be appreciated that because the comparison between readings of the two devices is conducted on site, errors in equipment can be detected within one to two core runs. This will enable errors in the direction of the hole being drilled to be rectified on site during the drilling process ensuring that the cores extracted relate to the strata that is desired to be examined.

In a minor variation, auditing of the mechanical and electronic devices can be performed at the surface (rather than downhole) by use of an appropriate jig or adaptor that enables firing or operation of the mechanical device.

This also ensures the accuracy in the correlation of the orientation of a core sample with the azimuth position and inclination of the bore hole.

The above auditing feature may of course be extended to apply to any two separate tools or devices that may be use to measure, record or mark directional characteristics of a core or bore hole. For example in relation to core orientation two mechanical devices can be audited against each other, or two electronic devices. Indeed the devices may also be of the same type, e.g. two EZY MARK core orientation devices. Similarly in relation to bore hole directional characteristics, one may use two mechanical devices, two electronic devices or one of each to perform the auditing feature.

It would be appreciated and understood by those in the art that embodiments of this method can provide the orientation of a core sample, as well as the azimuth

position, and inclination of the same core and/or borehole sample in the same process without significantly interfering with the core production process. It further facilitates the in-situ auditing or correlation of any or all of these independent pieces of information during the core production process.

CLAIMS:

1. A method for orientating a geological core sample extracted from a borehole comprising:

providing a first indication of a directional characteristic of the core or the borehole at the commencement of a core run;

providing a second indication of a directional characteristic of the core or the borehole at the end of the core run; and,

determining orientation of a core sample extracted from the borehole on the basis of both the first and second directional characteristics.

2. The method according to claim 1 wherein the first directional characteristic comprises (a) an indication of core orientation, or (b) an indication of borehole azimuth and/or inclination.

3. The method according to claim 1 or 2 wherein the second directional characteristic comprises (a) an indication of core orientation, or (b) an indication of borehole azimuth and/or inclination

4. The method according to any one of claims 1 - 3 further comprising
providing a first directional characteristic measuring, recording or marking device; providing a second directional characteristic measuring, recording or marking device; and operating each device to provide respective indications of directional characteristics of either a core sample or bore hole at substantially the same time.

5. The method according to any one of claims 1 - 4 further comprising making a comparison between the first and second indications to provide an audit on the accuracy of the tools or devices.

6. The method according to claim 5 further comprising assigning a high confidence level in the first and second indications when a difference between the first and second indications is less than or equal to predetermined difference and assigning a low confidence level in the first and second indications when the difference is more than the predetermined difference.

7. The method according to any one of claims 4 - 6 wherein the first device is a mechanical device or an electronic device and the second device is a separate mechanical or electronic device.

8. A method of orientating a geological core sample comprising:

providing a mechanical gravity based orientation device and an electronic based orientation device;

disposing both devices down a borehole; and,

operating both devices to take separate orientation readings at substantially the same time.

9. A method of orientating a core sample comprising:

obtaining first and second separate indications of a directional characteristic of a core sample or corresponding borehole from which the core sample is cut, the first and second separate indications either (a) captured at substantially the same time at the commencement of a core run or at the end of a core run by respective separate tools or devices or (b) captured at different times, one at the commencement of a core run and a second at the end of the core run, using either separate or the same tool or device.

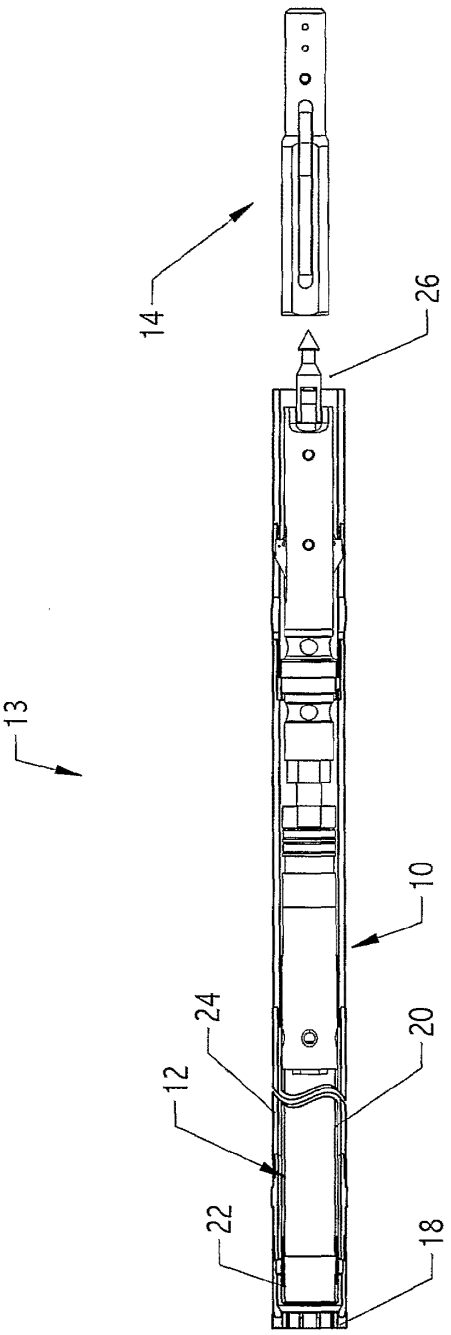


FIGURE 1

In front of Bit (outside drill string)	Bit	Lifter	Tube Back End/Head Assembly	Overshot
Profile with Ori +Az				
Profile with Ori +Az			Ori Reading	
Az				
Az			Ori Reading	
		Profile record	Ori Reading	
		Profile record	Ori Reading +Az	
		Profile record	Ori Reading	Az
		Profile record	Az	
		Profile record		Az
		Profile with Ori		
		Profile with Ori	Ori Reading	
		Profile with Ori	Ori Reading +Az	
		Profile with Ori	Ori Reading	Az
		Profile with Ori	Az	
		Profile with Ori		Az
		Az		
			Ori Reading	
			Ori Reading +Az	
			Ori Reading	Az
			Az	
				Az

FIGURE 2.

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Reflex USA LLC v. Longyear TM, Inc. and Globaltech Corporation Pty Ltd.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2007/000315

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

E21B 25/16 (2006.01)

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DWPI: IPC as above and keywirds (direction, azimuth, inclin+, mechanical, gravit+, electronic+)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2006/024111 A1 (AUSTRALIAN MUD COMPANY LTD) 9 March 2006 Page 8 lines 4-20, page 9 lines 14-25 and page 13 line 24 to page 14 line 6	1-7, 9
X	CA 2456506 A1 (SCOTT) 1 March 2005 Page 3 lines 7-21	1-7, 9
X	US 5105894 A (ENDERLIN) 21 April 1992 Whole document	1-7, 9
X	US 4389792 A (FUCHS) 28 June 1983 Whole document	1-7, 9

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

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

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
02 May 2007	- 7 MAY 2007
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized officer **S. GHOSH** AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : (02) 6283 2163

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2007/000315

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See Extra Sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT	International application No. PCT/AU2007/000315

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2251307 A (GOWANS) 1 July 1992 Whole document	1-7, 9
X	WO 2000/075480 A1 (SHELLJET PTY LIMITED) 14 December 2000 Claims 10-17	1-7, 9
X	WO 2005/078232 A1 (2iC AUSTRALIA PTY LTD) 25 August 2005 Claims 1 and 17 and page 11 line 23 to page 12 line 18	1-7, 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2007/000315

Supplemental Box
(To be used when the space in any of Boxes I to VIII is not sufficient)

Continuation of Box No: III

This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

This International Searching Authority has found that there are different inventions as follows:

- Claims 1 to 7 and 9 are directed to a method for orientating a geological core sample comprising obtaining first and second separate indications of a directional characteristic of a core sample. It is considered that the feature of obtaining the indications at the commencement of a core run and / or the end of a core run using either the separate or the same tool comprises a first distinguishing feature.
- Claim 8 is directed to a method for orientating a geological core sample comprising providing a mechanical gravity based orientation device and an electronic based orientation device. It is considered that the feature of providing a mechanical gravity based orientation device **and** an electronic based orientation device comprises a second distinguishing feature.

Each of the abovementioned groups of claims has a different distinguishing feature and they do not share any feature which could satisfy the requirement for being a special technical feature. Because there is no common special technical feature it follows that there is no technical relationship between the identified inventions. Therefore the claims do not satisfy the requirement of unity of invention ***a priori***.

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. PCT/AU2007/000315

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
WO	2006024111	AU	2005256104	AU	2006100113	CA	2559030
CA	2456506						
US	5105894						
US	4389792	DE	3000319	GB	2066955	JP	56101514
		SE	8008091	ZA	8100034		
GB	2251307	AU	18597/92	CA	2072203		
WO	0075480	AU	49004/00	CA	2294409	CA	2378748
		EP	1198657	GB	2370589	US	6659196
		ZA	200110321				
WO	2005078232	AU	2005212537				

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
25 September 2008 (25.09.2008)

PCT

(10) International Publication Number
WO 2008/113127 A1

(51) International Patent Classification:
E21B 25/16 (2006.01) *E21B 49/02* (2006.01)

(21) International Application Number:
PCT/AU2008/000395

(22) International Filing Date: 19 March 2008 (19.03.2008)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2007901412 19 March 2007 (19.03.2007) AU

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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, BR, BW, BY, BZ, CA, CH, 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, IS, JP, KE, KG, KM, 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, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, 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, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

(54) Title: A CORE ORIENTATION TOOL

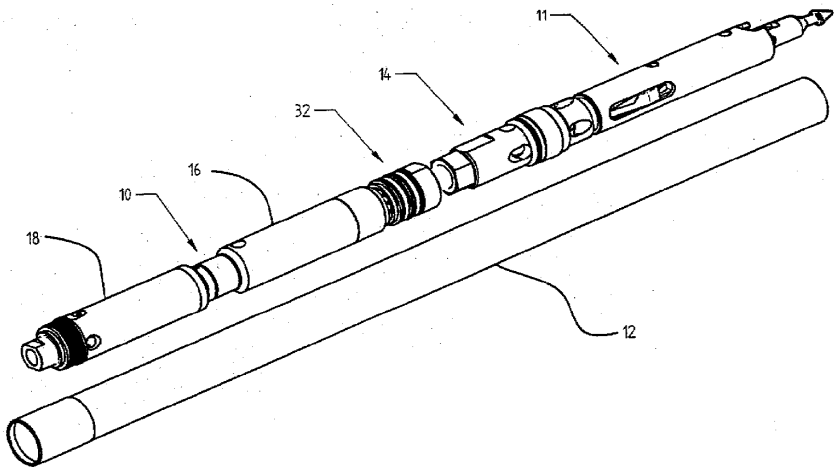


Figure 1

(57) Abstract: A core orientation tool (10) for providing an indication of orientation of a core sample (112) comprises an electronic orientation device (20), which upon receipt of a trigger signal, logs one or more indications of orientation of the tool (10). A trigger system (24) provides trigger signals to the electronic device (20) based one or both of (a) detecting one or more downhole events and (b) the effluxion of time. The downhole events relate to the action of core breaking and may include detecting: uphole motion of the tool; and, cessation of drilling and commencement of drilling.

WO 2008/113127 A1

A CORE ORIENTATION TOOL

Field of the Invention

The present invention relates to a core orientation tool that can provide directional characteristics of a geological core sample extracted from the subsurface.

Background of the Invention

Core sampling is used to allow geological surveying of the subsurface for various purposes including exploration and/or mine development. An analysis of the material within the core sample provides information of the composition of the subsurface. However in order to accurately interpret the information obtained from the core sample, it is necessary to have knowledge of the orientation of the core sample relative to the subsurface from which it was extracted.

Applicant has developed numerous devices, systems and methods for orientating a core sample including a method of orientating a core sample described in co-pending Australian patent application no. 2006901298; an orientation head described in International publication No. WO 07/109848; a core orientation system described in International publication No. WO 07/l137356; and an orientation device for a core sample described in International publication No. WO 03/038232; the contents of each of which is incorporated herein by way of reference.

The present invention is the result of Applicant's further research and development in the field of core orientation.

It is to be understood that, if any prior art publication is referred to herein, such reference does not constitute

an admission that the publication forms a part of the common general knowledge in the art, in Australia or any other country.

In the claims of this application and in the description of the invention, except where the context requires otherwise due to express language or necessary implication, the words "comprise" or variations such as "comprises" or "comprising" are used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the invention.

Summary of the Invention

According to a first aspect of the present invention there is provided a core orientation tool for providing an indication of *in situ* orientation of a core sample extracted from a borehole by a core drill the tool comprising:

an electronic orientation system coupled with the core drill, the electronic orientation system configured, upon receiving a trigger signal, to log one or more first indications of orientation of the tool; and,
a trigger system that provides the trigger signal upon detecting one or more downhole events associated with operation of the core drill.

According to a second aspect of the present invention there is provided a core orientation tool for providing an indication of *in situ* orientation of a core sample extracted from a borehole by a core drill the tool comprising:

an electronic orientation system coupled with the core drill, the electronic orientation system configured, upon

receiving a trigger signal, to log one or more first indications of orientation of the tool; and,
a trigger system that provides the trigger signal upon one or both of (a) detecting one or more downhole events associated with operation of the core drill, and (b) effluxion of time.

According to a third aspect of the present invention there is provided a core orientation tool for providing an indication of *in situ* orientation of a core sample extracted from a borehole by a core drill the tool comprising:

an electronic orientation system coupled with the core drill, the electronic orientation system configured to log one or more first indications of orientation of the tool; and,
a trigger system that provides a trigger signal upon detecting one or more downhole events associated with operation of the core drill; and,
wherein tool is configured to associate the one or more first indications of orientation with the trigger signal.

The trigger signal may be one of a plurality of trigger signals. Moreover, the tool may be further configured to log different first indications of orientation, for example dip, roll and azimuth upon receipt of different trigger signals.

The one or more downhole events may comprise respective physical events arising from motion of the tool or the drill in the borehole.

For example, the motion may comprise one or a combination of:
(a) motion in an uphole direction;

(b) a change in motion from motion having a linear component in a downhole direction to motion having no linear component;

(c) a change in motion from motion in a downhole direction to motion in an uphole direction;

(d) a change in motion from no linear motion to motion in an uphole direction;

(e) a change in characteristics of vibration motion on the tool or drill arising from the cessation or commencement of drilling;

(f) a change in speed of linear motion of the tool; and,

(g) a change in the rate or direction of rotation around the tool's longitudinal, lateral or normal axis.

(h) any change in velocity (speed and/or direction of movement).

The trigger signal may be provided upon detecting a predetermined sequence of downhole events such as a cessation of drilling followed by motion of the tool in an uphole direction.

The sequence of events may further comprise commencement of drilling prior to the cessation of drilling.

Other downhole events that may be detected by the electronic orientation device and used in producing the trigger signal comprise:
(a) detecting contact of a backend assembly to which the tool is coupled hitting a landing ring in the core drill;

(b) the backend assembly hitting a water table in the event that the drill is operated in the borehole below the water table;

(c) detecting release of the backend assembly from a wire line when initially inserting a core tube into the core drill;

(d) the core drill tagging a toe of the hole;

(e) an overshot hitting and latching onto the backend assembly;

(f) retrieval of the backend assembly from the drill hole; and,

(g) a change in the flow of fluid through or around the backend assembly.

Instead of utilising detected changes in vibration characteristics of the tool which are caused when the drill is cutting a core, the stopping and starting of drilling may be detected by sensing actual rotation of the core drill by using sensors or devices mounted on or adjacent to a rotating side of the backend assembly. Such devices may comprise an inductive RPM sensor, accelerometer or a gyroscope.

The tool 10 may be further configured to log or record time between one or more of the downhole events, for example the time between cessation of drill and motion in an uphole direction; and/or time between cessation of drilling and the provision of the trigger signal. Such information may be beneficial in accessing the accuracy or degree of confidence in the orientation readings.

According to a further aspect of the present invention there is provided a core retrieval system for a core drill comprising:

a core tube having an uphole end and a downhole end, the downhole end provided with an opening for receiving a core sample cut by the core drill; and,

a core orientation tool in accordance with the first aspect of the present invention wherein the core orientation tool is coupled to the core tube at a location uphole of the downhole end of the core tube.

The core retrieval system may further comprise a backend assembly coupled to the uphole end of the core tube and wherein the core orientation tool is attached to the backend assembly uphole of the uphole end of the core tube.

A further aspect of the present invention provides a method of logging *in situ* orientation of a core sample extracted from the ground by a core drill comprising:

coupling an electronic core orientation device in a known spatial relationship to a core sample cut by the core drill;

configuring the electronic core orientation device to log one or more indications of orientation of the device upon receipt of a trigger signal; and,

providing the trigger signal upon detecting one or more downhole events associated with the operation of the core drill.

The downhole events may be indicative of a, or an imminent, core break.

Detecting of the one or more downhole events may comprise detecting an uphole motion of the device.

The detecting of the downhole event may comprise detecting a cessation of drilling prior to detecting the uphole motion of the device. The detecting may further comprise detecting commencement of drilling prior to detecting cessation of drilling. Further, the detecting may comprise detecting a cessation of downhole movement of the device prior to detecting the commencement of drilling.

In one embodiment the tool comprises a switch that is activated by the tool, a downhole device such as an inner barrel assembly to which the tool is attached, or the drill, tagging the toe of the borehole. The switch may comprise a Hall effect switch, an optical switch, a pressure switch, and a mechanically operated electrical switch.

The first indications of orientation may comprise one or a combination of borehole dip, borehole azimuth, core orientation, core dip and core azimuth.

According to a further aspect of the present invention there is provided a core retrieval system for a core drill comprising:

an inner core tube having an uphole end and an opposite downhole end provided with an opening for receiving a core cut by the core drill; and,

a core orientation tool coupled to the inner core barrel and movable inside the inner core tube in an uphole direction by abutment with the core, the core orientation tool comprising an electronic orientation device which upon receiving a trigger signal logs one or more first indications of orientation of the tool;

a trigger system that provides the trigger signal to the electronic orientation device; and

a core face orientation device which records rotational orientation of a core sample, wherein the electronic orientation device is in a known rotational position relative to the core face orientation device.

According to another aspect of the present invention there is provided a core retrieval system for a core drill comprising:

a core tube having an uphole end and an opposite downhole end provided with an opening for receiving a core sample cut by the core drill;

a core orientation tool coupled to the inner core tube and movable inside the inner core barrel in an uphole direction by abutment with the core sample, the core orientation tool comprising: an electronic orientation device which, upon receiving a trigger signal logs one or more first indications of orientation of the tool; and a trigger system that provides the trigger signal to the electronic orientation device.

A further aspect of the present invention provides a core orientation apparatus for providing an indication of orientation of a core sample extracted from a borehole by a core drill the apparatus comprising:

an electronic orientation device which upon receiving a trigger signal logs one or more first indications of orientation of the tool;

a trigger system that provides the trigger signal to the electronic orientation device; and

one or more secondary orientation devices which provide one or more second indications of orientation of the core or borehole, wherein the electronic orientation device is in a known rotational position relative to the one or more secondary orientation devices.

The trigger system may provide the trigger signal on the basis of effluxion of time from a reference time. For example the reference time could be the time the tool is inserted into a core drill, or at a time when or after the core face orientation device records the orientation of the core face.

In an alternate embodiment, the trigger signal is delivered on multiple occasions during a period between the core orientation tool being inserted into the core drill and a time after the core face orientation device records the orientation of the core face.

In one embodiment, the trigger system provides the trigger signal to the electronic orientation device upon detecting one or more downhole events associated with the operation of the drill. The one or more downhole events may comprise one or more physical events arising from the motion of the tool in the borehole.

Brief Description of the Drawings

Embodiments of the present invention will now be described by way of example only with reference to the accompanying drawings in which:

Figure 1 is a schematic representation of an inner barrel assembly and core tube to which an embodiment of a core orientation tool is coupled;

Figure 2 is a cutaway view of the core orientation tool and adjacent parts of the inner barrel assembly to which it is coupled.

Figure 3 is a partially exploded schematic representation of a further embodiment of a core orientation tool in accordance with the present invention;

Figure 4 is a partially exploded representation of a third embodiment of the core orientation tool;

Figure 5 is a section view of the core orientation tool shown in Figure 4; and

Figure 6 depicts the use of a template for transferring indications of core orientation captured by the tool to a core.

Detailed Description of the Preferred Embodiment

Throughout this specification the term "orientation" is intended to mean one or more of "dip", "roll", and "azimuth" of an apparatus, tool, core sample, borehole, or other structure in relation to which orientation data is required or desired.

Further, the expression "electronic orientation device" is intended to denote an electronic device or system that utilises electronic sensors and transducers such as but not limited to accelerometers, inclinometers, gyroscopes and magnetometers.

Throughout this specification the expression "downhole direction" is intended, unless the context clearly suggests otherwise, a direction that increases distance along the hole away from a collar of the hole. Thus for example in a hole drilled directly downwards in the ground the downhole direction is the same as the direction of gravitational acceleration. Whereas in an uphole such as one drilled in a back of a tunnel, the downhole direction is in a direction opposite to the direction of gravitational acceleration.

Throughout this specification the expression "uphole direction" is intended, unless the context clearly

suggests otherwise, a direction that decreases distance along the hole away from the collar of the hole. Thus for example in a hole drilled directly downwards in the ground the uphole direction is opposite the direction of gravitational acceleration. Whereas in an uphole such as one drilled in a back of a tunnel, the uphole direction is the same as the direction of gravitational acceleration.

Figures 1 and 2 illustrate an embodiment of a core orientation tool 10 in accordance with the present invention. The core orientation tool 10 is shown in association with an inner barrel assembly 11 which comprises a core tube 12 for receiving a core being cut by a core drill, and a backend assembly 14 that is attached to the core tube 12 for lowering and retrieving the core tube 12 from the core drill. The core tube 12 is of conventional construction while the backend assembly 14 is modified by the inclusion of an adaptor 16. The tool 10 is coupled at one end to the conventional core tube cap 18 of the backend assembly 14 with the adaptor 16 being used to couple an opposite end of the tool 10 to the remainder of the backend assembly 14. The tool 10 is in a known or measurable spatial relationship with the core tube 12. Further, as the core sample is rotationally fixed inside the core tube 12, at least shortly before and during a core breaking action, the orientation data relating to the core tube 12 can be related to the *in situ* orientation of the core sample.

The tool 10 comprises an electronic core orientation device or system 20 housed within a body 22 that is coupled to and between the core tube cap 18 and the adaptor 16. The electronic core orientation device 20 is configured to log one or more first indications of orientation of the tool (ie, core orientation) upon receiving of a trigger signal. To this end, the tool 10 includes a trigger system 24 that provides the trigger

signal upon detecting one or more downhole events associated with the operation of the core drill. These events may particularly relate to the core breaking function of the core drill and/or various sequences of events expected prior to core breakage.

The system 20 comprises multiple sensors and transducers for sensing various events and orientation data of the tool 10 and core drill. The sensors may comprise for example accelerometers, gyroscopes, physical switches, magnetometers, vibration sensors, inclinometers, inductive RPM sensors, flow sensors and pressure sensors. Some of the sensors and transducers send information to the trigger system that analyses the information to determine when to provide the trigger signal. Other sensors and transducers, notionally forming an orientation module 26, may be either in an idle state or continually providing data indicative of core and/or bore hole orientation, however these sensors and transducers are not activated and/or the orientation data is not logged until the trigger system 24 provides the trigger signal. It will be appreciated by those skilled in the art that some of the sensors and transducers that are used by the trigger system may also provide orientation data. The orientation system 20 may further comprise a transceiver 28 coupled to an antenna 30 to communicate with a hand-held computer or other like device. The function of this will be explained in greater detail later in the specification.

Embodiments of the tool 10 are able to log *in situ* orientation data relating to the core and the borehole from which the core is extracted at a time shortly before or at core breakage. This is done by arranging a trigger system 24 to issue the trigger signal upon sensing particular events or sequences of events that are expected to occur when a core is broken from the ground. One or more of the downhole events relate to physical events

arising from the motion of the tool 10 and indeed the core drill in the borehole. One of the telltale physical events of a core break is an uphole motion of the core drill and thus the tool 10. Accordingly the trigger system 24 may be configured to issue the trigger signal when sensors in the module 26 detect an uphole movement or acceleration or a change in direction of motion from a downhole direction to an uphole direction. While such motion is characteristic of a core break, other events or motions may also be sensed which increase the degree of confidence that the uphole motion is related to a core break. Examples of such events or motions include:

1. The backend assembly 14 being released at the collar of the borehole.

2. When the toe of the hole is below the water table, detecting the backend assembly 14 hitting the water table.

3. The backend assembly 14 contacting or hitting a landing ring within the core drill.

4. The commencement of drilling.

5. The cessation of drilling.

6. The breaking of the core itself.

7. An overshot hitting and latching onto the backend assembly 14.

For example, in addition to simply detecting an uphole motion of the tool 10 or the core tube 12 or core drill itself, the trigger system 24 may be arranged to issue the trigger signal upon the module detecting in sequence commencement of drilling, cessation of drilling and a

motion in an uphole direction. The sensing of the commencement and cessation of drilling may be via the use of vibration sensors in the module 26. It is known that during drilling as a core bit is bearing against rock, vibrations of known characteristics will be generated.

The trigger signal may be one of a plurality of trigger signals provided upon detection of different downhole events. That is a trigger signal may be provided when commencement of drill is detected, another when cessation of drilling is detected and another when an uphole motion of the tool 10 or drill is detected. Thus logging (recording) of data will commence prior to the breaking of the core. Additionally different orientation indications may be logged at different trigger signals. For example dip may be logged at when the trigger system detects drilling has stopped (e.g. detecting no rotation of the core drill following previously detecting the commencement of drilling; and core orientation may be logged upon the trigger system detecting a core lifter case gripping the core just prior to the core break.

The tool 10 and more particularly the electronic orientation system 20 comprises a memory device for storing logged data. The trigger signal may be considered to act as a pointer to identify the logged orientation data at the time the trigger signal(s) where provided so that the orientation data can be correlated to particular downhole event, particularly the core break.

Accordingly sensing a change in the characteristics of the vibrations would be indicative of the commencement and cessation of drilling. However this is not the only way in which the commencement and cessation of drilling may be sensed. As an alternate, sensors may be provided in the module 26 or trigger system 24 to sense the speed, direction or change in speed or direction of rotation of

the core drill. For example upon commencement of drilling, the sensor will detect rotation of the core drill, while on cessation of drilling the sensor will subsequently detect a change in the speed of rotation and more particularly a zero speed of rotation. Such a sensor may comprise an inductive RPM sensor, accelerometer or gyroscope having a component on or adjacent a rotating section of the backend assembly 14, such as for example on an uphole side of bearing 32 of the backend assembly.

Other possible variations for detecting the commencement and cessation of drilling include by detecting flow of fluid through or around the backend assembly 14. In this regard, fluid is pumped through or around the core drill and backend assembly during drilling with the flow being cut off when drilling ceases. Therefore detecting a change in the flow of water will also be indicative of the cessation of drilling. Also while uphole motion may typically be sensed by an accelerometer, other types of sensors including optical sensors or lasers may be used for sensing motion in an uphole direction.

A substantive benefit of the tool 10 over other core orientation devices that rely on the logging of time to correlate orientation data to a core is that the tool 10 does not require the use of timers by human operators and is therefore less susceptible to error. The above described embodiment of the tool 10 may be considered as a "drop and forget" sensor which will automatically log core orientation data shortly before or at the time of a core break.

The tool 10 may be further configured to provide borehole azimuth and vertical core orientation relative to azimuth. It is known to use gyroscopes to obtain azimuth information when logging boreholes. However gyroscope technology is not suitable for use in downhole core

orientation during the drilling process. The reasons for this include that the gyroscopes are prone to drift when operated for extended periods as would be required when lowering the gyroscope through the core drill; the inability for the gyroscope to maintain accurate orientation when exposed to sudden movements such as a shunt or vibration as typically would occur when dropping a backend assembly down a drill string; and, the need for the azimuth measurement to be made relative to a known reference point.

Notwithstanding the above limitations, an embodiment of the tool 10 may comprise a gyroscope 34 or similar device for logging azimuth and dip. This is enabled by the use of the trigger system 24 which will only trigger the gyroscope 34 to move from an off or idle state to a logging state at the same time as it supplies a trigger signal to the measurement module 26. Prior to the trigger system 24 providing the trigger signal, the gyroscope 34 is either off or in an idle state. Upon receipt of the trigger signal, the gyroscope 34 is activated to commence tracking changes in orientation.

As the inner barrel assembly 11 is being withdrawn from the core drill, the gyroscope 34 continues to tracking changes in orientation. Orientation of a collar of the borehole may be used as a known reference orientation. Thus changes in orientation since the issuance of the trigger signal can be related back to the collar orientation so as to enable determination of the azimuth of the tool 10 and the borehole at the toe of the hole substantially at the time of a core break. This in effect provides a single survey shot at the bottom of the hole. This data may be used to build an ongoing survey of the borehole for determining its path when combined with a measurement or estimate of the hole depth. This may be

determined by simply counting the number of rods in the core drill at each core run.

As the gyroscope 34 will only need to track changes in the orientation of the tool 10 after drilling has stopped, the need to track changes during the descent of the tool down the hole and during drilling is avoided. This substantially reduces the running time of the gyroscope therefore reducing the drift that may occur. It also obviates the need for the gyroscope to track changes in high vibration periods during drilling thus avoiding a significant loss of accuracy.

In the above embodiment, the tool 10 is used as a stand alone tool to obtain orientation data. In order to extract the data and relate the data to a core sample held within the core tube 12, the tool 10 may be used in conjunction with a core orientation system of the type described in Applicant's International application No. WO 2007/137356. In brief, the core orientation system in the abovereferenced publication comprises a combination of:

an electronic orientation device which may have some features common to the current device 10;

a core position indicator adapted for engagement with the core tube 12 when on the ground; and,

a remote unit such as a hand-held computer that communicates between the tool 10 and the core position indicator.

In short, the transceiver 28 in the tool 10 communicates via wireless communication with the hand-held computer which in turn transfers data to the core position indicator. More particularly, the tool 10 logs orientation data of a reference point on the core tube 12

relative to a first datum at the time the particular downhole event has occurred, ie, at or shortly before a core break. The reference point on the core tube need not be a physical marking. Once the core tube 12 is retrieved and placed in a stable position say on a core tray, the tool 10 is again operated to log orientation data of the same reference point on the core tube to a second datum. A rotational displacement σ from the first datum to the second datum is calculated by the hand-held computer and wirelessly communicated to the core position indicator. The core position indicator is then rotated about the core tube 12. When the core position indicator is moved to a position where it is rotated by the appropriate rotational displacement σ from the second datum, it emits a signal to indicate the position of the first datum.

The core position indicator also includes a guide in the form of a slat having an elongated slot for receiving a scribing or marking device such as a pencil. The forward most end of the slat extends over the front of a core lifter case 36 and a portion of the core extending from the core lifter case. The marker is then used to mark the core lifter case and/or core to signify the location of the core relative to the particular datum.

The core position indicator may be modified over and above that described in the above referenced application by the inclusion of a sensor to sense when a marker has been run along the slot to signify that a marking has been made on the core lifter case and/or core. The core position indicator and the hand-held computer can record how accurately an operator marks the core by comparing its position when marked to its required position. This accuracy of marking information can then be transferred back to the hand-held computer and integrated with the original orientation information. The information contained in the hand-held computer is transferable to a

removal medium so that all the information can be provided to the recipient of the core.

Alternately, the core position indicator may be arranged so as to prevent a user from marking the core until the core position indicator is correctly orientated. This may be achieved for example by having a moveable gate that slides across the slot to block the slot when the core position orientator is not in the correct orientation.

In one variation the trigger system may be modified to provide trigger signals on based on one or both of (a) one or more downhole events, and (b) effluxion of time.

The time triggers may comprise one or a combination of:

(a) a single trigger at a specified delay time relative to a time the device was initialized by an operator or triggered by a physical event;

(b) multiple continuous triggers at preset intervals commencing at a specified delay time relative to a time the device was initialized by an operator or triggered by a physical event and from which one or more data sets are selected.

The trigger system 24 may trigger the sensors in the module 26 to record one, or a combination of readings of orientation at a point/points in time:

(a) exactly when the trigger occurs;

(b) after some time delay;

(c) prior to the trigger by selecting a pre recorded reading where multiple readings are taken at predetermined intervals.

The trigger system 24 may cyclically provide trigger signals for a prescribe period of time after the first trigger is provided. For example trigger signals may be

provided every 10 seconds for a two minute period. Alternately, the electronic orientation device 20 may be arranged so that upon receiving a trigger signal, it logs the one or more first directional characteristics cyclically for a prescribed period of time, for example every 10 seconds for a 2 minute period.

Figures 3-6 illustrate various core orientation apparatuses 100 which comprise a combination of the core orientation tool 10 together with one or more secondary orientation devices. As described in greater detail below, one of the secondary orientation devices may be a core face orientation device which records the *in situ* orientation of the face of the core. Another secondary orientation device that may be incorporated into the apparatuses 100 is a bottom orientator which records the location of a zero gravity vector at the toe of the hole provided that the hole is inclined to the vertical. The secondary orientation devices may be mechanical or electronic.

In the embodiment of the apparatus 100 shown in Figure 3, the trigger system 26 is depicted as being contained in the common housing 22 with the remainder of the electronic system 20. However this need not be the case and the trigger system 26 may be physically separate from the tool 100 but in communication remainder of the electronic system 20 (for example by radio communication) to allow delivery of the trigger signals.

The trigger system 24 may provide trigger signals based on the same downhole events described in relation to the first embodiment.

This embodiment of the apparatus 100 comprises: a secondary orientation device which provides core face orientation and is in the form of a profile device 120;

and, body 122 having a downhole end 124 and an uphole end 126. The body 122 comprises a lock body 127, a latch body 128 and an anchor 130, which are described in detail hereinafter with reference to the embodiment shown in Figures 5 and 6. In the embodiment of Figure 3, the electronic orientation device 20 is located downhole of the body 122.

The device 120 may take the form of the face orientator as described in Applicant's above referenced International publication No. WO 07/109848. The device 120 comprises a substantially cylindrical body 132 having a plurality of internal axially extending holes 134 for seating respective pins 136. The pins 136 are held within the holes 134 with a degree of resilience so that if an axial force is placed on the pins 136 in the uphole direction, the pins 136 can slide within the body 132, but when the force is removed, the pins 136 maintain their relative position in their holes 134. The body 132 is also provided with a bearing scale 138 marked on its outer circumferential surface 140. The scale provides markings in five degree increments from 0° to 360°. The 0° mark is aligned with a positional reference mark 142 provided at a downhole end of a shaft 144 that extends into the electronic orientation device 20.

The mark 142 also provides a zero reference for the electronic orientation device 20 so that by coupling of the device 120 to the electronic device 20 both are keyed to the same zero reference.
The face orientator 120 provides a profile recording of a toe of the hole from which a core 112 is cut. It will be understood by those skilled in the art that the toe of the hole becomes an uphole face of the core 112. Typically the device 120 is constructed as a single use device that, upon extraction of the core, is removed from the apparatus 100 and is stored with the core 112. Prior to this

occurring, the scale 138 is marked with an angle denoting the orientation of the core relative to the zero degree mark on the scale 138. This marking may be obtained by transferring data from the electronic device 20 to the device 120 by an intervening hand held telemetry device (hand held computer) that interrogates the device 20 to obtain for example the tool face orientation data at the time the trigger signal is provided by the triggering system 26. This will provide for example a bearing in degrees referenced to the reference mark 142. This bearing can then be physically marked on the scale 138. For example if the tool face orientation was 35° relative to the marking 142, then an indelible mark can then be made on the 35° position on the scale 138.

Figure 4 illustrates a further embodiment of the apparatus 100. In this figure the features which are identical to those described with reference to Figure 3 are denoted by the same reference numbers. The substantive difference between the apparatus 100 shown in Figure 4 and that shown in Figure 3 is that the tool 10 in Figure 4 is located at the uphole end 126 of the body 122 and, an additional secondary orientation device in the form of a mechanical bottom orientator 146 is coupled between the downhole end 124 of the body 122 and the core face profile device 120. The bottom orientator 146 is provided with three balls 148a, 148b and 148c (hereinafter referred to in general as "balls 148") disposed within respective races 150a, 150b, and 150c (hereinafter referred to in general as "races 150"). Prior to the bottom orientator 146 being activated the balls 148 are free to roll within their respective races 150. Accordingly, by action of gravity, provided that the apparatus 100 is disposed in a borehole that is not absolutely vertical, the balls 148 will roll to the lowest point within their respective races. When the bottom orientator 146 is activated, the width of the races 150 is reduced so that the balls 148 are clamped in their

races. This prevents any further rolling of the balls and thus maintains the indication of the bottom of the hole.

The bottom orientator 146 is operated by the apparatus 100, and in particular the core face profile device 120, tagging the bottom of the borehole. The operation of the bottom orientator 146, the latch body 128 and the anchor 130 are described in detail in Applicant's above referenced applications WO 03/038232 and WO 2005/078232. Nevertheless a brief description of the operation of these components is provided below with particular reference to Figures 4 and 5.

A shaft 152, which is provided with the key mark 142, extends axially through the races 150 and up into the lock housing 127 and latch body 128. The device 120 is coupled to a downhole end of the shaft 152. The lock housing 127 includes a tubular extension 156 which has seats 157 on its outer surface for respective latches 158 that are pivotally coupled to the latch body 128 and can extend through windows 160 formed in the latch body 128. A shroud 159 is attached to a downhole end of the lock housing 127 and covers the bottom orientator 146. A recess 161 is also formed in the lock housing 127 between the seats 157 and the shroud 159. A pretensioned spring 162 is disposed about an upper end of the shaft 152 within the extension 156 and biases the shaft to in an uphole direction. A further spring 164 is held in a cavity between the latch body 128 and the extension 156 and acts to bias the extension 156 and thus the lock housing 127 in a downhole direction.

Another spring 166 acts between the latch body 128 and an anchor sleeve 168 of the anchor 130 biasing the sleeve 168 toward a shoulder 170 formed about an anchor body 172 of the anchor 130. A plurality of anchor balls 174 are retained within the anchor sleeve 168. The anchor balls

174 roll along an outer surface 176 of the anchor body 172. When the anchor sleeve 168 is butted against the shoulder 170 by the spring 166, the balls 174 extend radially beyond the anchor sleeve 168. In this position, the anchor balls 168 are held on a constant outer diameter portion 178 of the anchor body 172.

Moving in a downhole direction from the portion 176 the outer circumference of the outer body 172 is formed with a tapered portion 180 that leads to a circumferential recess 182. The anchor body 172 also has, at its down downhole end, a portion 184 of a first constant inner diameter, then a contiguous tapered portion 186 that has an increasing inner diameter, and which then leads to a further portion 188 having a constant inner diameter greater than the inner diameter of the portion 184.

A trigger seat 190 is attached to a uphole end of the shaft 152 and a plurality of trigger balls 192 are each seated partially in a circumferential groove 194 formed in the trigger seat 190 and in holes 196 formed in an uphole end of the extension 156.

The apparatus 100 is loaded into a downhole end of a core tube 12 by first inserting the end provided with the tool 10. Eventually the latch dogs 158 abut a downhole end of the core tube 12 preventing further insertion of a tool 100. During the insertion, the anchor body 168 slides axially away from the shoulder 170 so that the anchor balls 174 roll along the tapered portion 180 and thus move radially inward. Once insertion of the apparatus 100 has been ceased by abutment of the latches 158 with the downhole end of the core tube, the spring 166 pushes the sleeve 168 in a uphole direction causing the anchor balls 174 to commence to ride up the tapered length 180 to a position where they extend radially outward from the sleeve 168 to an extent where they bear against an inner

surface of the core tube 12. This effectively locks the apparatus 100 to the core tube 12 preventing it from falling out. The core tube 12 is then lowered into a core drill 193 via a conventional backend and wire line or other insertion method, with the core drill being suspended above the toe of the borehole. With the core tube correctly seated within the core drill, the core face profile device 120 extends from the shroud 159 and a drill bit 195 coupled to á downhole end of the core drill 193. During this time, the orientation balls 148 are free to roll within their races 150.

The core drill is then lowered onto the toe of the hole resulting in the pins 136 sliding axially within the cylindrical body 132 to provide a profile of the toe of the hole.

As the core drill is further lowered, prior to the commencement of drilling, an end of the shroud 59 will eventually be brought into contact with the toe of the hole. Now, further lowering of the core drill results in the extension 156 sliding axially inward relative to the latch body 128 in a uphole direction compressing the spring 164. Eventually, the trigger balls 192 will roll outwardly along the tapered portion 186 to the portion 188 of the anchor body 172. When this occurs, the trigger balls 192 are able to move outwards in a radial direction and disengage from the groove 194 in the trigger seat 190. This releases the spring 162 allowing it to push the trigger seat 190 and thus the shaft 152 in an uphole direction relative to the extension 156. This results in a clamping of the orientation balls 148 within their races 150.

Continued lowering of the core drill onto the toe of the hole results in the seats 157 sliding from under the latches 158 so that the recess 161 underlies the latches

58. The latches 158 are now free to rotate inwardly thereby disengaging the apparatus 100 from the downhole end of the core tube 12.

The axial motion of the shaft 152 may be used to activate a switch such as, but not limited to, a microswitch, a Hall Effect switch, an optical switch or a pressure switch, which may be considered as forming part of the trigger system, to provide a trigger signal for the electronic orientation device 20. The electronic orientation device 20 can then log data relating to the orientation of a tool 10, the borehole in which it resides, and/or the core 112. The logging of information by the electronic device 20 may occur at a predetermined frequency for a predetermined period of time. For example the electronic orientation device/system 20 may log orientation data every 10 seconds for a two minute period after receipt of the initial trigger signal.

The electronic orientation device 20 may be arranged so that the logging of indications of orientation occur only when trigger signals are received from both motion of shaft 152 and at least one other sensor or transducer of the trigger system 24.

The indication of orientation provided by the core face profile device 120 and bottom orientator 146 can be transferred to the core 112 in a manner described in Applicant's above referenced Australian patent application no. 2006901550 using template 198 as depicted in Figure 7. Template 198 comprises a pair of parallel lines 200 for location on opposites sides of the orientation balls 148, and a pointer line 202 that extends parallel with an centrally between the tram lines 200. An elongated slot 204 is cut in the template 198 and has one edge 206 in alignment with the pointer line 202. The slot 204 extends over the scale 138 on the body 132 as well as over a

portion of the core sample 112. An operator can use a marker such as a pen or pencil to draw line segments 208a along the edge 206 from the body 132 across the scale 138 and 208b along the core 112. Indication of orientation logged by the electronic orientation device 20 may be obtained and marked on the core 112 in the same manner as described in Applicant's above referenced Australian application no. 2006902873.

The provision of both the tool 10 and the mechanical orientation device 146, as depicted in Fig.4, also enables auditing of the apparatus 100 to provide a degree of confidence in the orientation data obtained therefrom. This arises because embodiments where there is both the electronic orientation device 20 and one or more mechanical orientation devices 146, a comparison can be made between the same indications of orientation obtained from each of the devices. For example if bottom of hole indications provided by the separate devices are within a acceptable tolerance range (e.g. up to 5°) a high degree of confidence is provided that each of the devices 20 and 146 is providing reliable indications of orientation. However, if the devices give indications that differ more than an acceptable range, potential errors can be flagged on site to enable corrective action.

The combination of the core tube 12 and the core orientation tool 10 forming the apparatuses shown in Figures 3-6 comprise what is believed to be a unique core retrieval system in that the electronic orientation device 20 is, at least at the time of deployment, located at a downhole or front end of the core tube 12. More particularly, as will be appreciated from the above description, the apparatus 100 being at the front or down hole end of the core tube 12 is physically close to the core sample 112 at the time, or one of the times, at which the electronic orientation device 14 logs orientation data

of the tool 100. It is believed that this may give rise to higher accuracy in the orientation data recorded than other systems in which electronic orientation devices are located at a backend of the inner core tube, i.e. between an uphole end of the inner core tube and an overshot. In this regard, inner core tubes typically come in lengths of three or six metres.

It is envisaged that various embodiments of the tool 10 may perform self checks and provide users with information regarding the status of the tool 10. Status messages may include one or a combination of low battery power, communications error, system faults. The tool 10 may also collect and process data so as to provide users with a measure of the accuracy and reliability of the recorded orientation data. The data collected by the tool 10 to provide orientation information may be analysed using statistical measures of its accuracy. Log data may be analysed to identify the presence of any movement during the logging of orientation data. The direction of motion may also be determined and provided to a user. These self checks may be beneficial to identify surface requirements. In particular the indication of movement during logging may be beneficial in identifying improper operation of the tool 10 and thus flag the need for training or retraining of operators.

For example one can analyze data from the sensors to determine whether the core drill was rotating and/ subject to excessive vibration at the time of a core break. Such events, particularly the rotation, will decrease the reliability of the orientation data. The tool 10 would typically comprise three accelerometers to provide acceleration data about the X, Y and Z axes respectively. Rotation of the core drill at the time of the core break would be indicated by readings from these accelerometers.

More particularly the tool 10 may provide the operator with information regarding the proper operation of its components parts and systems. If a component or system fails the tool 10 could report the failure to the operator via the handheld control unit. If the failure occurs or is detected while the tool 10 is down a bore hole it can be reported to the operator via the handheld control unit ounce the tool has been recovered to the surface.

Further to the above operation the tool 10 could also be capable of performing a complete self check that verifies the correct operation of the entire system. This self diagnostics could be run on demand by an operator or automatically when the operator is preparing the tool for a core run (being run down a bore-hole to perform its function). In this way a faulty tool would not be used for a core run and result in a failed orientation.

The tool 10 may also be able to provide information to the operator regarding the certainty of a provided orientation measure. The certainty of a orientation measure can be determined by analysing the tools sensor input before during and after the orientation measure is made. When analysed the sensor data may reveal that there was an unwanted environmental condition present when the orientation measure was made. The unwanted environmental condition could be motion in the form of a linear movement, rotation or vibration. It could also be some other environmental condition such as a high or low temperature. The results of the analyses could be reported to the operator in one or a combination of the following ways:

1. By providing an indication of the source of unwanted environmental condition.

2. By associating the unwanted environmental condition to a known down-hole event that should not have occurred and providing the event to the operator.

3. By providing a calculated measure of the orientations certainty from the analysed sensor data. For example a scale of 1 to 5 could be employed where 1 is a certain orientation and 5 is a very uncertain orientation (failed). The certainty of orientations could then be provided using this scale.

The information provided by the tool in the above ways will be useful in identifying procedural errors made by the operators of the tool. For example if the core drill was spinning when the orientation was measured the tool 10 would report that the orientation is uncertain because rotation was detected during the orientation. It could also report that the likely cause of the rotation was that the core drill was spinning. In future the operator will know to ensure that the core drill is not spinning when the orientation is being measured. Similarly if the core drill was being raised or lowered when the orientation was measured the tool 10 could provide a relevant report to the operator.

By providing feedback regarding device faults and the certainty of the orientations when something goes wrong the operator will be fully informed as to the cause. Thus operator error can be discerned from tool failure/error. These reports can also be made available to supervisors or managers via the hand held control device or when the data is exported to an external memory device or laptop to assist them in maintaining equipment or attending to training issues.

Now that various embodiments of the present invention have been described in detail it will be apparent to those skilled in the relevant arts that numerous modifications and variations may be made without departing from the basic inventive concepts. For example, a mechanical orientation device 146 is described which utilises three orientation balls 148. However in an alternate variation,

this orientation device may comprise only a single orientation ball. In addition or alternately, the mechanical orientation device may include a washer that is indented with a mark representative of the location of the bottom of the hole such as described in Applicant's international publication no. WO 03/038232. Embodiments of the invention may also include in addition or as an alternate to the mechanical orientator 146 a mechanical inclinometer an example of which is described in Applicant's above referenced international publication no. WO 03/038232.

As an alternative to the Van Ruth (ie pin type) face orientator 120, core face orientation may be obtained by other devices including, marker pencils and scribes, optical or electromagnetic imaging and distance measuring devices. The logging of azimuth can be achieved using any known electronic system when measured by the electronic orientation device 20, or any known mechanical system when measured by a mechanical orientation device 146. These include for example the use of magnetometers to sense magnetic direction when used in conjunction with non-magnetic drilling equipment or if attached in a position outside the drill string to avoid magnetic interference. Azimuth may also be recorded using gyroscope type sensors to measure inertial change in position from a known reference point; or by use of a gyrocompass or north seeking gyroscope type sensor.

All such modifications and variations together with others that would be obvious to a person of ordinary skill in the art are deemed to be within the scope of the present invention the nature of which is to be determined from the above description, and the appended claims.

The claims defining the invention are as follows:

1. A core orientation tool for providing an indication of *in situ* orientation of a core sample extracted from a borehole by a core drill the tool comprising:

an electronic orientation system coupled with the core drill, the electronic orientation system configured, upon receiving a trigger signal, to log one or more first indications of orientation of the tool; and,

a trigger system that provides the trigger signal upon detecting one or more downhole events associated with operation of the core drill.

2. A core orientation tool for providing an indication of *in situ* orientation of a core sample extracted from a borehole by a core drill the tool comprising:

an electronic orientation system coupled with the core drill, the electronic orientation system configured, upon receiving a trigger signal, to log one or more first indications of orientation of the tool; and,
a trigger system that provides the trigger signal upon one or both of (a) detecting one or more downhole events associated with operation of the core drill, and (b) effluxion of time.

3. A core orientation tool for providing an indication of *in situ* orientation of a core sample extracted from a borehole by a core drill the tool comprising:

an electronic orientation system coupled with the core drill, the electronic orientation system configured to log one or more first indications of orientation of the tool; and,

a trigger system that provides a trigger signal upon detecting one or more downhole events associated with operation of the core drill; and,
wherein tool is configured to associate the one or more first indications of orientation with the trigger signal.

4. The core orientation tool according to any one of claims 1-3 wherein trigger signal is one of a plurality of trigger signals provided by the trigger system.

5. The core orientation tool according to claim 4 wherein the tool is configured to log different first indications of orientation upon receipt of different trigger signals.

6. The tool according to any one of claims 1-5 wherein the one or more downhole events comprise respective physical events arising from motion of the tool or the drill in the borehole.

7. The tool according to claim 6 wherein the motion comprise one or a combination of:

(a) motion in an uphole direction;

(b) a change in motion from motion having a linear component in a downhole direction to motion having no linear component;

(c) a change in motion from motion in a downhole direction to motion in an uphole direction;

(d) a change in motion from no linear motion to motion in an uphole direction;

(e) a change in characteristics of vibration motion on the tool or drill arising from the cessation or commencement of drilling;

(f) a change in speed of linear motion of the tool;

(g) any change in velocity (speed and/or direction of movement); and,

(h) a change in the rate or direction of rotation around the tool's longitudinal, lateral or normal axis.

8. The tool according to any one of claims 1-7 wherein the trigger system is configured to provide the trigger signal upon detecting a predetermined event or sequence of downhole events.

9. The tool according to claim 8 wherein the sequence of downhole events comprise a cessation of drilling followed by motion of the tool in an uphole direction.

10. The tool according to claim 9 wherein the sequence of downhole events further comprise commencement of drilling prior to the cessation of drilling.

11. The tool according to claim 10 wherein the sequence of downhole events further comprise one or more of:

(a) detecting contact of a backend assembly to which the tool is coupled hitting a landing ring in the core drill;

(b) detecting the backend assembly hitting a water table in a drilling operation where the drill is operated in the borehole below the water table;

(c) detecting release of the backend assembly from a wire line when initially inserting a core tube into the core drill;

(d) detecting the tool or core drill tagging a toe of the bore hole;

(e) an overshot hitting and latching onto the backend assembly;

(f) retrieval of the backend assembly from the drill hole; and,

(g) a change in the flow of fluid through or around the backend assembly.

12. The tool according to any one of claims 1-11 wherein the electronic orientation system further comprises an electronic azimuth measuring device, wherein the electronic azimuth measuring device operates to log azimuth upon receiving the trigger signal.

13. The tool according to claim 12 wherein the electronic azimuth measuring device is configured to operate in an idle state prior to receipt of the trigger signal.

14. The tool according to claim 13 wherein the electronic azimuth measuring device comprises an electronic gyroscope.

15. A core retrieval system for a core drill comprising:

a core tube having an uphole end and a downhole end, the downhole end provided with an opening for receiving a core sample cut by the core drill; and,

a core orientation tool in accordance with any one of claims 1-14, wherein the core orientation tool is coupled to the core tube at a location uphole of the downhole end of the core tube.

16. The core retrieval system according to claim 15 further comprising a backend assembly coupled to the uphole end of the core tube and wherein the core orientation tool is attached to the backend assembly uphole of the uphole end of the core tube.

17. A method of logging *in situ* orientation of a core sample extracted from the ground by a core drill comprising:

coupling an electronic core orientation device in a known spatial relationship to a core sample cut by the core drill;

configuring the electronic core orientation device to log one or more indications of orientation of the device upon receipt of a trigger signal; and,

providing the trigger signal upon detecting one or more downhole events associated with the operation of the core drill.

18. The method according to claim 17 wherein the downhole events are indicative of a, or an imminent, core break.

19. The method according to claim 17 or 18 wherein detecting of the one or more downhole events comprises detecting an uphole motion of the device.

20. The method according to claim 19 wherein the detecting of the downhole event comprises detecting a cessation of

drilling prior to detecting the uphole motion of the device.

21. The method according to claim 20 wherein the detecting further comprises detecting commencement of drilling prior to detecting cessation of drilling.

22. The method according to claim 21 wherein the detecting comprise detecting a cessation of downhole movement of the device prior to detecting the commencement of drilling.

23. The method according to any one of claims 17- 22 wherein the configuring comprises configuring the electronic core orientation device to determine azimuth.

24. The method according to claim 23 further comprising withdrawing the tool after the trigger system provides the trigger system and operating the electronic core orientation device to track changes in orientation until the tool reaches a collar of the borehole.

25. A core orientation apparatus for providing an indication of orientation of a core sample extracted from a borehole by a core drill the apparatus comprising:

a core orientation tool according to any one of claims 1-14 and,

one or more secondary orientation devices which provide one or more second indications of orientation of the core or borehole, wherein the electronic orientation device is in a known rotational position relative to the one or more secondary orientation devices.

26. The apparatus according to claim 25 wherein the secondary devices comprise one or both of (a) a core face orientation device which records orientation of an uphole face of a core sample; and (b) a bottom of hole recording device.

27. The apparatus according to claim 25 or 26, wherein the tool comprises a body having a downhole end and an uphole end, wherein a the one or more secondary orientation devices are located downhole of the body and the electronic orientation device is located between the secondary orientation devices and the downhole end of the body.

28. The apparatus according to claim 25 or 26, wherein the tool comprises a body having a downhole end and an uphole end, wherein the one or more secondary orientation devices are located downhole of the body and the electronic orientation device is located uphole of the body.

29. The apparatus according to claim 27 or 28, wherein the body is provided with a positional reference for the first and second indications of orientation, and one or more keys for keying the electronic orientation device and the one or more secondary orientation devices to the position reference.

30. A core retrieval system for a core drill comprising:

an inner core tube having an uphole end and an opposite downhole end provided with an opening for receiving a core cut by the core drill; and,

a core orientation tool coupled to the inner core barrel and movable inside the inner core tube in an uphole direction by abutment with the core, wherein the core orientation tool accords with any one of claims 1-14.

31. The core orientation tool according to any one of claims 1-14 wherein the tool is configured to analyse outputs from sensors and transducers in the trigger system that detect the downhole events, to verify correct operation of the tool.

32. The core orientation tool according to claim 31

wherein the tool is configured to analyse outputs from sensors and transducers in the trigger system that detect the downhole events to verify that the core drill was stationary when a core break operation was performed.

33. The method according to any one of claims 17-24 comprising analyzing outputs from sensors and transducers in the trigger system that detect the downhole events, to verify correct operation of the tool.

34. The method according to claim 33 wherein the analyzing comprises analyzing the outputs to verify the core drill was stationary at when a core break operation occurred.

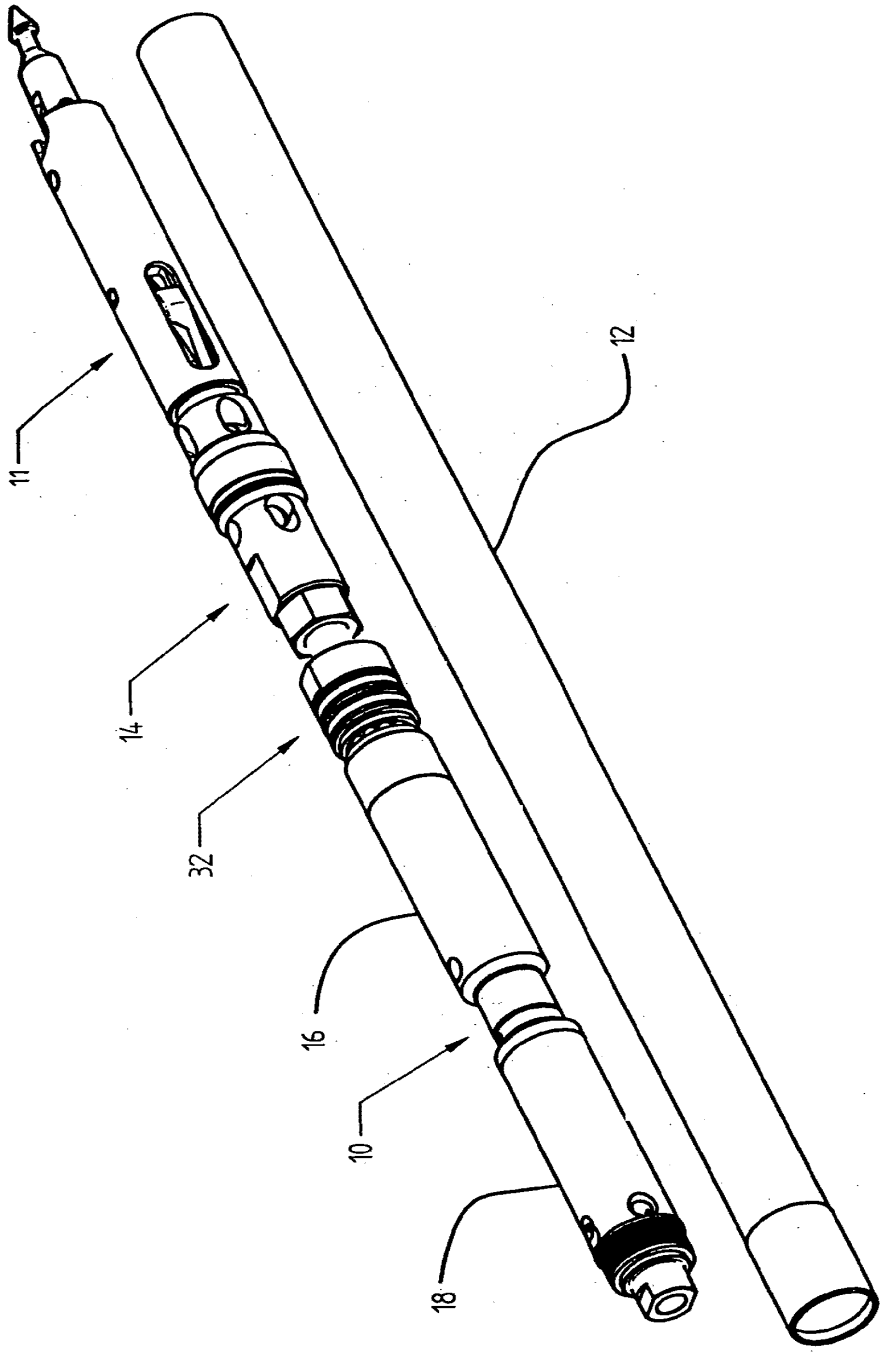


Figure 1

Figure 2

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Reflex USA LLC v. Longyear TM, Inc. and Globaltech Corporation Pty Ltd.

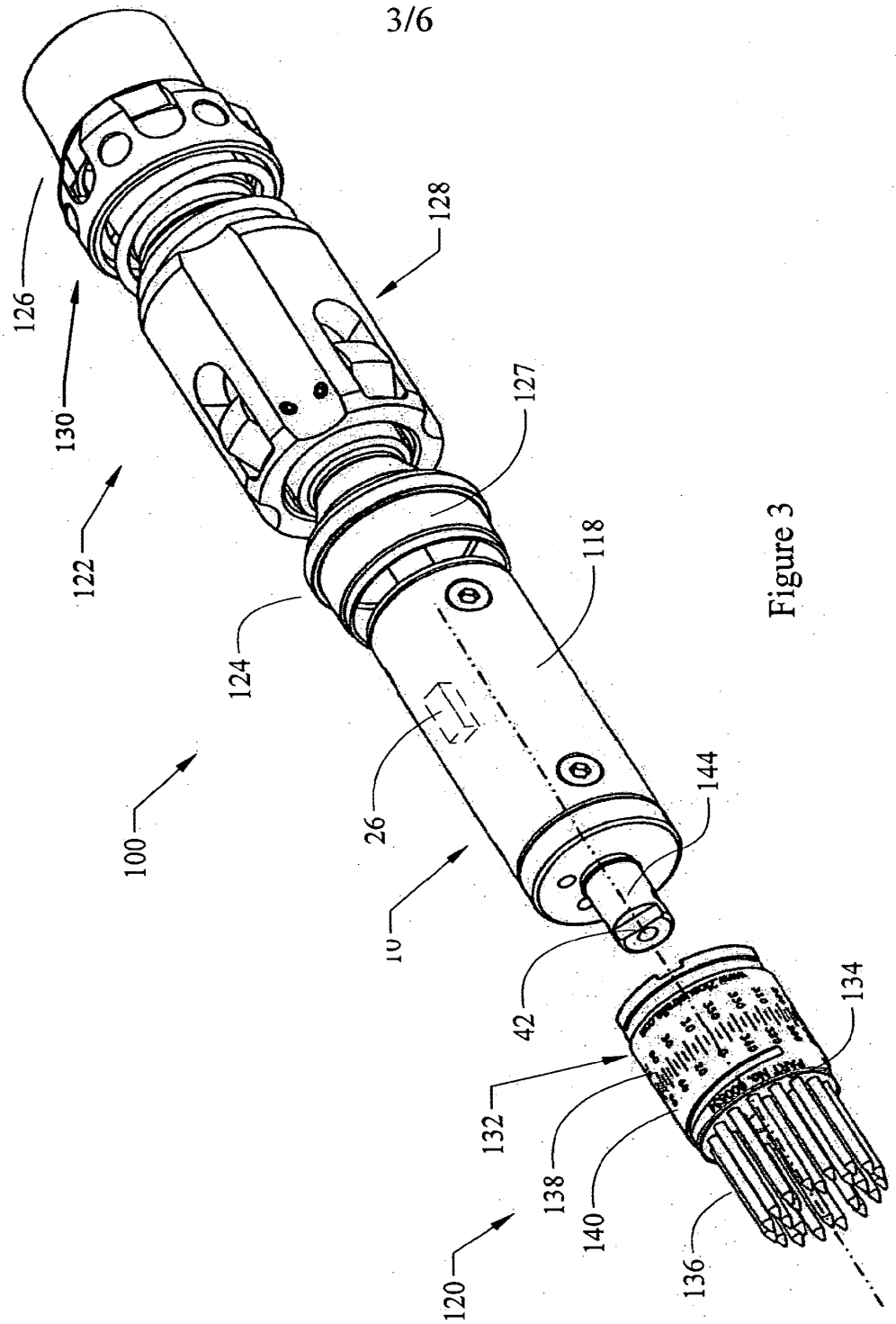

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120

Figure 3

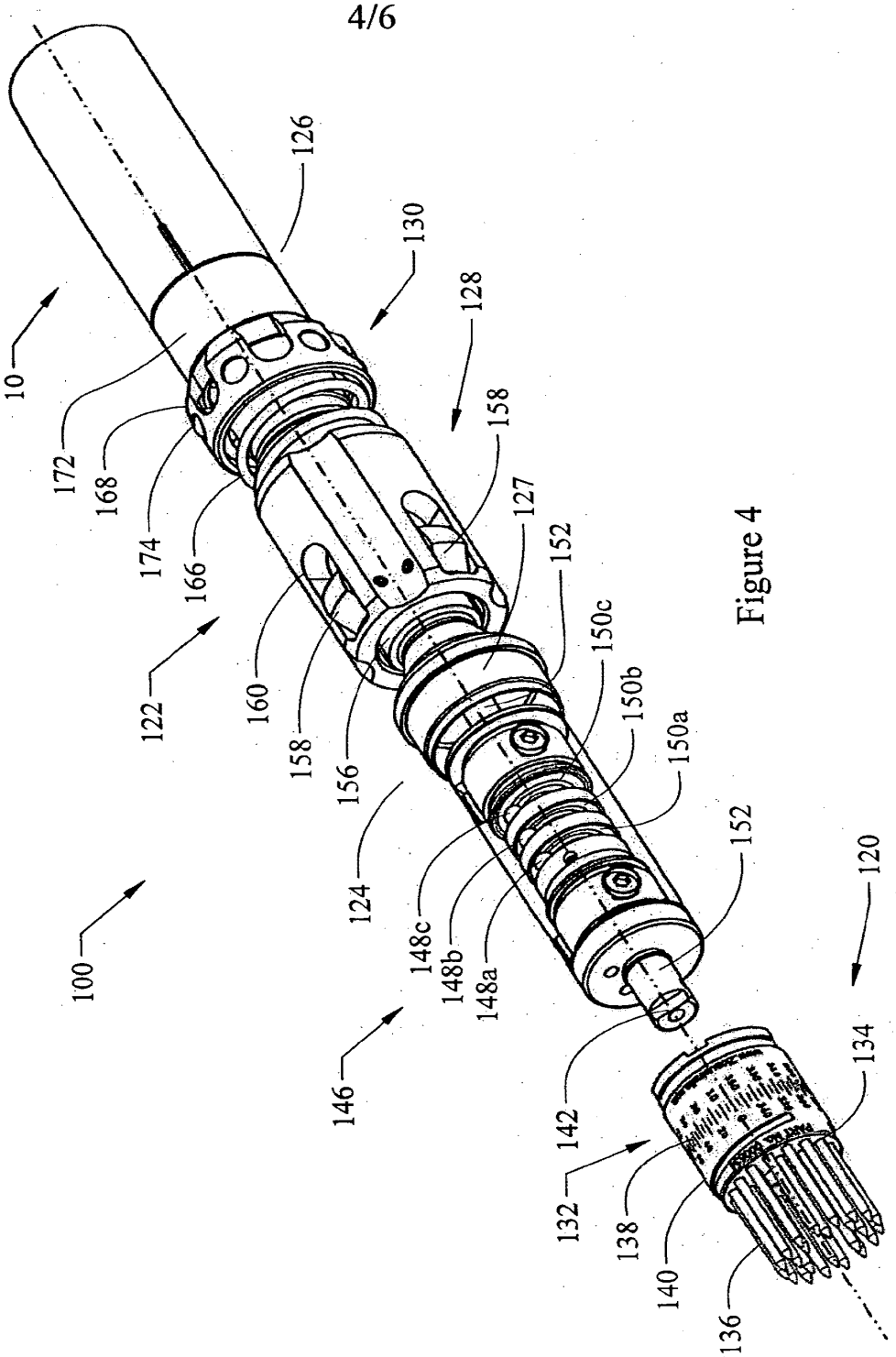

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150a
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126

Figure 4

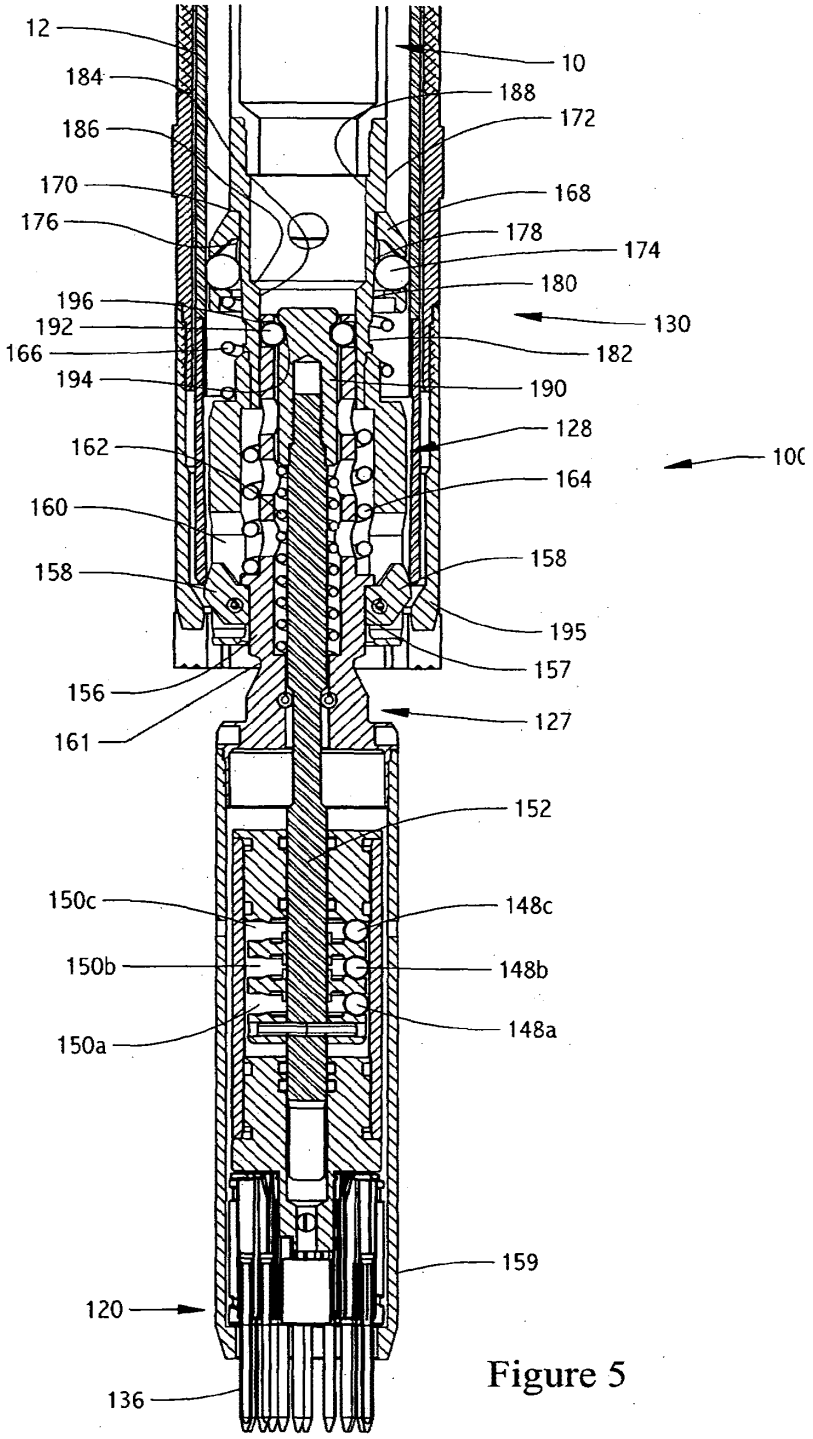

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Figure 5

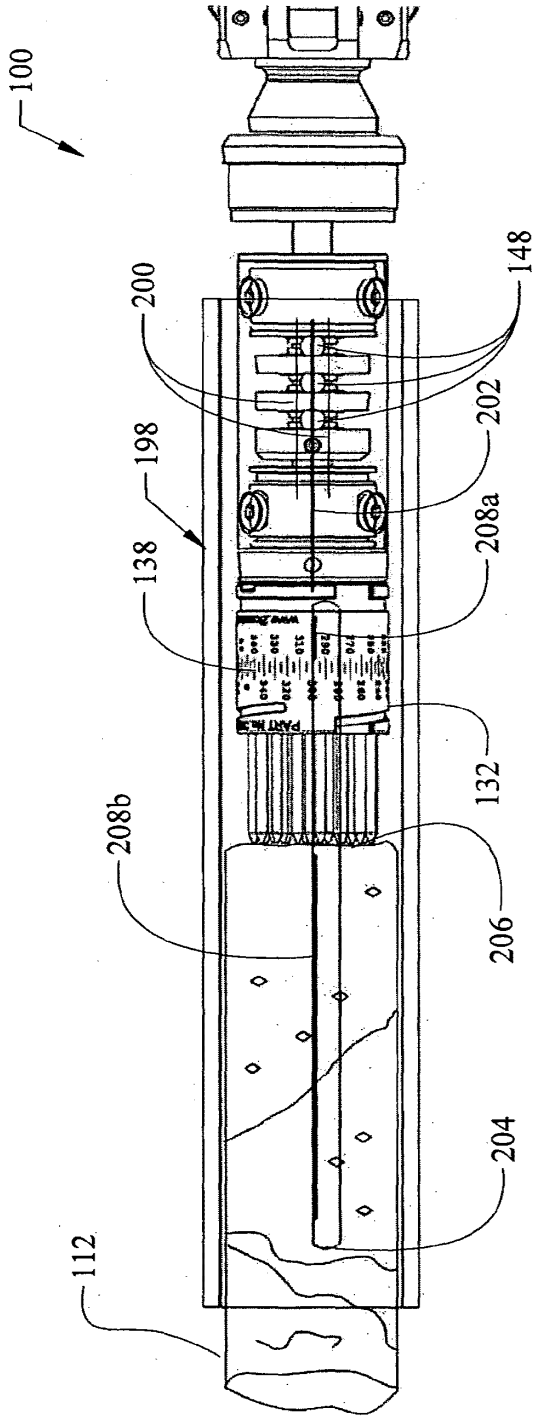


Figure 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2008/000395

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. ***E21B 25/16*** (2006.01) ***E21B 49/02*** (2006.01)

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Dwpi: E21B 25/16, 49/02 with keywords (trigger+, sens+, signal+, azimuth+, gyroscop+, generat+, activate+, detect+, electronic+)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2006/024111 A1 (AUSTRALIAN MUD COMPANY LTD) 9 March 2006 Page 10, line 18 – page 24, line 25	1-10, 12-25, 30 and 31-34
X	WO 2006/058377 A1 (CORETRACK PTY LTD) 8 June 2006 Page 3, line 9 – page 5, line 15; claims 1-9 and Figures 1-4	1-10, 12-25, 30 and 31-34
X	Derwent Abstract Accession No. 97-242837/22, Class X25, JP 09078975 A (NIPPON SHINKO KK) 25 March 1997	1-10, 12-25, 30 and 31-34
A	US 6006844 (PUYMBROECK et al) 28 December 1999 The whole document	1-34

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

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

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
05 May 2008	17 MAY 2008
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. +61 2 6283 7999	Authorized officer **LEOPOLD FILIPOVIC** AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : (02) 6283 2105

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2008/000395

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CA 2456506 A1 (SCOTT) 3 January 2005 The whole document	1-34
A	WO 2005/085584 A1 (2iC AUSTRALIA PTY LTD) 15 September 2005 The whole document	1-34

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Reflex USA LLC v. Longyear TM, Inc. and Globaltech Corporation Pty Ltd.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU2008/000395

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
WO	2006024111	AU	2005256104	AU	2006100113	CA	2559030
		US	2007282533				
WO	2006058377	AU	2005312340	EP	1817480		
JP	9078975						
US	6006844	BE	1011414	CA	2158903	DE	19745947
		GB	2293395	GB	2318372	NO	953755
		NO	974786	US	5568838		
CA	2456506						
WO	2005085584	AU	2005219460	CA	2559085		

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
10 April 2014 (10.04.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/053012 A1

(51) International Patent Classification:
E21B 25/16 (2006.01)

(21) International Application Number:
PCT/AU2013/001126

(22) International Filing Date:
2 October 2013 (02.10.2013)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2012904354 5 October 2012 (05.10.2012) AU

(71) Applicant: **MINNOVARE PTY LTD** [AU/AU]; Enterprise Unit 3, 9 De Laeter Way, Technology Park, Bentley, Western Australia 6102 (AU).

(72) Inventors: **AYRIS, Michael Charles**; 70 Greary Street, Mundaring, Western Australia 6073 (AU). **MCCRACKEN, Thomas, Callum**; 8 Kennon Street, Willeton, Western Australia 6155 (AU).

(74) Agent: **LORD AND COMPANY**; PO Box 530, West Perth, Western Australia 6872 (AU).

(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, 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,

[Continued on next page]

WO 2014/053012 A1

(54) Title: CORE ORIENTATION APPARATUS

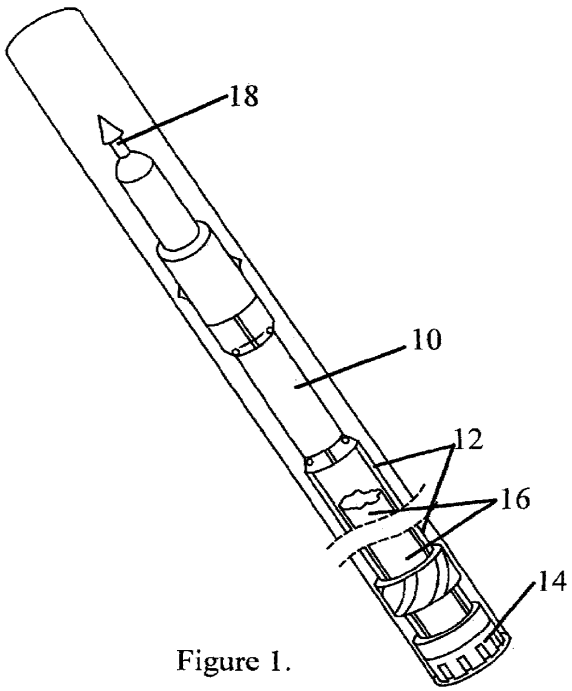


Figure 1.

(57) Abstract: Disclosed is a core sample orientation system for determining the relative orientation of a core sample with respect to its surrounding prior to removal from a bore hole. The system comprising an alignment device and a display device, the alignment device being arranged to engage with a core barrel, the alignment device comprising a protective shroud, at least one sensing means and control electronics, the sensing means comprising at least one set of mutually orthogonal gyroscopes, characterized in that the sensing means is capable of determining the relative orientation of the alignment device with respect to true north and the relative orientation of a core sample within the core barrel and the control electronics are configured to transmit relative orientation information to the display device.

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))*

TITLE

"CORE ORIENTATION APPARATUS"

Technical Field

[0001] The present invention relates to a core orientation apparatus.

Background Art

[0002] Core samples are obtained through core drilling operations. Core drilling is typically conducted with a core drill comprising inner and outer tube assemblies. A cutting head is backed up by a cylindrical core barrel that is pressed against the subject materials. The cutting head is then rotated at speed and constant pressure applied to cut out a core sample, a cylinder of the subject material for geological testing. The lengths of samples can range from less than a meter to around 100 meters in one run.

[0003] Once a core sample of sufficient length is generated, the core sample is broken away from the surrounding rock and then bought to the surface along with the core sample storage device so that it may be studied.

[0004] Typically core drilling operations are performed at an angle to the vertical and it is desirable to have an indication of the orientation of the core sample relative to the underground environment from which it was extracted.

[0005] It is a well known practice to mark the relative orientation of the core sample with respect to the low side of the drill hole via the use of a spear or a pencil, wherein the core is marked with a scribe that falls down the bore hole marking the low side of the core.

[0006] Once the core is removed this is then transcribed to the high side of the core sample. In this manner the 'high side' of the core is commonly marked so that the relative orientation of the core, relative to surface can be determined.

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[0007] As will be appreciated by those skilled in the art, determining the relative orientation of the core sample in respect to the gravity vector affords a geologist a better understanding of the formation of minerals in the drilling area. Other core orientation systems have been designed to increase the available information regarding the relative orientation of the core sample prior to breaking.

[0008] Whilst it is the aim of the drilling operation to produce a hole that is straight, it is common for deviations in the azimuth and pitch of the hole to occur. These deviations cause errors in the determination of the orientation of the core sample relative to its original environment.

[0009] Previous examples of core orientation devices have lacked the ability to determine the azimuth orientation of the core as it removed from the ground and therefore are unable to determine the true orientation of the core relative to its underground environment prior to it having been bought to the surface.

[0010] Previously two systems have been required to orientate the core and to determine the time orientation of the core; low side orientation and borehole deviation. Previous examples of core orientation devices have used MEMS systems to determine the azimuth orientation of the core. However, such devices are not autonomous and rely on a reference direction and measure inertia from one station to another. That is existing MEMS systems require at least two devices to determine a relative direction.

[0011] The present invention attempts to overcome at least in part the aforementioned disadvantages of previous core orientation apparatus.

Summary of the Invention

[0012] In accordance with one aspect of the present invention there is provided a core sample orientation system for determining the relative orientation of a core sample with respect to its surrounding prior to removal from a bore hole, the system comprising an alignment device and a display device, the alignment device being arranged to engage with a core barrel, the alignment device comprising a protective shroud, at least one

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sensing means and control electronics, the sensing means comprising at least one set of mutually orthogonal gyroscopes, characterized in that the sensing means is capable of determining the relative orientation of the alignment device with respect to true north and the relative orientation of a core sample within the core barrel and the control electronics are configured to transmit relative orientation information to the display device.

[0013] Preferably, the mutually orthogonal gyroscopes comprise micro-electronic mechanical systems (MEMS) gyroscopes.

[0014] More preferably, the mutually orthogonally opposed gyroscopes comprise a fibre-optic gyroscope.

[0015] Preferably, the alignment device is arranged to be attached to the core barrel whilst drilling is being undertaken.

[0016] More preferably, the alignment device is arranged as part of a spear to be dropped down the bore hole to engage a core barrel.

[0017] Alternatively, the alignment device is arranged to engage a core barrel after a core has been removed from the bore hole and the core barrel is being returned to the bore hole.

[0018] Preferably, the control electronics are configured to reduce or remove signal noise in the signals generated by the gyroscopes.

[0019] Preferably, the control electronics are configured to control pulse width modulation of the laser used in the fibre-optic gyroscope.

[0020] Preferably, the control electronics are configured to wirelessly transmit orientation information to the display device.

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[0021] Preferably, the control electronics are configured to transmit orientation information to a RFID scanning device, the scanning device being configured to write the orientation information to a RFID tag which is physically associated with the core sample.

[0022] Preferably, the RFID tag comprises a mark for indicating the relative orientation of the core sample to which it is attached.

Brief Description of Drawings

[0023] The present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is an alignment device in accordance with the present invention.

Best Mode for Carrying out the Invention

[0024] Referring to the Figures, there is shown a core orientation apparatus comprising an alignment device 10. The alignment device 10 is preferably arranged to engage with a core barrel 12. The alignment device 10 further comprises an outer casing of impact resistant material to protect the internal components of the alignment device 10. The alignment device 10 preferably comprises at least one set of mutually orthogonal gyroscopes.

[0025] The mutually orthogonal gyroscope are arranged to enable the alignment device 10 to determine the device's relative orientation to true north, thereby allowing the relative azimuth of the device to be determined. This allows the true orientation of the device relative to the drill hole to be determined as well as the relative angle of the device and the drill head to which it is attached.

[0026] Preferably, the mutually orthogonal aligned gyroscopes used in the alignment device 10 are Micro Electrical Mechanical System (MEMS) devices which are

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autonomously north seeking. Although MEMS devices are preferably used the alignment device 10 may use any suitable gyroscope such as a fibre-optic gyroscope (FOG).

[0027] The alignment device preferably comprises electrical control equipment to allow the alignment device to determine the true north bearing from its present location. MEMS based gyroscopes often suffer limitations due to the large amount of signal noise generated by their operation, with this noise effectively causing 'drift' in the readings generated. The control electronics are capable of running a proprietary algorithm which reduces the signal noise and 'drift'.

[0028] A surface computer is used to synchronise time between the alignment device and a computer. Depth can be manually entered into the surface computer or fed into the computer via a depth encoder device such as an optical depth encoder or non contact sensors.

[0029] Preferably, the alignment device further comprises a means of transmitting the orientation information such as via a wireless or Bluetooth connection. Alternatively, the alignment device may be connected to equipment on the surface via a cable which is disposed within the inner tube assemblies.

[0030] In use, as the drilling operation progresses a core sample is produced, it is gripped by a core barrel 12, with the alignment device 10 being arranged to engage the core barrel. Preferably, the alignment device 10 is located as far away from the cutting head 14 attached to the core barrel 12 as practicable.

[0031] Once a core sample of sufficient size is generated and gripped within the core barrel, the drilling assembly will be bought to rest and the alignment device 10 will determine the orientation of the drilling assembly relative to true north.

[0032] Core orientation as well as azimuth and dip readings may be taken at regular intervals as the core barrel is filled and prior to breaking off the core sample for retrieval to the surface.

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[0033] Once the orientation of the alignment device 10 and therefore the core sample 16 is determined, the core barrel 12 is bought to the surface by a spear engaging with a core barrel lifter 18 or overshot.

[0034] On the way to the surface it is possible for the core barrel 12 and alignment device 10 to be stopped at a number of points to allow the modelling of the drill hole and the actual path of travel of the drill hole.

[0035] Once at the surface, the core sample orientation information captured by the alignment device 10 prior to removal of the core sample 16 from the drill hole is used to allow the core to be rotated such that the orientation of the alignment device 10 relative to the low side of the drill hole is the same as when the alignment device 10 was in the drill hole. The core sample 16 may then be marked to demonstrate its relative orientation to the drill hole. The additional information relating to the core samples orientation is then passed into a computerised database for later use.

[0036] In accordance with another aspect of the present invention, the orientation data generated by the alignment device may be written to a Radio Frequency Identification (RFID) device and associated with the sample. The RFID device may be written to and read in a known manner, allowing the data associated with a specific sample to be read when required once the sample has moved away from the drill hole.

[0037] The actual orientation of the RFID tag may be used to mark or demonstrate the orientation of the core sample 16 in the ground. The RFID tag used may have a marking to indicate orientation relative to the ground when attached to an end portion of the core sample 16.

[0038] In accordance with an alternative embodiment of the present invention the alignment device 10 is accommodated within a protective shroud and is fed down the drill hole after the core barrel has been removed from the drilling assembly. Once the

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alignment device is in the distal portion of the drilling hole, it is allowed to rest and determine the orientation of the drill hole relative to true north.

[0039] Preferably, the orientation information generated by the alignment device 10 is then transmitted to the surface either through a cable which may also be the tether for the alignment device 10 or is transmitted wirelessly once the device 10 is at the surface of the drill hole.

[0040] In accordance with another preferred embodiment of the present invention, the alignment device 10 is arranged to comprise part of the spear or overshot, which is fed down the bore hole to retrieve the sample. Once the spear or overshot has engaged with the barrel, the alignment device 10 then determines the relative orientation of the core prior to removal.

[0041] Preferably, the orientation information generated by the alignment device 10 is then transmitted to the surface either through a cable which may also be the tether for the alignment device 10 or is transmitted wirelessly once the device 10 is at the surface of the drill hole.

[0042] Modifications and variations as would be apparent to a skilled addressee are deemed to be within the scope of the present invention.

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Claims

1. A core sample orientation system for determining the relative orientation of a core sample with respect to its surrounding prior to removal from a bore hole, the system comprising an alignment device and a display device, the alignment device being arranged to engage with a core barrel, the alignment device comprising a protective shroud, at least one sensing means and control electronics, the sensing means comprising at least one set of mutually orthogonal gyroscopes, characterized in that the sensing means is capable of determining the relative orientation of the alignment device with respect to true north and the relative orientation of a core sample within the core barrel and the control electronics are configured to transmit relative orientation information to the display device.

2. A core sample orientation system in accordance with claim 1, characterized in that the mutually orthogonally opposed gyroscopes comprise micro-electronic mechanical systems (MEMS) gyroscopes.

3. A core sample orientation system in accordance with claim 1, characterized in that the mutually orthogonally opposed gyroscopes comprise a fibre-optic gyroscope.

4. A core sample orientation system in accordance with any one of the preceding claims characterized in that alignment device is arranged to be attached to the core barrel whilst drilling is being undertaken.

5. A core sample orientation system in accordance with any one of the claims 1-3, characterized in that the alignment device is arranged as part of a spear to be dropped down the bore hole to engage a core barrel.

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Reflex USA LLC v. Longyear TM, Inc. and Globaltech Corporation Pty Ltd.

6. A core sample orientation system in accordance with any one of the claims 1-3, characterized in that the alignment device is arranged to engage a core barrel after a core has been removed from the bore hole and the core barrel is being returned to the bore hole.

7. A core sample orientation system in accordance with any one of the preceding claims characterized in that the control electronics are configured to reduce or remove signal noise in the signals generated by the gyroscopes.

8. A core sample orientation device in accordance with claim 3, characterized in that the control electronics are configured to control pulse width modulation of the laser used in the fibre-optic gyroscope.

9. A core sample orientation device in accordance with any one of the preceding claims, characterized in that the control electronics are configured to wirelessly transmit orientation information to the display device.

10. A core sample orientation device in accordance with any one of the preceding claims, characterized in that the control electronics are configured to transmit orientation information to a RFID scanning device, the scanning device being configured to write the orientation information to a RFID tag which is physically associated with the core sample.

11. A core sample orientation device in accordance with claim 10, characterized in that the RFID tag comprises a mark for indicating the relative orientation of the core sample to which it is attached.

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Reflex USA LLC v. Longyear TM, Inc. and Globaltech Corporation Pty Ltd.

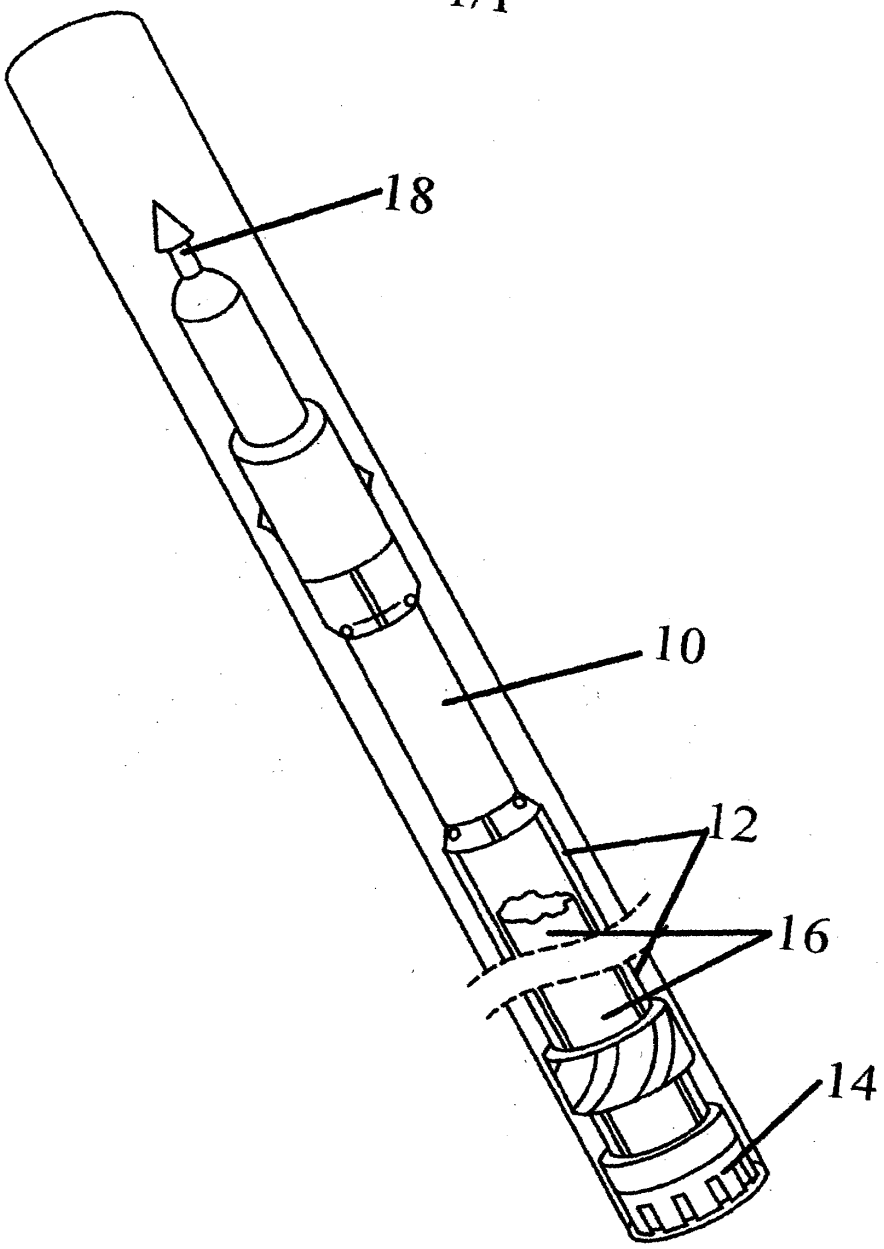


Figure 1.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2013/001126

A. CLASSIFICATION OF SUBJECT MATTER

E21B 25/16 (2006.01)

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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

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

EPODOC, WPI: IPC (E21B25/16, E21B47) & KEYWORDS: Gyroscope, Down Hole, Core, Rod, Pipe, String, Tube, Casing, Shaft, Orientate, Position, Steer, Direction, MEMS, Micro Electronic, Accelerometer, Drill, Bore and the like terms.

GOOGLE: Core Sample, Orientation

ESP@CENET: Cited and Citing most relevant documents, APPLICANT SEARCH: 2ic

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	

[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

* Special categories of cited documents:

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

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 November 2013	15 November 2013
Name and mailing address of the ISA/AU	**Authorised officer**
AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaustralia.gov.au Facsimile No.: +61 2 6283 7999	Matthew Batley AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. 0262832589

Form PCT/ISA/210 (fifth sheet) (July 2009)

INTERNATIONAL SEARCH REPORT C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		International application No. **PCT/AU2013/001126**
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2008/113127 A1 (2IC AUSTRALIA Pty Ltd.) 25 September 2008 Abstract, Pages 11, 12, 17, 18, fig 1.	1-11
A	WO 2012/012839 A1 (GLOBALTECH CORPORATION Pty Ltd.) 02 February 2012 Whole Document	1-11
A	WO 2010/094060 A1 (IMDEX TECHNOLOGY AUSTRALIA Pty Ltd.) 26 August 2010 Whole Document	1-11

Form PCT/ISA/210 (fifth sheet) (July 2009)

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/AU2013/001126**

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**
WO 2008/113127 A1	25 Sep 2008	AU 2008229644 B2	16 Jun 2011
		EP 2134921 A1	23 Dec 2009
		WO 2008113127 A1	25 Sep 2008
WO 2012/012839 A1	02 Feb 2012	CA 2806885 A1	02 Feb 2012
		WO 2012012839 A1	02 Feb 2012
WO 2010/094060 A1	26 Aug 2010	AU 2010215060 A1	22 Sep 2011
		CA 2752390 A1	26 Aug 2010
		EP 2398999 A1	28 Dec 2011
		MX 2011008618 A	18 Nov 2011
		US 2012037421 A1	16 Feb 2012
		WO 2010094060 A1	26 Aug 2010

End of Annex

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

Electronic Acknowledgement Receipt

EFS ID:	23777567
Application Number:	14692484
International Application Number:	
Confirmation Number:	3851
Title of Invention:	Core Barrel Head Assembly With An Integrated Sample Orientation Tool And System For Using Same
First Named Inventor/Applicant Name:	CHRISTOPHER L. DRENTH
Customer Number:	23859
Filer:	Joseph P. Anderson
Filer Authorized By:	
Attorney Docket Number:	36362.0150U2-
Receipt Date:	14-OCT-2015
Filing Date:	21-APR-2015
Time Stamp:	14:15:46
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	36362_0150U2_SIDS_2015_10_14.PDF	132102 bb3e1deab2ed923f1466258017a902091661409a	no	2
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2	Information Disclosure Statement (IDS) Form (SB08)	36362_0150U2_SIDS_SB08_2015_10_14.PDF	183604 2fdc2aa93dadb7f227924c8ff89c65407311f027	no	2
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4	Foreign Reference	WO2007104103A1.PDF	1166483 b21695a18d7ace35d2edfbd2518b3806762 15504	no	27
Warnings:					
Information:					
5	Foreign Reference	WO2008113127A1.PDF	1862720 a96f4c3b3458677fc4f1793808c06cc28e0b e43b	no	49
Warnings:					
Information:					
6	Foreign Reference	WO2014053012A1.PDF	521813 a9c025e75175d6f91cdc5a954cd7c83cd168 7b89	no	15
Warnings:					
Information:					
		Total Files Size (in bytes):	5167377		

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

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

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

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

I hereby certify that this paper (along with any paper referred to as being attached or enclosed) is being transmitted via the Office electronic filing system in accordance with 37 CFR § 1.6(a)(4).

Dated: October 14, 2015
Electronic Signature for Joseph P. Anderson, III: /Joseph P. Anderson, III/

ATTORNEY DOCKET NO. 36362.0150U2-
VIA EFS-WEB
PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	)	
	)	
Christopher L. Drenth, et al.	)	Art Unit: 3676
	)	
Application No.: 14/692,484	)	Examiner: Thomas S. Bomar
	)	
Filing Date: April 21, 2015	)	Confirmation No.: 3851
	)	
For: **CORE BARREL HEAD ASSEMBLY WITH AN INTEGRATED SAMPLE ORIENTATION TOOL AND SYSTEM FOR USING SAME**	)	

INFORMATION DISCLOSURE STATEMENT

MAIL STOP AMENDMENT
Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

BALLARD SPAHR LLP
Customer No. 23859

October 14, 2015

Commissioner:

Pursuant to the requirements set forth in 37 C.F.R. § 1.56, Applicant now submits a list of documents known to Applicant or Applicant's attorneys. Pursuant to 37 C.F.R. § 1.98(a)(2)(iv), and for the Examiner's review, Applicant has enclosed (1) copies of documents from the prosecution of related non-U.S. patent applications, and (2) copies of non-U.S. patents or non-U.S. patent application publications. In accordance with 37 C.F.R. § 1.98(a)(2), copies of any cited U.S. patent or U.S. patent application publication documents are not enclosed.

Regarding the documents from the prosecution of related non-U.S. patent applications, Applicant has identified the prosecution record of non-U.S. patent applications as the source for each document. The information provided mirrors the requirements for cited U.S. and non-U.S. patent applications as set forth by 37 C.F.R. § 1.98(b).

Applicant respectfully requests consideration of all documents submitted in the present Information Disclosure Statement and List and entry into the record for the present application (Application No. 14/692,484).

Ex.2001 / IPR2023-00642 / Page 790 of 870
Reflex USA LLC v. Longyear TM, Inc. and Globaltech Corporation Pty Ltd.

Applicant would like to bring to the Examiner's attention the existence of the following non-U.S. patent application.

INFORMATION DISCLOSURE STATEMENT for Application No. 14/692,484 (Attorney Docket No. 36362.0156U1-) **Disclosure of Non-U.S. Patent Applications**					
Examiner's Initials	**Country**	**Application No. (Publication No.)**	**Filing Date**	**1st Named Inventor (Applicant)**	**Attorney Docket Number**
	PCT	PCT/US2015/026907	04/21/15	Drenth (Boart Longyear)	36362.0150P1-

Applicant hereby certifies, pursuant to 37 C.F.R. § 1.97(e)(1), that each item of information contained in this Supplemental Information Disclosure Statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this Supplemental Information Disclosure Statement.

Pursuant to 37 C.F.R. § 1.97(b)(3), Applicant submits that this document is timely filed in that the Patent and Trademark Office has not yet mailed to Applicant a first Office Action on the merits. Applicant submits that no fee is due; however, Applicant hereby authorizes the Commissioner to charge to Deposit Account No. 14-0629 any fee that may be required to effect the consideration and entry of this Supplemental Information Disclosure Statement and List and the references contained therein.

Respectfully submitted,

Electronic signature: /Joseph P. Anderson, III/
Joseph P. Anderson, III
Registration No.: 59,245
BALLARD SPAHR LLP
Correspondence Customer Number: 23859

1903488

Ex.2001 / IPR2023-00642 / Page 791 of 870
Reflex USA LLC v. Longyear TM, Inc. and Globaltech Corporation Pty Ltd.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/692,484	04/21/2015	CHRISTOPHER L. DRENTH	36362.0150U2-

CONFIRMATION NO. 3851

23859
Ballard Spahr LLP
SUITE 1000
999 PEACHTREE STREET
ATLANTA, GA 30309-3915

POA ACCEPTANCE LETTER

OC00000076681639

Date Mailed: 08/05/2015

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 07/28/2015.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/ltaba/

Doc Code: PA..

Document Description: Power of Attorney

PTO/AIA/82A (07-12)
Approved for use through 11/30/2014. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B or equivalent) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5. If the Power of Attorney by Applicant form is not accompanied by this transmittal form or an equivalent, the Power of Attorney will not be recognized in the application.

Application Number	14/692,484
Filing Date	April 21, 2015
First Named Inventor	Drenth, Christopher L.
Title	Core Barrel Head Assembly With An Integrated Sample Orientation Tool And System For Using Same
Art Unit	3672
Examiner Name	Unassigned
Attorney Docket Number	36362.0150U2-

SIGNATURE of Applicant or Patent Practitioner

Signature	/Joseph P. Anderson, III/	Date	July 28, 2015
Name	Joseph P. Anderson, III	Telephone	(678) 420-9300
Registration Number	59245		

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications.

■ *Total of 2 forms are submitted.

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Doc Code: PA..

Document Description: Power of Attorney

PTO/AIA/82B(07-12)
Approved for use through 11/30/2014. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in the attached transmittal letter.

☒ I hereby appoint Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A or equivalent):

23859

OR

☐ I hereby appoint Practitioner(s) named below as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A or equivalent):

Name	Registration Number	Name	Registration Number

Please recognize or change the correspondence address for the application identified in the attached transmittal letter to:

☒ The address associated with the above-mentioned Customer Number.

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant:

☐ Inventor or Joint Inventor

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor

☒ Assignee or Person to Whom the Inventor is Under an Obligation to Assign

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (*e.g.*, a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document)

SIGNATURE of Applicant for Patent

Signature		Date	7/13/15
Name	Fabrizio Rosetti	Telephone	
Title and Company	President, Longyear TM, Inc.		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms for more than one signature, see below *.

☒ *Total of 2 forms are submitted.

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: **Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Electronic Acknowledgement Receipt

EFS ID:	23046332
Application Number:	14692484
International Application Number:	
Confirmation Number:	3851
Title of Invention:	Core Barrel Head Assembly With An Integrated Sample Orientation Tool And System For Using Same
First Named Inventor/Applicant Name:	CHRISTOPHER L. DRENTH
Customer Number:	23859
Filer:	Joseph P. Anderson
Filer Authorized By:	
Attorney Docket Number:	36362.0150U2-
Receipt Date:	28-JUL-2015
Filing Date:	21-APR-2015
Time Stamp:	16:20:15
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Power of Attorney	36362_0150U2_Power_of_Attorney.PDF	110965 41437e0aacfe1a02c90fb3a7a69f10d29b7ca31d	no	2
Warnings:					
Information:					

Total Files Size (in bytes):	110965

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

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

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

ATTORNEY DOCKET NO. 36362.0150U2-
PATENT
VIA EFS-WEB

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	)	
	)	
DRENTH et al.	)	Art Unit: 3672
	)	
Application No.: 14/692,484	)	Examiner: Unassigned
	)	
Filing Date: April 21, 2015	)	Confirmation No.: 3851
	)	
FOR: **CORE BARREL HEAD ASSEMBLY WITH AN INTEGRATED SAMPLE ORIENTATION TOOL AND SYSTEM FOR USING SAME**	)	

RESPONSE TO INFORMATIONAL NOTICE TO APPLICANT

MAIL STOP MISSING PARTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Ballard Spahr LLP
Customer Number 23859

July 28, 2015

Commissioner:

In response to the May 5, 2015 Informational Notice to Applicant issued in the above-referenced patent application, attached are the executed Declarations of co-inventors Christopher L. Drenth, Gordon Stewart, and Khaled Hejleh.

No fee is due; however, the Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. 14-0629.

Dated: July 28, 2015

Respectfully submitted,

Electronic signature: /Joseph P. Anderson, III/
Joseph P. Anderson, III
Registration No.: 59,245
BALLARD SPAHR LLP
Correspondence Customer Number: 23859

(678) 420-9300 Phone
(678) 420-9301 Fax

In accordance with 37 C.F.R. § 1.8, I certify that this correspondence is being transmitted to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 via the USPTO's EFS-Web Electronic Filing System on July 28, 2015
/Joseph P. Anderson, III/
Joseph P. Anderson, III – Reg. No. 59, 245

1865565

PTO/AIA/01 (06-12)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	CORE BARREL HEAD ASSEMBLY WITH AN INTEGRATED SAMPLE ORIENTATION TOOL AND SYSTEM FOR USING SAME

As the below named inventor, I hereby declare that:

This declaration is directed to:

☐ The attached application, or

☒ United States application or PCT international application number 14/692,484 filed on April 21, 2015.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Christopher L. Drenth Date (Optional): 11/13/2015

Signature: _____

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/AIA/01 (08-12)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	CORE BARREL HEAD ASSEMBLY WITH AN INTEGRATED SAMPLE ORIENTATION TOOL AND SYSTEM FOR USING SAME

As the below named inventor, I hereby declare that:

This declaration is directed to:

☐ The attached application, or

☒ United States application or PCT international application number 14/692,484 filed on April 21, 2015.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

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LEGAL NAME OF INVENTOR

Inventor: Gordon Stewart Date (Optional): 10/7/15

Signature: Gord Stewart

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/AIA/01 (08-12)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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As the below named inventor, I hereby declare that:

This declaration is directed to:

☐ The attached application, or

☒ United States application or PCT international application number 14/692,484

filed on April 21, 2015.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Khaled Hejleh Date (Optional) :

Signature:

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Electronic Acknowledgement Receipt

EFS ID:	23047157
Application Number:	14692484
International Application Number:	
Confirmation Number:	3851
Title of Invention:	Core Barrel Head Assembly With An Integrated Sample Orientation Tool And System For Using Same
First Named Inventor/Applicant Name:	CHRISTOPHER L. DRENTH
Customer Number:	23859
Filer:	Joseph P. Anderson
Filer Authorized By:	
Attorney Docket Number:	36362.0150U2-
Receipt Date:	28-JUL-2015
Filing Date:	21-APR-2015
Time Stamp:	16:22:20
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Applicant Response to Pre-Exam Formalities Notice	36362_0150U2_Response_to_Informational_Notice_to_Applicant.pdf	75292 cb011375ee44954d2e795a9c30d3efd3a533a4b6	no	1

Warnings:	
Information:	

2	Oath or Declaration filed	36362_0150U2_Declaration_Drenth.PDF	61288 2fe316c96f7dc33d7411d8cada27f0fa8fbc83df	no	1
Warnings:					
Information:					
3	Oath or Declaration filed	36362_0150U2_Declaration_Stewart.PDF	233358 e7b89607cb746e1ef872461fd75611084e3e4e17	no	1
Warnings:					
Information:					
4	Oath or Declaration filed	36362_0150U2_Declaration_Hejleh.PDF	240736 6a242a05ed43dfe1b699bff504bf400902e3b1ad	no	1
Warnings:					
Information:					
			Total Files Size (in bytes):	610674	

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

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

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

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

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
14/692,484	04/21/2015	3672	2780	36362.0150U2-	33	1

CONFIRMATION NO. 3851

23859
Ballard Spahr LLP
SUITE 1000
999 PEACHTREE STREET
ATLANTA, GA 30309-3915

FILING RECEIPT

OC000000074945308

Date Mailed: 05/05/2015

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

CHRISTOPHER L. DRENTH, Ontario, CANADA;
GORDON STEWART, Claremont, AUSTRALIA;
KHALED HEJLEH, Peppermint Grove, AUSTRALIA;

Applicant(s)

LONGYEAR TM, INC., Salt Lake City, UT

Power of Attorney: None

Domestic Priority data as claimed by applicant

This appln claims benefit of 61/982,052 04/21/2014

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access - A proper **Authorization to Permit Access to Application by Participating Offices** (PTO/SB/39 or its equivalent) has been received by the USPTO.

If Required, Foreign Filing License Granted: 05/01/2015
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 14/692,484**
Projected Publication Date: 10/22/2015
Non-Publication Request: No
Early Publication Request: No

Title

Core Barrel Head Assembly With An Integrated Sample Orientation Tool And System For Using Same

Preliminary Class

175

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

Ex.2001 / IPR2023-00642 / Page 804 of 870
Reflex USA LLC v. Longyear TM, Inc. and Globaltech Corporation Pty Ltd.

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

SelectUSA

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/692,484	04/21/2015	CHRISTOPHER L. DRENTH	36362.0150U2-

CONFIRMATION NO. 3851

23859
Ballard Spahr LLP
SUITE 1000
999 PEACHTREE STREET
ATLANTA, GA 30309-3915

NOTICE

OC000000074945309

Date Mailed: 05/05/2015

INFORMATIONAL NOTICE TO APPLICANT

Applicant is notified that the above-identified application contains the deficiencies noted below. No period for reply is set forth in this notice for correction of these deficiencies. However, if a deficiency relates to the inventor's oath or declaration, the applicant must file an oath or declaration in compliance with 37 CFR 1.63, or a substitute statement in compliance with 37 CFR 1.64, executed by or with respect to each actual inventor no later than the expiration of the time period set in the "Notice of Allowability" to avoid abandonment. See 37 CFR 1.53(f).

The item(s) indicated below are also required and should be submitted with any reply to this notice to avoid further processing delays.

- A properly executed inventor's oath or declaration has not been received for the following inventor(s):
  CHRISTOPHER L. DRENTH
  GORDON STEWART
  KHALED HEJLEH

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 14/692,484

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	280
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	600
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	720
TOTAL CLAIMS (37 CFR 1.16(i))	33 minus 20 =	* 13			OR	x 80 =	1040
INDEPENDENT CLAIMS (37 CFR 1.16(h))	1 minus 3 =	*				x 420 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	2640

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)	OR	RATE($)	ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

ATTORNEY DOCKET NO. 36362.0150U2-
PATENT
VIA EFS-WEB

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	)	
	)	
DRENTH et al.	)	Art Unit: Unassigned
	)	
Application No.: Unassigned	)	Examiner: Unassigned
	)	
Filing Date: April 21, 2015	)	Confirmation No.: Unassigned
	)	
FOR: **CORE BARREL HEAD ASSEMBLY WITH AN INTEGRATED SAMPLE ORIENTATION TOOL AND SYSTEM FOR USING SAME**	)	

AUTHORIZATION TO TREAT REPLY REQUIRING EXTENSION OF TIME AS INCORPORATING PETITION FOR EXTENSION OF TIME

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

Ballard Spahr LLP
Customer Number 23859

April 21, 2015

Commissioner:

Pursuant to 37 C.F.R. §1.136(a)(3), the Commissioner is hereby requested and authorized to treat any concurrent or future reply in the above-identified application, requiring a petition for an extension of time for its timely submission, as incorporating a petition for extension of time for the appropriate length of time.

The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. 14-0629.

Respectfully submitted,

BALLARD SPAHR LLP

Kean J. DeCarlo
Registration No. 39,956

Ballard Spahr LLP
Customer Number 23859
(678) 420-9300 Phone
(678) 420-9301 Fax

In accordance with 37 C.F.R. § 1.8, I certify that this correspondence is being transmitted to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 via the USPTO's EFS-Web Electronic Filing System on April 21, 2015

/Kean J. DeCarlo/
Kean J. DeCarlo – Reg. No. 39,956

1820377

PTO/AIA/14 (12-13)
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Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	36362.0150U2-
	Application Number	
Title of Invention	Core Barrel Head Assembly With An Integrated Sample Orientation Tool And System For Using Same	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	CHRISTOPHER	L.	DRENTH	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Ontario	Country of Residence i	CA

Mailing Address of Inventor:

Address 1	2311 Hoover Court		
Address 2			
City	Burlington	**State/Province**	ON
Postal Code	L7P 4V2	**Country** i	CA

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	GORDON		STEWART	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Claremont	Country of Residence i	AU

Mailing Address of Inventor:

Address 1	18 Airle Street		
Address 2			
City	Claremont	**State/Province**	
Postal Code	6010	**Country** i	AU

Inventor 3 Remove

Legal Name

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	36362.0150U2-
	Application Number	
Title of Invention	Core Barrel Head Assembly With An Integrated Sample Orientation Tool And System For Using Same	

Prefix	Given Name	Middle Name	Family Name	Suffix
	KHALED		HEJLEH	

Residence Information (Select One) ◯ US Residency ◉ Non US Residency ◯ Active US Military Service

City	Peppermint Grove	Country of Residence i	AU

Mailing Address of Inventor:

Address 1	34A Leake Street		
Address 2			
City	Peppermint Grove	**State/Province**	
Postal Code	6011	**Country** i	AU

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	23859		
Email Address	uspatentmail@ballardspahr.com	Add Email	Remove Email

Application Information:

Title of the Invention	Core Barrel Head Assembly With An Integrated Sample Orientation Tool And System For Using Same		
Attorney Docket Number	36362.0150U2-	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)		**Suggested Figure for Publication (if any)**	

Filing By Reference :

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country i

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	36362.0150U2-
	Application Number	
Title of Invention	Core Barrel Head Assembly With An Integrated Sample Orientation Tool And System For Using Same	

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	23859		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the application number blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	Claims benefit of provisional	61982052	2014-04-21

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(d). When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX) [i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(h)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country [i]	Filing Date (YYYY-MM-DD)	Access Code [i] (if applicable)

PTO/AIA/14 (12-13)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	36362.0150U2-
	Application Number	
Title of Invention	Core Barrel Head Assembly With An Integrated Sample Orientation Tool And System For Using Same	

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. Add

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Authorization to Permit Access:

☒ Authorization to Permit Access to the Instant Application by the Participating Offices

If checked, the undersigned hereby grants the USPTO authority to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the instant patent application is filed access to the instant patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the instant patent application is filed to have access to the instant patent application.

In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the instant patent application with respect to: 1) the instant patent application-as-filed; 2) any foreign application to which the instant patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the instant patent application; and 3) any U.S. application-as-filed from which benefit is sought in the instant patent application.

In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date of filing this Authorization.

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	36362.0150U2-
	Application Number	
Title of Invention	Core Barrel Head Assembly With An Integrated Sample Orientation Tool And System For Using Same	

Applicant 1 Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

(•) Assignee	( ) Legal Representative under 35 U.S.C. 117	( ) Joint Inventor
( ) Person to whom the inventor is obligated to assign.	( ) Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor :

If the Applicant is an Organization check here. [X]

Organization Name	LONGYEAR TM, INC.

Mailing Address Information:

Address 1	10808 South River Front Parkway		
Address 2	Suite 400		
City	Salt Lake City	**State/Province**	UT
Country [i]	US	Postal Code	84095
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not subsitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication . An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

Remove

If the Assignee or Non-Applicant Assignee is an Organization check here. [ ]

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	36362.0150U2-
	Application Number	
Title of Invention	Core Barrel Head Assembly With An Integrated Sample Orientation Tool And System For Using Same	

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. Add

Signature:

Remove

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications

Signature	/Kean J. DeCarlo/			Date (YYYY-MM-DD)	2015-04-21
First Name	Kean	Last Name	DeCarlo	Registration Number	39956

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CORE BARREL HEAD ASSEMBLY WITH AN INTEGRATED SAMPLE ORIENTATION TOOL AND SYSTEM FOR USING SAME

CROSS REFERENCE TO RELATED PATENT APPLICATION

[0001] This application claims priority to U.S. Provisional Application No. 61/982,052 filed April 21, 2014, which is herein incorporated by reference in their entirety.

FIELD OF THE INVENTION

[0002] The present invention relates to down hole surveying in drilling operations. More particularly, to a core barrel assembly having at least one electronic instrument that is configured for use in a core sample down hole surveying and sample orientation system. In one example, the at least one electronic instrument is configured to provide an indication of the orientation of a core sample relative to a body of material from which the core has been extracted, and also to a method of core sample orientation identification.

BACKGROUND

[0003] Conventionally, core samples are obtained through the use of core drilling systems that comprise outer and inner tube assemblies. In operation, a cutting head is attached to the outer tube assembly so that rotational torque applied to the outer tube assembly can be transmitted to the cutting head. A core is generated during the drilling operation, with the core progressively extending along the elongate axis of the inner tube assembly as drilling progresses. Typically, when a core sample is acquired, the core within the inner tube assembly is fractured and the inner tube assembly and the fractured core sample contained therein are then retrieved from within the drill hole, typically by way of a retrieval cable lowered down the drill hole. Once the inner tube assembly has been brought to ground surface, the core sample can be removed and subjected to the desired analysis.

[0004] It is desirable for analysis purposes to have an indication of the orientation of the core sample relative to the ground from which it was extracted. This is complicated in that it is common to drill at an angle relative to the vertical. For efficiency

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and accuracy of the mineralogical record, it is desirable to determine the orientation and survey position of each core's position underground before being drilled out and extracted. Such orientation and survey positions allow for the subsequent production of a three dimensional map of underground mineral/rock content.

[0005] One common way of obtaining an indication of the orientation of a core sample is through use of an orientation spear comprising a marker (such as a crayon) projecting from one end of a thin steel shank, the other end of which is attached to a wire line. The orientation spear is lowered down the drill hole, prior to the inner tube assembly being introduced. The marker on the orientation spear strikes the facing surface of material from which the core is to be generated, leaving a mark thereon. Because of gravity, the mark is on the lower side of the drill hole. The inner tube assembly is then introduced into the outer tube assembly in the drill hole. As drilling proceeds, a core sample is generated within the inner tube assembly. The core sample so generated carries the mark which was previously applied. Upon completion of the core drilling run and retrieval of the core sample, the mark provides an indication of the orientation of the core sample at the time it was in the ground.

[0006] Other conventional technologies use core orientation units attached to core inner tubes and back-end assemblies to determine the correct orientation of the drilled out core sample after a preferred predetermined drilling distance intervals during drilling. These core orientation units typically measure rotational direction of the core sample before extraction. On retrieval at the surface of the hole, the rotational direction can be determined by electronic means and the upper or lower side of the core material physically 'marked' for later identification by geologists.

[0007] Coupled with the core orientation system, a survey instrument is conventionally used. In this technique, at periodic depths, the survey instrument is lowered down the drill hole to determine azimuth (angular measurement relative to a reference point or direction), dip (or inclination) and any other required survey parameters. These periodic depth survey readings are used to approximate the drill-path at different depths. Together with the rotational position of the extracted core (from the core orientation device), the three dimensional subsurface material content map can be determined.

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[0008] It has been found desirable to provide an improved core barrel assembly having an integrated sample orientation subassembly and method for using same that is configured for use in a core sample down hole surveying and sample orientation that minimizes the need to add additional drill string elements, which allows for increased efficiency and speed of drilling.

SUMMARY

[0009] In one aspect, the present invention provides a core barrel head assembly having an elongate tube body that defines a selectively sealed interior cavity. The core barrel head assembly can have at least one electronic instrument positioned in the interior cavity that is configured to obtain core orientation data of a core sample and a power source positioned in the interior cavity and in electrical communication with the at least one electronic instrument. The core barrel head assembly can also have a communication means that is configured to receive and/or transmit orientation data for use in a core sample down hole surveying and/or sample orientation system. The derived core orientation data provides an indication of the orientation of the core sample relative to a body of material from which the core has been extracted, and also to a method of using same.

[0010] The core barrel head assembly is configured for connection to tube portions of a drill string via respective connection means. In another aspect, the at least one electronic instrument of the core barrel head assembly can be mounted, for example and without limitation, within the interior cavity defined the body, within an interior cavity that is defined therein a side wall of the body of the core barrel head assembly, or potted or in sealed contact with a portion of a side wall of the core barrel assembly (on either an exterior surface or an interior surface of a cavity defined therein the body). As one skilled in the art will contemplate, the core barrel head assembly can comprise at least one electronic instrument that is configured to obtain orientation data, an electrically coupled power source and communication means to receive and/or transmit orientation data.

[0011] In another aspect, the communication means can comprise a wireless communication means that is configured to wirelessly receive and/or transmit survey

data. Optionally, the communication means can be configured to communicate one way or two ways with each other, when drilling has ceased or during drilling.

[0012] In one aspect, the at least one electronic instrument of the core barrel head assembly advantageously enables obtaining drill hole survey readings without the need to insert unwieldy extension drill rods and/or a survey probe to measure azimuth and inclination/dip of the drill hole path. This results in a reduction of equipment handling and usage of equipment, a reduction of operations by not needing to periodically withdraw the drill bit a certain distance in order to advance a survey probe ahead of, and therefore distanced from, the drill bit, with a resultant increase in operational efficiency.

[0013] Another aspect of the present invention provides a method of conducting a down hole survey of drilling, the method including: a) drilling the core from a subsurface body of material; b) recording data relating to orientation of the core to be retrieved, the data recorded using the at least one electronic instrument of the core barrel head assembly, c) separating the core from the subsurface body, and d) obtaining an indication of the orientation of the core based on the recorded core orientation data obtained before the core was separated from the subsurface body.

[0014] Optionally, the method can comprise: determining that drilling has ceased for a period of time, using the at least one electronic instrument of the core barrel head assembly to record data relating to orientation of the core to be retrieved, separating the core from the subsurface body, retrieving the core to the surface, and obtaining an indication of the orientation of the core based on the recorded core orientation data obtained once the drilling had ceased and before the core was separated from the subsurface body.

[0015] Advantages are that there is more time available for drilling due to less time required for surveying and manipulating additional pieces of equipment and mechanical extensions during the survey process.

BRIEF DESCRIPTION OF THE FIGURES

[0016] Figure 1 shows a perspective view of a core barrel head assembly being operatively coupled to a head assembly.

[0017] Figure 2 shows a longitudinal cross-sectional view of Figure 1.

[0018] Figure 3 shows an expanded view of a portion of Figure 2, showing the core barrel head assembly.

[0019] Figure 4 shows a perspective exploded view of the core barrel head assembly of Figure 1.

[0020] Figure 5 shows a longitudinal cross-sectional view of the core barrel head assembly, showing an at least one electronic instrument and an electrically coupled power source disposed therein an interior cavity of a body of the core barrel head assembly.

[0021] Figure 6 shows a longitudinal cross-sectional view of another aspect of the core barrel head assembly, showing an at least one electronic instrument and an electrically coupled power source disposed therein an interior cavity of a body of the core barrel head assembly.

[0022] Figure 7 shows a longitudinal cross-sectional view of the body of the core barrel head assembly.

[0023] Figure 8 shows a longitudinal cross-sectional view of a core barrel head assembly being operatively coupled to a head assembly.

[0024] Figure 9 shows a schematic view of an exemplary at least one electronic instrument.

[0025] Figure 10 shows a schematic view of an exemplary at least one electronic instrument and an electrically coupled power source for disposition therein an interior cavity of a body of the core barrel head assembly.

[0026] Figure 11 shows an exemplary high level flowchart relating to a method of using the present invention.

[0027] Figure 12 shows an exemplary flowchart relating to an alternative embodiment of a method of using the present invention.

[0028] Figure 13 shows an exemplary flowchart relating to an alternative embodiment of a method of using the present invention.

[0029] Figure 14 shows an exemplary prior art hand held device for wirelessly interrogating the core barrel head assembly of the present invention.

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DETAILED DESCRIPTION

[0030] The present invention can be understood more readily by reference to the following detailed description, examples, drawings, and claims, and their previous and following description. However, before the present devices, systems, and/or methods are disclosed and described, it is to be understood that this invention is not limited to the specific devices, systems, and/or methods disclosed unless otherwise specified, as such can, of course, vary. It is also to be understood that the terminology used herein is for the purpose of describing particular aspects only and is not intended to be limiting.

[0031] The following description of the invention is provided as an enabling teaching of the invention in its best, currently known embodiment. To this end, those skilled in the relevant art will recognize and appreciate that many changes can be made to the various aspects of the invention described herein, while still obtaining the beneficial results of the present invention. It will also be apparent that some of the desired benefits of the present invention can be obtained by selecting some of the features of the present invention without utilizing other features. Accordingly, those who work in the art will recognize that many modifications and adaptations to the present invention are possible and can even be desirable in certain circumstances and are a part of the present invention. Thus, the following description is provided as illustrative of the principles of the present invention and not in limitation thereof.

[0032] As used throughout, the singular forms "a," "an" and "the" include plural referents unless the context clearly dictates otherwise. Thus, for example, reference to "a port" can include two or more such ports unless the context indicates otherwise.

[0033] Ranges can be expressed herein as from "about" one particular value, and/or to "about" another particular value. When such a range is expressed, another aspect includes from the one particular value and/or to the other particular value. Similarly, when values are expressed as approximations, by use of the antecedent "about," it will be understood that the particular value forms another aspect. It will be further understood that the endpoints of each of the ranges are significant both in relation to the other endpoint, and independently of the other endpoint.

[0034] As used herein, the terms "optional" or "optionally" mean that the subsequently described event or circumstance may or may not occur, and that the description includes instances where said event or circumstance occurs and instances where it does not.

[0035] The word "or" as used herein means any one member of a particular list and also includes any combination of members of that list.

[0036] As will be appreciated by one skilled in the art, the methods and systems may take the form of an entirely hardware embodiment, an entirely software embodiment, or an embodiment combining software and hardware aspects. Furthermore, the methods and systems may take the form of a computer program product on a computer-readable storage medium having computer-readable program instructions (*e.g.*, computer software) embodied in the storage medium. More particularly, the present methods and systems may take the form of web-implemented computer software. Any suitable computer-readable storage medium may be utilized including, without limitation, hard disks, CD-ROMs, optical storage devices, magnetic storage devices, or solid-state electronic storage devices.

[0037] Embodiments of the methods and systems are described below with reference to block diagrams and flowchart illustrations of methods, systems, apparatuses and computer program products. It will be understood that each block of the block diagrams and flowchart illustrations, and combinations of blocks in the block diagrams and flowchart illustrations, respectively, can be implemented by computer program instructions. These computer program instructions may be loaded onto a general purpose computer, special purpose computer, or other programmable data processing apparatus to produce a machine, such that the instructions which execute on the computer or other programmable data processing apparatus create a means for implementing the functions specified in the flowchart block or blocks.

[0038] These computer program instructions may also be stored in a computer-readable memory that can direct a computer or other programmable data processing apparatus to function in a particular manner, such that the instructions stored in the computer-readable memory produce an article of manufacture including computer-

readable instructions for implementing the function specified in the flowchart block or blocks. The computer program instructions may also be loaded onto a computer or other programmable data processing apparatus to cause a series of operational steps to be performed on the computer or other programmable apparatus to produce a computer-implemented process such that the instructions that execute on the computer or other programmable apparatus provide steps for implementing the functions specified in the flowchart block or blocks.

[0039] Accordingly, blocks of the block diagrams and flowchart illustrations support combinations of means for performing the specified functions, combinations of steps for performing the specified functions and program instruction means for performing the specified functions. It will also be understood that each block of the block diagrams and flowchart illustrations, and combinations of blocks in the block diagrams and flowchart illustrations, can be implemented by special purpose hardware-based computer systems that perform the specified functions or steps, or combinations of special purpose hardware and computer instructions.

[0040] In one aspect, a drill assembly for drilling into a subsurface body of material can comprise a drill string 10 comprising a drill bit, an outer tube formed of linearly connected tube sections, and an inner tube for receiving the core drilled from the subsurface body. In one aspect, the core barrel head assembly 30 is integrated into the drill string 10 to form a portion of the drill string, such as shown in Figure 1, where the core barrel head assembly is operably coupled to a conventional head assembly 20.

[0041] The core barrel head assembly is configured for connection to tube portions of a drill string via respective connection means. In another aspect, the at least one electronic instrument of the core barrel head assembly can be mounted, for example and without limitation, within the interior cavity defined the body, within an interior cavity that is defined therein a side wall of the body of the core barrel head assembly, or potted or in sealed contact with a portion of a side wall of the core barrel assembly (on either an exterior surface or an interior surface of a cavity defined therein the body). As one skilled in the art will contemplate, the core barrel head assembly can comprise at least one electronic instrument that is configured to obtain orientation data, an

electrically coupled power source and communication means to receive and/or transmit orientation data.

[0042] In one aspect, and referring to Figures 1-7, the core barrel head assembly 30 can comprise at least one electronic instrument 40 that is configured to obtain orientation data, a operatively electrically coupled power source 50 and communication means to receive and/or transmit orientation data. In one aspect, at least one electronic instrument 40 can comprise at least one digital and/or electro-mechanical sensors 42, and/or one or more physical data sensors 44 in a core orientation data recording tool that can be configured to determine the core orientation just prior to or after the core break, and, optionally, to detect the signal of the break of the core from the body of material. In various aspects, it is contemplated that the recorded data can optionally include "dip" angle and/or azimuth datum to increase the reliability of the core orientation results as described below.

[0043] In this aspect, the at least one digital and/or electro-mechanical sensor 42 in operative communication with the at least one electronic instrument 40 of the core barrel assembly can be configured to detect vibration and/or to detect tri-axial gravitation loading acting on the electronic instrument. In one exemplary aspect, once a desired vibration state is detected and/or a desired G-loading state is detected , drilling can cease and the core barrel head assembly can record data relating to the orientation of the core, such as, for example and without limitation, gravitational field strength and direction, and/or magnetic field strength and direction.

[0044] The core barrel head assembly 30 has a proximal end 32 that is operatively oriented toward the drill bit end of the drill string and an opposed distal end 34. As shown in Figures 1 and 5-6, the core barrel head assembly 30 has an elongate tube body 60 that is conventionally joined to a conventional wire line retrieval portion of a head assembly 10. Thus, the head assembly of the drill string is complete without the necessity for the use of an unwieldy extension tube as required in the prior art designs.

[0045] The threaded proximal end 62 of the elongate tube body 60 is in communication with a first interior cavity 64 that extends distally to a base portion 65. Proximate the base portion of the second interior cavity, a port 66 is defined that

extends from the exterior surface of the elongate tube body into fluid communication with the first interior cavity. Optionally, in this aspect, it is contemplated that a grease fitting 68 can be mounted in the port 66 to allow for selective passage of grease or lubricant into communication with the first interior cavity and vice versa.

[0046] A second interior cavity 70 is defined therein the elongate tube body 60 that is spaced from and extends distally from the first interior cavity. The second interior cavity 70 can be sized to hermetically enclose at least one of the least one electronic instrument 40 that is configured to obtain orientation data, the power source 50 and the communication means to receive and/or transmit orientation data. In another aspect, the second interior cavity 70 can be sized to hermetically enclose the least one electronic instrument 40 that is configured to obtain orientation data and the power source 50. In one aspect, the at least one electronic instrument 40 can comprise the electronic instrument discussed above and schematically shown in Figures 8 and 9. The at least one electronic instrument 40 is operatively electrically coupled to the power source 50, which can comprise any conventional power source, such as, for example and without limitation, a battery, a rechargeable battery, and the like.

[0047] In one aspect, as shown, a plurality of windows 74 can be defined in the elongate tube body that extend from the exterior surface 61 of the elongate tube body into the second interior chamber 70 proximate the closed proximal end 72 of the second interior chamber. In a further aspect, an orientation indicator module 80 can be provided that comprises a plurality of light emitters 82. The orientation indicator module 80 can be sized and shaped to sealingly close the second interior chamber from any intrusion of pressurized fluid into the second interior chamber 70 via the defined plurality of windows 74.

[0048] In another aspect, it is contemplated that the second interior cavity can comprise at least one orienting slot defined therein. In this aspect, the orientation indicator module can be oriented manually and the desired position can be maintained to the at least one O-ring seal 84 described below. Optionally, in a further aspect, the orientation indicator module 82 is configured to orient or otherwise position a plurality of light emitters 88 so that each light emitter underlies one window.

[0049] In one aspect, the orientation indicator module 80 can further comprise a sealing means for preventing any pressurized fluid from entering the second interior cavity 70 from the defined windows 74. In one aspect, the sealing means can comprise at least one O-ring seal 84 that is mounted on an exterior portion of the orientation indicator module and that is configured to seal between the exterior portion of the orientation indicator module and a portion of the interior surface of the second interior cavity.

[0050] In one exemplary aspect, light from the plurality of light emitters 88 (*e.g.* LEDs, and the like) passes through or can be observed through the plurality of windows 74. Reference arrow A refers to the drill bit end direction, and reference arrow B refers to the head assembly direction. Further, as described above, the process of obtaining core orientation is made easier by only requiring two color lights, such as, for example and without limitation, green and red, to indicate one or other direction of rotation to establish correct core orientation prior to marking. The indicators form part of the sealed device and can be low power consumption LED lights.

[0051] Alternatively, flashing lights may be used, such as, for example and without limitation, a certain frequency or number of flashes for one direction and another frequency or number of flashes for the other direction of rotation. A steady light could be given when correct orientation is achieved. Thus, advantageously, when the core barrel head assembly 30 and the core sample are recovered from down the hole, the core barrel head assembly 30 need not be separated from the drill string in order to determine a required orientation of the core sample. Wireless communication to a remote device, such as a hand held device, to transfer data between the core barrel head assembly and the remote device, can also be effected by transmitting through the at least one aperture.

[0052] In another aspect, the second interior cavity 70 extends distally to the open distal end 73 of the elongate tube body 60. To further effect a hermetical enclosure of the least one electronic instrument 40 that is configured to obtain orientation data, the power source 50 and, optionally, the communication means to receive and/or transmit orientation data, a seal coupler 90 can be provided that is configured to be sealingly

received in the open threaded distal end 73 of the elongate tube body 60. As noted, a sealing means can be provided to prevent any pressurized fluid from entering the second interior cavity. In one aspect, the sealing means can comprise at least one O-ring seal 95 that is mounted on a portion of the seal coupler and that is configured to seal between a portion of the seal coupler and a portion of the interior surface of the open distal end of the elongate tube body.

[0053] In a further aspect, to further effect a hermetical seal of the second interior cavity and to provide fluid control for the wire line operation, a check valve assembly 100 is provided. In one aspect, the check valve assembly 100 comprises a coupled proximal end assembly and a distally tapered seat that defines an interior chamber 110 for operative receipt of a check ball 120.

[0054] In one aspect, the proximal end assembly102 of the check valve assembly can define a female threaded coupling that is configured to be threadably coupled to the male threads defined on the exterior surface of the distal end 73 of the elongate tube body 60. As one skilled in the art will appreciate, as the proximal end assembly of the check valve assembly 100 is threadably coupled to the distal end 73 of the elongate tube body, the seal coupler 90 is driven into a sealed position therein the second interior cavity 70 to affect complete hermeticity.

[0055] Further, as one skilled in the art will appreciate, because the orientation indicator module 90 is sealingly disposed in the proximal end of the second interior chamber 70, the least one electronic instrument 40, the power source 50 and, optionally, the communication means to receive and/or transmit orientation data is disposed in operative contact with the orientation indicator module, and the seal coupler 90 is disposed in contact with the least one electronic instrument 40, the power source 50 and, optionally, the communication means to receive and/or transmit orientation data, as the proximal end assembly of the check valve assembly is threadably coupled to the distal 73 end of the elongate tube body, both the sealing means on the respective orientation indicator module 80 and the seal coupler 90 are driven into a sealed position therein the second interior cavity to affect complete hermeticity of the second interior cavity.

[0056] In another aspect, the interior chamber 110 of the check valve assembly extends to a distal end 104 of the check valve assembly. In this aspect, at least one port 106 is provided that extends from the exterior surface of the check valve assembly and is in fluid communication with the interior chamber of the check valve assembly. In one aspect, the at least one port 106 can comprise a plurality of ports. In this aspect, it is contemplated that the plurality of ports can be angularly spaced an equal or an unequal number of degrees apart.

[0057] In this aspect, the interior chamber 110 can have a distally tapered seat 112 that is adapted to selectively receive the ball 120 that is sized to selectively block the distally tapered seat. One skilled in the art will appreciate that the interior chamber 110 of the check valve assembly 100 can be sized and shaped to allow the ball to selectively move axially between an open position, in which the ball is spaced proximally away from the surface of the tapered seat so that pressurized fluid can move through the distal end of the check valve assembly and subsequently through the interior chamber to exit out of the at least one port, and a closed position, in which the ball is pressurized against the surface of the tapered seat so that pressurized fluid cannot move through the check valve assembly.

[0058] In a further aspect, the exterior surface 61 of the elongate tube body 60 can define a plurality of female planar stops 67 proximate the mid-body portion. These female planar stops aid in grasping and selectively orienting the orientation of the core barrel head assembly 30. Optionally, additional female planar stops 69 can be defined proximate the indicator widows defined in the elongate tube body to aid in ease of selectively orienting the sample.

[0059] Referring now to Figure 8, an alternative embodiment of the core barrel head assembly 30 is shown that comprises at least one electronic instrument 40 that is configured to obtain orientation data, a operatively electrically coupled power source 50 and communication means to receive and/or transmit orientation data.

[0060] In this aspect the core barrel head assembly 130 has a proximal end 132 that is operatively oriented toward the drill bit end of the drill string and an opposed distal end 134. As shown in Figure 8, the core barrel head assembly 130 is

conventionally joined to a conventional wire line retrieval portion of a head assembly 10. Thus, the head assembly of the drill string is complete without the necessity for the use of an unwieldy extension tube as required in the prior art designs.

[0061] The core barrel head assembly 130 has an elongate tube body 160 that is operably coupled to elongate hollow spindle 170 that is, in turn, operably coupled to a selectively open check valve assembly 180. The elongate tube body has a threaded proximal end 162 that defines an internal bushing mount 163. The open distal end 164 of the elongate tube body defines an internal shoulder 165 that is sized and shaped to receive at least one conventional cylindrical bearing 190.

[0062] A bushing 192 is mounted in the bushing mount and is sized and shaped to rotatably receive the proximal end 172 of the hollow spindle 170. As shown in the figures, a mid-portion of the hollow spindle is rotatably supported by the at least one bearing 190. In a further aspect, a nut 194 is coupled to a treaded portion 174 of the hollow spindle 170 adjacent to the proximal end of the hollow spindle 170.

[0063] The a portion of the interior wall 165 of the elongate tube body 160, a portion of the nut 194 and a portion of the exterior surface of the hollow spindle define a an interior cavity 166 into which a spring is mounted and the at least one electronic instrument 40 that is configured to obtain orientation data, a operatively electrically coupled power source 50 and communication means to receive and/or transmit orientation data are mounted. The least one electronic instrument 40 that is configured to obtain orientation data, a operatively electrically coupled power source 50 and communication means to receive and/or transmit orientation data can be integrated; potted or otherwise affixed to the elongate tube body within the interior cavity 166. As one skilled in the art will appreciate, as the hollow spindle turns, the elongate tube body will remain in the same position, *i.e.*, the elongate tube body does not turn when the hollow spindle is turned.

[0064] In an optional aspect, a port 167 is defined that extends from the exterior surface of the elongate tube body into fluid communication with the interior cavity. Optionally, in this aspect, it is contemplated that a grease fitting 168 can be mounted in

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the port 167 to allow for selective passage of grease or lubricant into communication with the interior cavity.

[0065] It is contemplated that the interior cavity 166 can be sized to hermetically enclose at least one of the least one electronic instrument 40 that is configured to obtain orientation data, the power source 50 and the communication means to receive and/or transmit orientation data. In another aspect, the interior cavity 166 can be sized to hermetically enclose the least one electronic instrument 40 that is configured to obtain orientation data and the power source 50. In one aspect, the at least one electronic instrument 40 can comprise the electronic instrument discussed above and schematically shown in Figures 9 and 10. The at least one electronic instrument 40 is operatively electrically coupled to the power source 50, which can comprise any conventional power source, such as, for example and without limitation, a battery, a rechargeable battery, and the like.

[0066] In a further aspect, to provide fluid control for the wire line operation, a selectively open check valve assembly 180 is provided. In one aspect, the check valve assembly 180 comprises a coupled end assembly 182 defining a proximally tapered seat 184 that defines an interior chamber 185 for operative receipt of a check ball 195.

[0067] In one aspect, the coupled end assembly 182 of the check valve assembly can define a female threaded coupling that is configured to be threadably coupled to the male threads defined on the exterior surface of the distal end 173 of the hollow spindle 170. Thus, as shown in the figures, the tapered seat 184 is operably coupled to the distal end 173 of the spindle 170 such that the hollow interior of the spindle 170 can be selectively placed in fluid communication with fluid governed by the check valve assembly 180.

[0068] As one skilled in the art will appreciate, the end assembly 182 of the check valve assembly defines at least one port 186 that extends from the exterior surface of the check valve assembly and is in fluid communication with the interior chamber of the check valve assembly. In one aspect, the at least one port 186 can comprise a plurality of ports. In this aspect, it is contemplated that the plurality of ports can be angularly spaced an equal or an unequal number of degrees apart.

[0069] In this aspect, the interior chamber 185 can have a proximally tapered seat 184 that is adapted to selectively receive the ball 195 that is sized to selectively block the proximally tapered seat. One skilled in the art will appreciate that the interior chamber 185 of the check valve assembly 180 can be sized and shaped to allow the ball to selectively move axially between an open position, in which the ball is spaced proximally away from the surface of the tapered seat so that pressurized fluid can move out through the elongate spindle into the proximal end of the check valve assembly and subsequently through the interior chamber of the check valve assembly to exit out of the at least one port, and a closed position, in which the ball is pressurized against the surface of the tapered seat so that pressurized fluid cannot move through the check valve assembly to through the hollow spindle.

[0070] In operation, it is contemplated that, in one non-limiting example, the at least one electronic instrument 40 of the core barrel head assembly 30 does not take any orientation measurements while vibrations, such as from the drilling operation, are present. In this aspect, the combination of mechanical, electromechanical and/or electronic sensors and software algorithms programmed into the at least one electronic instrument of the core barrel head assembly are configured to determine that the core barrel head assembly is in motion while descending down the hole and during drilling and is therefore not yet needed to detect breaking of the core sample from the body of material. Similarly, in a further aspect, it is contemplated that the at least one electronic instrument of the core barrel head assembly can be configured to detect that the core barrel head assembly is ascending to the surface for core retrieval after core breaking and subsequently will not take any core orientation measurements during the ascending operation.

[0071] In one non-limiting example, in operation, when the driller is ready to break the core, the driller can selectively not rotate the drill string for a first predetermined delay time period that can range from between about 10 seconds to about 90 seconds. During the delay time period, it is contemplated that an orientation and dip measurement can be taken during this non-rotation, *i.e.*, minimal vibration, period. Subsequently, after breaking the core, the driller can wait a second predetermined delay

time period that can range from between about 60 seconds to about 120 seconds, or at least 90 seconds before initiating further rotation.

[0072] Optionally, it is contemplated that pressure created within the borehole by drilling mud and/or water, which may be pumped down the borehole from the surface can be detected by the at least one electronic instrument 42, which can comprise at least one pressure sensor. In various non-limiting examples, the at least one pressure sensor can be mounted on the drill string, such as on the inner and/or outer drill tube or on the drill bit or on the core barrel head assembly. The detected pressure, such as, for example and without limitation, pressure within the inner tube receiving the core, or pressure differential, such as, for example and without limitation, pressure differential between/across the inner and outer tubes, can be indicative of the inner tube being nearly or totally full of core material. This can occur before the core is separated from the subsurface body of material (such as by breaking the core from the body by a sharp pull back on the core) and hence can provide an indicator that the core is about to be broken.

[0073] Optionally, it is contemplated that the least one electronic instrument 40, which is configured to obtain orientation data, the power source 50 and the communication means to receive and/or transmit orientation data can be sized and shaped to be integrally mounted therein conventional wire line assemblies. It this aspect, the least one electronic instrument 40 that is configured to obtain orientation data, the power source 50 and the communication means to receive and/or transmit orientation data can be miniaturized and/or flexible to be received within defined cavities therein the conventional wire line assemblies and can be subsequently hermetically sealed, such as with, for example and without limitation, an epoxy, therein the defined cavities.

[0074] One skilled in the art will appreciate that the core barrel head assembly 30 does not need to be separated from the head assembly 20 in order to determine core sample orientation and/or to gather data recorded by the tool means that there is less risk of equipment failure and drilling downtime, as well as reduced equipment handling time through not having to separate the sections in order to otherwise obtain core sample orientation. Known systems require an end-on interrogation of the tool. By

providing a sealed apparatus and the facility to determine orientation of the core sample by observing the orientation indications through one or more windows 74 in the side of the elongate tube body 60, reliability and efficiency of core sample collection and orientating is improved. Consequently operational personnel risk injury, as well as additional downtime of the drilling operation. Without having to separate core barrel head assembly 30 from the head assembly, the orientation of the core sample can be determined and the gathered information retrieved with less drilling delay and risk of equipment damage/failure.

[0075] Further, unlike known systems, the core barrel head assembly 30 provides for the desired flow of pressurized fluid in the wire-line assemblies to conventionally operate the fluid control vales that are commonly used in wire-line operations. As noted, the check valve assembly 100 allows for the selectively passage of fluid therethrough that assembly and to the exterior surface of the core barrel head assembly 30 and subsequently through the pressure relief valve to exit out of the first interior cavity of the elongate tube body.

[0076] In one aspect, the one or more pressure sensors 42 can be provided to detect pressure data, which can comprise pressure readings; changes in pressure and/or pressure differentials. The pressure data can be operative communication with the core barrel head assembly 30 and/or an operator at the surface. In one exemplary aspect, once a desired pressure value is detected, drilling can cease and the at least one electronic instrument 40 of the core barrel head assembly 30 can record data relating to the orientation of the core, such as gravitational field strength and direction, and/or magnetic field strength and direction.

[0077] In various aspects, it is contemplated that the recorded data can optionally include “dip” angle or azimuth datum to increase the reliability of the core orientation results. Conventionally, dip is the angle of the inner core tube drill assembly with respect to the horizontal plane and can be the angle above or below the horizontal plane depending on drilling direction from above ground level or from underground drilling in any direction. This provides further confirmation that the progressive drilling of a hole follows a maximum progressive dip angle which may incrementally change as

drilling progresses, but not to the extent which exceeds a dogleg severity, *i.e.*, a normalized estimate (*e.g.* degrees / 30 meters) of the overall curvature of an actual drill-hole path between two consecutive directional survey/orientation stations.

[0078] In operation, prior to obtaining an orientation and core sample, a remote external communication device can be set by an operator to a start time. The remote external communication device communicates with the at least one electronic instrument 40 of the core barrel head assembly 30 before it is tripped into the drill hole. Subsequently, after a predetermined timed interval has elapsed from the start time, the at least one electronic instrument 40 can be configured to begin normal operation to detect the signature of vibration indicating a core break.

[0079] Optionally, in another aspect, pressure changes or levels can be detected to indicate a pre-break condition or period, such as pressure of mud/water within the inner tube increasing due to the core filling or nearly filling the inner tube holding the core.

[0080] In one aspect, the at least one electronic instrument 40 of the core barrel head assembly 30 can be configured to not take any orientation measurements while vibrations, such as from the drilling operation, are present. In this aspect, the combination of mechanical, electromechanical and/or electronic sensors and software algorithms programmed into the at least one electronic instrument 40 of the core barrel head assembly 30 can be configured to determine that the core barrel head assembly is in motion while descending down the hole and during drilling and is therefore not yet needed to detect breaking of the core sample from the body of material. Similarly, in a further aspect, it is contemplated that the at least one electronic instrument 40 of the core barrel head assembly 30 can be configured to detect that the core barrel head assembly is ascending to the surface for core retrieval after core breaking and subsequently will not take any core orientation measurements during the ascending operation.

[0081] Optionally, dip angle can be included in determining orientation of the core. In one aspect, the dip angle of the drill hole can be used to determine whether or not to use the obtained orientation data. For example, a valid core orientation sample can be determined from the previously discussed validation steps being acceptable and, additionally, from the dip angle of the drill hole also being within acceptable limits. In

one aspect, the dip can be sampled as a reference prior to the first run of a new drill hole. This particular reference is called a setup function. In this aspect, the setup function can be selected on the remote communications device, which then communicates to the core barrel head assembly. For clarity, the core sample orientation subassembly does not orientation the core, rather, it records signals indicative of the orientation of the core to be retrieved. The core barrel head assembly can then be lowered down the hole or aligned to the angle of the drill rods in the case of no hole yet to be drilled. Once the core barrel head assembly is down to a desired position or to the end of the hole the user can "mark" the "shot," preferably via use of the remote communications device.

[0082] Subsequently, the core barrel head assembly is retrieved and the remote communications device can be used to communicate the dip (angle) of the drill hole to the communication means of the core barrel head assembly. Optionally, the dip of the end of the hole can be manually entered into the remote communications device and this communicated back to the core barrel head assembly.

[0083] In one aspect, a compliant datum is obtained when one or more signals indicative of the orientation of the core is/are obtained by the core orientation device during a period of no drilling vibration prior to detecting vibration from breaking the core and that being prior to a subsequent period of no drilling vibration. It is contemplated that one or more embodiments can utilize the final compliant datum instead of the first obtained compliant datum.

[0084] In one aspect, it is contemplated that the at least one electronic instrument 40 can comprise an LCD display 41 at one end. This can allow for setting up of the orientation system prior to deployment and to indicate visually alignment of the core sample when retrieved to the surface. The core barrel head assembly 30 can be connected to the core barrel head assembly which can be operably is connected to a sample tube for receiving a core sample. In one aspect, and as exemplarily shown in Figures 8 and 9, the at least one electronic instrument 40 can comprise at least one vibration sensor, at least one accelerometer 43, a memory 45, a timer 47 and the aforementioned LCD display 41. Optionally, at least one electronic instrument 40 can further comprise one or more of at least one of a gravity sensor, magnetic field sensor,

inclinometer, a direction measuring sensor, a gyro, and/or preferably a combination two or more of these devices.

[0085] In this aspect, the at least one electronic instrument 40 can be configured to record orientation data every few seconds during core sampling. The start time can be synchronized with actual time using a common stop watch. The operably coupled core barrel head assembly 30 and the core barrel head assembly can then be lowered into the drill string outer casing to commence core sampling. After drilling and capturing a core sample in the inner core sample tube, the operator, can stop the stop watch and retrieve the core sample tube back to the surface. At the surface, before removing the core sample from the inner tube, the operator can views the LCD display, if it is still working, which steps the operator through instructions to rotate the core tube until the core sample lower section is at the core tube lower end . The core sample is then marked and stored for future analysis.

[0086] Another aspect of the present invention provides a method of conducting a down hole survey of drilling, the method including: a) drilling the core from a subsurface body of material; b) recording data relating to orientation of the core to be retrieved, the data recorded using the at least one electronic instrument of the core barrel head assembly, c) separating the core from the subsurface body, and d) obtaining an indication of the orientation of the core based on the recorded core orientation data obtained before the core was separated from the subsurface body.

[0087] Optionally, the method can comprise: determining that drilling has ceased for a period of time, using the at least one electronic instrument of the core barrel head assembly to record data relating to orientation of the core to be retrieved, separating the core from the subsurface body, retrieving the core to the surface, and obtaining an indication of the orientation of the core based on the recorded core orientation data obtained once the drilling had ceased and before the core was separated from the subsurface body.

[0088] In one exemplary aspect, for the embodiment shown in the flowchart in Figure 11, the core orientation can be validated when the following events have occurred:

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a) Step 200: detecting no vibration above a threshold by the core barrel head assembly, or is detected to be below a threshold, for the first predetermined delay time period;

b) Step 220: taking a core orientation measurement during the first predetermined delay time period;

c) Step 230: detecting noise from breaking the core from the subsurface body after the first predetermined delay time period and before the second predetermined delay time period;

d) Step 240: detecting no vibration above a threshold by the core barrel head assembly, or is detected to be below a threshold, for the second predetermined delay time period;

e) Step 250: retaining the orientation measurement obtained in Step 220 only if Steps 200, 230 and 240 are present;

f) Step 260: disregarding detected signals or to not detect vibration or lack of vibration if only if Steps 200, 230 and 240 are obtained. If the detected signals are disregarded, a vibration silence signal in Step 280 must be detected before the core is broken.

[0089] Optionally, as shown in Step 270, a dip measurement can be obtained during the period of no drilling prior to breaking the core (period Y), preferably if dip is within the set limits.

[0090] In one aspect, once the required core orientation is obtained, the core barrel head assembly may be shut down or turned to low power standby mode in Step 290 in preparation to be subsequently placed into an orientation mode. Once the core barrel head assembly 30 is retrieved to the surface in Step 300, an operator can set the core barrel head assembly to the orientation mode in Step 310. In one example, and not meant to be limiting, this can be done via the remote communication means for communicating with the communication means of the core barrel head assembly in Step 320.

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[0091] In a further aspect, it is contemplated that the core barrel head assembly can comprise an orientation indicator assembly that comprises one or more lights or other visual indicators, such as, for example and without limitation, one or more display panels to give an indication of orientation direction and required orientation for marking the core. In this aspect, once in orientation mode, visual indications, such as flashing of one or more LEDs, can indicate to the operator which direction to rotate the core to find the" correct down side" for marking. In this aspect, the "correct downside" is the part of the core that was lowermost prior to separating from the subsurface body.

[0092] Once the correct downside is identified in Step 330, the operator can again effect communication to the communication means of the core barrel head assembly via the remote communication device. In Step 340, and based on the orientation data recorded, the remote communication device can be configured to verify that the correct orientation was achieved. Subsequently, in Step 350, the operator can perform another orientation operation.

[0093] Optional and exemplary methods of using the present invention are shown in Figures 12 and 13. In one aspect, as shown in Figure 12, the at least one electronic instrument 40 of the core barrel head assembly 30 can be programmed to be used in a running mode, a hibernation mode and an orientating mode. In this aspect, the at least one electronic instrument 40 of the core barrel head assembly 30 is configured to actuate and take sequential provisional data readings (POD1, POD2, POD3, etc.) when the at least one electronic instrument senses that vibrations have stopped. These provisional data readings are taken as desired time intervals that can be between about 0.1 to about 1.0 seconds. In this aspect, the core barrel head assembly 30 is configured to actuate or power up when the at least one electronic instrument is taken out hibernation. Further, it is contemplated that the time clock starts operation whenever the at least one electronic instrument 40. For example, this could happen on the surface prior to insertion into the hole. The programming can also optionally disregard any acquired provisional data (POD1, POD2, POD3, etc.) if vibrations are sensed during any portion of the acquisition of the sequential provisional data readings. In this case, the programming would automatically go to the step "Turn Off G-Sensor" in the running mode.

[0094] In one aspect, as shown in Figure 13, the at least one electronic instrument 40 of the core barrel head assembly 30 can be similarly programmed to be used in a running mode, a hibernation mode and an orientating mode. In this aspect, the at least one electronic instrument 40 of the core barrel head assembly 30 is configured to actuate in accord with a time interval scheme in which a signal is sent to the tri-axial g-sensors to take readings in accord with the predetermined time interval scheme.

[0095] In one aspect, it is contemplated that the core barrel head assembly 30 can be utilized in asynchronous time operation for core sampling. In this aspect, the data recording events taken by the core barrel head assembly 30 are not synchronized in time with the communication device. That is, the core barrel head assembly can be programmed to not commence timing from a reference time, and can optionally be programmed such that the at least one electronic instrument 40 of the core barrel head assembly 30 does not take samples (shots) at specific predetermined time intervals. For example, and not meant to be limiting, the at least one electronic instrument 40 of the core barrel head assembly 30 can be programmed to not take a three second sample every one minute with that one minute interval synchronized to the remote, which would therefore know when each sample is about to take place. In this aspect, the communication means or device is not synchronized to the core orientation unit, *i.e.* asynchronous operation, and therefore the communication device does not know if or when a sample is being taken. Thus, obtaining an indication of core sample orientation is simplified over known arrangements.

[0096] In one aspect, while the core barred head assembly is on the surface, the external communication device can signal to the at least one electronic instrument 40 to activate or come out of a standby mode prior to deployment down hole. Optionally, the at least one electronic instrument 40 can already be activated such that it is not necessary to have the at least one electronic instrument 40 switch on from a deactivated ('turned off') state.

[0097] Alternatively, the at least one electronic instrument 40 can be configured to activate and commence taking data samples after a predetermined period from deployment from the surface or after elapse of an activation delay timer or other delay mechanism. For example, the data gathering device may be configured at the surface

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to only 'wake-up' from a standby mode to an activated mode after at least a predetermined period of time has elapsed or a counter has completed a predetermined count relating to a time period delay.

[0098] In one aspect, it is contemplated that the at least one electronic instrument 40 can be programmed to take measurements/record orientation data based on the time intervals and/or randomly generated time intervals. In this aspect, the programmed instructions to record data generated as a result of the regular or randomly generated time intervals can remain on-going while the at least one electronic instrument 40 activated. However, because at least one of the sensor(s) in the at least one electronic instrument 40 may be shut down/deactivated during sensed vibrations, no orientation data gets acquired during time period in which vibrations are sensed. When the vibrations stop, the sensors are turned on and the time intervals instructions would then resume execution as per the time regular or random intervals. In this aspect, orientation data is being measured/obtained per the time intervals being used, as preferably initiated at the beginning of the run or after a delay timer. But, data will not be recorded during the time intervals due to the fact that the sensor(s) will be off/deactivated, *e.g.* during a time period in which vibrations are sensed. In this aspect, when drilling ceases, which results in vibrations ceasing, data will be taken, and may preferably continue to be taken, in accordance with the time intervals scheme initiated at the surface, and preferably may always running in the background even when the sensor(s) is/are off or deactivated (*e.g.*, asleep).

[0099] In a further aspect, the at least one electronic instrument 40 can log and/or record orientation related data down hole at intervals (regular or randomly generated intervals within minimum and maximum interval time limits) and can also measures total lapsed survey time T.

[00100] In a further aspect, the at least one electronic instrument 40 can be started by an external communication device at the surface but a second, different, communication device can be used to 'mark' (to set) the point in time, *i.e.*, to commence the elapsed period of time t relating to breaking the core sample from the underlying rock and thereby be used for identifying the data set recorded immediately before that break.

[00101] In one aspect, to compensate for taking regular or random time period orientation measurements, which uses up battery power as the at least one electronic instrument 40 advances down hole, a start delay can be provided. For example, when the external communication device at the surface is operated, *e.g.*, turned on, an option to set a delay time in the at least one electronic instrument 40 may be displayed. For example, a delay in minutes between 0 to 99 minutes might be displayed. In this aspect, when the at least one electronic instrument 40 is started-up and the communication device communicates the delay period to the at least one electronic instrument 40, the timer in the at least one electronic instrument 40 will allow the delay period to elapse before any orientation measurements are recorded.

[00102] In one aspect, orientation data can be recorded while drilling is ceased and closest to time Tx, where Tx is preferably less than or equal to T-t, and where T is the time recorded by the at least one electronic instrument 40 (survey time) and t is the elapsed time recorded by the external communication device that was commenced once drilling ceased and the orientation data was recorded. In this exemplary aspect, it will be appreciated that the required recorded data may be at a time Tx greater than T-t, *i.e.*, if the drilling remained ceased after commencing the elapsed time and separating (breaking) the core sample from the rock was delayed while the at least one electronic instrument 40 recorded orientation data. Thus, Tx can be greater than T-t providing no drilling activity takes place after drilling ceases and before the core is broken from the underlying rock. In this aspect, in operation, when the core barrel head assembly 30 is retrieved back at the surface with the core sample), the external communication device interrogates the at least one electronic instrument 40 to identify the recorded core orientation data closest to T-t, *i.e.*, the timer of the external communication device is not synchronised to the timer of the at least one electronic instrument 40, and both timers are not commenced at a reference time.

[00103] For example and without limitation, orientation data may be recorded by the at least one electronic instrument 40 at regular irregular intervals of time within a known range of allowed time intervals, such as one or more of 10s, 15s, 20s or 30s intervals within a range of 1s to 1 minute. It is contemplated that the time intervals can

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be generated by a random (time) number generator operating within the minimum and maximum allowed range. Thus, the time intervals for obtaining orientation data may be repeated (e.g. 10s, 10s, 10s, 20s, 20s, 10s…). In this exemplary aspect, data recording events ('shots') are therefore not constantly taken on a set time period. However, it is contemplated that predetermined set time intervals may be used. That is, the at least one electronic instrument 40 may record orientation data every time interval, preferably up until the core is broken form the underlying rock, though recording may also continue afterwards.

[00104] In operation, the at least one electronic instrument 40 can be deployed down hole. Optionally, the at least one electronic instrument 40 can be started at the surface and its timer commence the survey time timing at the surface, or the timer can have a delay to save power until the at least one electronic instrument 40 is all or partway down the borehole. Subsequently, when the core sample has been captured sufficiently in the core tube, drilling ceases and during this period of non-drilling, the at least one electronic instrument 40 records orientation data relating to its own orientation in the borehole, and therefore, of the associated core sample that is captured in the core barrel head assembly 30, which cannot rotate unless the at least one electronic instrument 40 also rotates. Next, the core sample is broken away from the underlying rock and the core barrel head assembly 30 is retrieved to the surface.

[00105] In one aspect, an external communication device can record the elapsed time t by a user, *i.e.*, commencing the timer in the handheld external communication device at the surface. This is preferably either when drilling has ceased or immediately before breaking the core from the rock while drilling has ceased, or immediately after the core is broken. However, it will be appreciated that the elapsed time can be commenced after the core is broken away from the underlying rock because the at least one electronic instrument 40 can be programmed to identify the nearest recorded data older than the commencement of the elapsed time that occurred during no drilling. In this aspect, the external communication device retains a record of the elapsing time.

[00106] When the at least one electronic instrument 40 and core barrel head assembly 30 containing the core sample are retrieved to the surface, the user can

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interrogate the at least one electronic instrument 40. In this aspect, once the at least one electronic instrument 40 confirms receiving the interrogation command, the communication device can command halting of the survey time T (stopping the at least one electronic instrument 40's timer) and elapsed time t (stopping the external communication device's timer). In this aspect, the external communication device can instruct the at least one electronic instrument 40 to identify the recorded orientation data from immediately before or after the commencement of the elapsed period of time going back from the end of the survey time, *i.e.*, the at least one electronic instrument 40 has to 'look back' in time for the data recorded at or around the elapsed ago. In this aspect, the at least one electronic instrument 40 subtracts the elapsed time t from its survey time T to provide a time Tx associated with the required recorded data obtained when drilling was ceased.

[00107] In this aspect, once the correct recorded orientation data is identified in its memory, the at least one electronic instrument can go into orientation mode so that the core sample can be orientated and that orientation recorded. In one exemplary aspect, recording of orientation data by the at least one electronic instrument 40 is triggered on a time interval basis; this may be by the regular or random time intervals mentioned above. Recording the orientation data may only commence once the time delay has ended. For example, the timer within the at least one electronic instrument 40 may be running from deployment (or before) of the device into the borehole. However, the delay may prevent the device from recording orientation data until the delay has ended. Once the delay has ended, orientation data is recorded according to the prevailing time interval sequence, *i.e.*, randomly generated time intervals or regular time intervals.

[00108] Optionally, when vibration or other motion of the at least one electronic instrument 40 stops down hole sufficiently, the at least one electronic instrument 40 may resume recording orientation data according to the prevailing time interval regime or may switch to another time interval regime for sensing and recording orientation.

[00109] Optionally, the at least one electronic instrument 40 can be programmed to identify core orientation data recorded before breaking of the core sample but based on an elapsed time period commenced after breaking the core sample. The at least

one electronic instrument 40 can be programmed to identify the recorded orientation data that that was recorded before commencement of the elapsed time. In a further aspect, the recorded data can be recorded after breaking of the core sample because of the time interval recording regime. In this aspect, if that data set was recorded while nothing was moving down hole (and has not moved since breaking the core), the data set can be trusted to be sufficiently accurate. It can be compared with one or more previous data sets, and if they concur, then can be deemed sufficiently accurate for orientation purposes. Only one of those data sets is needed and any other of them may be discarded or disregarded.

[00110] In a further aspect, it is contemplated that operation of the at least one electronic instrument 40 to commence recording orientation data can be initiated at the surface and device then deployed into the borehole. Commencement of recording orientation data can also be delayed, so as to save battery power by avoiding taking unnecessary or unusable orientation measurements whilst the device is progressing down the borehole. Orientation measurement immediately before or after breaking the core sample from the underlying rock is/are required. In one exemplary aspect, the at least one electronic instrument 40 can have a delay preventing recording of orientation data until the delay ends.

[00111] In another aspect, the at least one electronic instrument 40 can take orientation measurements periodically, such as at random or regular periods of time, and record one or more of those measurements. Preferably the at least one electronic instrument 40 can be in a sleep mode, change to a power-up (wake-up) mode and then take a measurement, and re-enter sleep each interval. In one aspect, if two or more consecutive orientation measurements are the same, the at least one electronic instrument 40 can ignore, not record or delete from memory unnecessary repeat measurements and only retain one of the repeat measurements, preferably being the first of the identical measurements. In this aspect, each recorded measurement of orientation can be tagged or 'time stamped', preferably relative to the timer running in the at least one electronic instrument 40, *i.e.*, the recorded orientation data is given a time stamp Tx, where x is the particular time within the survey timeframe running in the

device. Thus, Tx is the time since the survey time T commenced that that orientation data set was recorded. It is contemplated that Tx can be a real time or cumulative time since commencement of the survey time T. Thus, in this aspect, the at least one electronic instrument 40 can have a real time clock type timer or a 'start-stop' (counter or stopwatch) type timer. When drilling ceases and the core is to be broken from the underlying rock (because there is sufficient core sample in the core barrel), a 'mark' is taken, which commences an elapsed time t at the surface. In this aspect, it is contemplated that this mark can be taken before or after the break at either regular or irregular time intervals.

[00112] Referring now to Figure 14, an exemplary known hand held device 400 which receives wirelessly receives data or signals from the communication means of the core barrel head assembly. In this aspect, communication means of the core barrel head assembly comprises a transmitter which can use line of sight data transfer through the window, such as by infra-red data transfer, or a wireless radio transmission. The communication device 400 can store the signals or data received from the communication means of the core barrel head assembly. In one aspect, the communication device 400 can comprise a display 402, navigation buttons 404, 406, and a data accept confirmation button 408.

[00113] In one aspect, setting up of the core barrel head assembly 30 can be carried out before insertion into the drill hole. Data retrieval can be carried out by infrared communication between the communication means of the core barrel head assembly and a core orientation data receiver or communication device 400. In this aspect, after recovering the core sample inner tube back at the surface, and before removing the core sample from the tube, the operator can optionally remove the head assembly. The operator can use the remote communication device to obtain orientation data from the communication means of the core barrel head assembly using a line of sight wireless infrared communication between the remote device and communication means of the core barrel head assembly. However, it will be appreciated that communication of data between the communication means of the core barrel head assembly and the communication device 400 can be by other wireless means, such as by radio transmission.

[00114] In this prior art aspect, the whole inner tube, core sample, and core barrel head assembly can be rotated as necessary to determine a required orientation of the core sample. The indicators on the proximal end of the core barrel head assembly indicate to the operator which direction, clockwise or anti-clockwise, to rotate the core sample. One color of indicator can be used to indicate clockwise rotation and another color can be used to indicate anticlockwise rotation is required. This is carried out until the core sample is oriented with its lower section at the lower end of the tube. The core sample is then marked for correct orientation and then used for analysis.

[00115] In one aspect, it is contemplated that the visual and/or audible orientation indicators, under certain site and/or environmental conditions, may not be sufficiently visible or audible. Thus, an additional or alternative means and/or method may be utilized to ensure that the core sample has been correctly oriented. In this embodiment, the exterior surface 61 of the body of the core barrel head assembly 30 can have angular degree marks that optionally are scribed/ etched, machined, molded or otherwise provided, such as by printing or painting, on the exterior surface 61. For example, dashes can be equally spaced around the outside parameter represent one or more angular degrees of the full circle or perimeter. Further scribing of a number every five dashes starting with the number 0 then 5, 10, 15 etc. until 355.

[00116] When the core is retrieved and the communication means of the core barrel head assembly communicates with the hand held communicator 400, additional information can be transmitted from the core barrel head assembly to the communicator 400, such as a number between zero 0 and 359 (inclusive) denoting an angular degree of rotation of core barrel head assembly and the core sample. When the core is oriented during one or more embodiments of the method of the present invention, the numerical scribing the core barrel head assembly should be the same as the number transmitted, to the communicator 400, which re-confirms correct orientation. Thus, if the visual or audible means for indicating core orientation are not useful or available, then the core can be oriented using the angular degree arrangement to match the transmitted number, and then can be audited using the communicator 400.

[00117] Embodiments of the present invention provide the advantage of a fully operating down hole core barrel head assembly without having to disconnect or

disassemble any part of the tool/device from the inner tube and/or from the head assembly or any other part of the drilling assembly that the core barrel head assembly would need to be assembled within for its normal operation. Disconnecting or disassembling the core barrel head assembly from the head assembly and/or inner tube risks failure of seals at those connections and/or risks cross threading of the joining thread. Also, because those sections are threaded together with high force, it takes substantial manual force and large equipment to separate the sections. High surrounding pressure in the drill hole means that the connecting seals between sections function to prevent water and dirt from ingressing into and damaging the device.

[00118] Although several embodiments of the invention have been disclosed in the foregoing specification, it is understood by those skilled in the art that many modifications and other embodiments of the invention will come to mind to which the invention pertains, having the benefit of the teaching presented in the foregoing description and associated drawings. It is thus understood that the invention is not limited to the specific embodiments disclosed hereinabove, and that many modifications and other embodiments are intended to be included within the scope of the appended claims. Moreover, although specific terms are employed herein, as well as in the claims which follow, they are used only in a generic and descriptive sense, and not for the purposes of limiting the described invention, nor the claims which follow.

What is claimed is:

1. A core barrel head assembly, comprising:

an elongate tube body defining a selectively sealed interior cavity;

at least one electronic instrument that is configured to obtain orientation data mounted therein the sealed interior cavity, wherein the at least one electronic instrument comprises at least one digital and/or electro-mechanical sensors in a core orientation data recording tool that can be configured to determine a core orientation of a sample core just prior to or after the core break;

a power source in operable communication with the at least one electronic instrument, wherein the power source is mounted therein the interior cavity; and

communication means to receive and/or transmit core orientation data.

2. The core barrel head assembly of Claim 1, wherein the elongate tube body has a threaded proximal end for coupling to a wire line retrieval portion of a head assembly.

3. The core barrel head assembly of Claim 1, wherein the elongate tube body has a first interior cavity that extends distally to a base portion of the tube body.

4. The core barrel head assembly of Claim 3, wherein the selectively sealed interior cavity is spaced from and extends distally from the first interior cavity.

5. The core barrel head assembly of Claim 4, wherein a port is defined proximate the base portion of the sealed interior cavity that extends from the exterior surface of the elongate tube body into fluid communication with the first interior cavity.

6. The core barrel head assembly of Claim 5, wherein a pressure fitting is mounted in the port to allow for selective passage of fluid to and from the exterior surface of the barrel head assembly into communication with the first interior cavity

7. The core barrel head assembly of Claim 1, wherein the sealed interior cavity is sized and shaped to hermetically enclose at least one of the least one electronic instrument, the power source , and the communication means to receive and/or transmit orientation data.

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8. The core barrel head assembly of Claim 1, wherein the sealed interior cavity is sized and shaped to hermetically enclose the least one electronic instrument and the power source

9. The core barrel head assembly of Claim 1, further comprising a plurality of windows defined in the elongate tube body that extend from the exterior surface of the elongate tube body into optical communication with the sealed interior cavity proximate a closed proximal end of the sealed interior cavity

10. The core barrel head assembly of Claim 9, further comprising an orientation indicator module comprising a plurality of light emitters.

11. The core barrel head assembly of Claim 10, wherein the orientation indicator module is sized and shaped to sealingly close the sealed interior cavity from any intrusion of pressurized fluid into the sealed interior cavity via the plurality of windows.

12. The core barrel head assembly of Claim 10, wherein the orientation indicator module is configured to orient or otherwise position the plurality of light emitters so that each light emitter underlies one window.

13. The core barrel head assembly of Claim 10, wherein the orientation indicator module further comprises a first sealing means for preventing any pressurized fluid from entering the sealed interior cavity from the plurality of windows defined in the elongate tube body.

14. The core barrel head assembly of Claim 13, wherein the first sealing means comprises at least one O-ring seal that is mounted on an exterior portion of the orientation indicator module and that is configured to seal between an exterior portion of the orientation indicator module and a portion of an interior surface of the sealed interior cavity.

15. The core barrel head assembly of Claim 14, wherein the sealed interior cavity can comprised at least one orienting slot defined therein.

16. The core barrel head assembly of Claim 14, wherein a desired position of the orientation indicator module is maintained relative to at least one O-ring seal.

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17. The core barrel head assembly of Claim 1, wherein the sealed interior cavity extends distally to an open threaded distal end of the elongate tube body.

18. The core barrel head assembly of Claim 18, further comprising a seal coupler that is configured to be sealingly received in the open threaded distal end of the elongate tube body.

19. The core barrel head assembly of Claim 18, further comprises a second sealing means for preventing any pressurized fluid from entering the sealed interior cavity.

20. The core barrel head assembly of Claim 19, wherein the second sealing means comprises at least one O-ring seal that is mounted on a portion of the seal coupler and that is configured to seal between a portion of the seal coupler and a portion of an interior surface of the open distal end of the elongate tube body.

21. The core barrel head assembly of Claim 18, further comprising a check valve assembly configured to affect a hermetical seal of the sealed interior cavity and to provide fluid control for wire line operation.

22. The core barrel head assembly of Claim 21, wherein the check valve assembly comprises a coupled proximal end assembly and a distally tapered seat that defines an interior chamber for operative receipt of a check ball.

23. The core barrel head assembly of Claim 22, wherein the proximal end assembly defines a female threaded coupling that is configured to be threadably coupled to male threads defined on an exterior surface of a distal end of the elongate tube body.

24. The core barrel head assembly of Claim 23, wherein, when the proximal end assembly is threadably coupled to the distal end of the elongate tube body, the seal coupler is driven into a sealed position therein the sealed interior cavity to affect complete hermeticity.

25. The core barrel head assembly of Claim 22, wherein the interior chamber of the check valve assembly extends to a distal end of the check valve assembly, and wherein the check valve assembly further defines at least one port that extends from an

exterior surface of the check valve assembly and is in fluid communication with the interior chamber of the check valve assembly.

26. The core barrel head assembly of Claim 25, wherein the interior chamber has a distally tapered seat that is adapted to selectively receive the check ball that is sized to selectively block the distally tapered seat.

27. The core barrel head assembly of Claim 26, wherein the interior chamber is sized and shaped to allow the check ball to selectively move axially between an open position, in which the check ball is spaced proximally away from the surface of the tapered seat so that pressurized fluid can move through the distal end of the check valve assembly and subsequently through the interior chamber to exit out of the at least one port, and a closed position, in which the check ball is pressurized against the surface of the tapered seat so that pressurized fluid cannot move through the check valve assembly.

28. The core barrel head assembly of Claim 1, wherein an exterior surface of the elongate tube body defines a plurality of female planar stops proximate the mid-body portion.

29. The core barrel head assembly of Claim 1, wherein the at least one electronic instrument is programmed to obtain orientation data when the at least one electronic instrument senses no relative movement of the at least one electronic instrument.

30. The core barrel head assembly of Claim 29, wherein the at least one electronic instrument is programmed to obtain orientation data when the at least one electronic instrument senses no vibrations.

31. The core barrel head assembly of Claim 30, wherein the at least one electronic instrument does not take any orientation measurements if vibrations are sensed by the at least one electronic instrument.

32. The core barrel head assembly of Claim 29, wherein the at least one electronic instrument is programmed to not obtain orientation data when the at least one

electronic instrument determines that the core barrel head assembly is in motion while descending down or ascending up the hole and during drilling.

33. The core barrel head assembly of Claim 1, wherein the at least one electronic instrument is programmed to obtain orientation data based on a predetermined time interval scheme.

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ABSTRACT

A core barrel head assembly having at least one electronic instrument that is configured to obtain orientation data; a power source; and a communication means to receive and/or transmit orientation data for use in a core sample down hole surveying and sample orientation system that is configured to provide an indication of the orientation of a core sample relative to a body of material from which the core has been extracted, and also to a method of core sample orientation identification..

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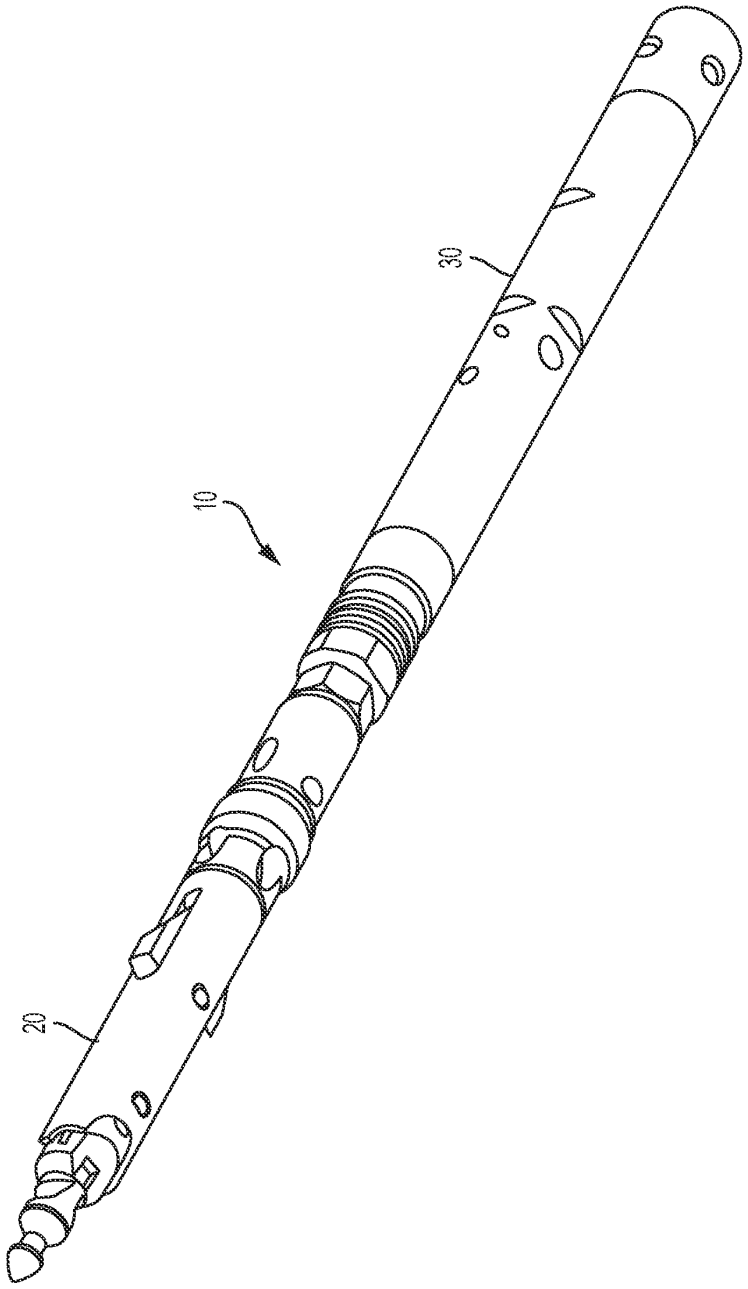


FIG. 1

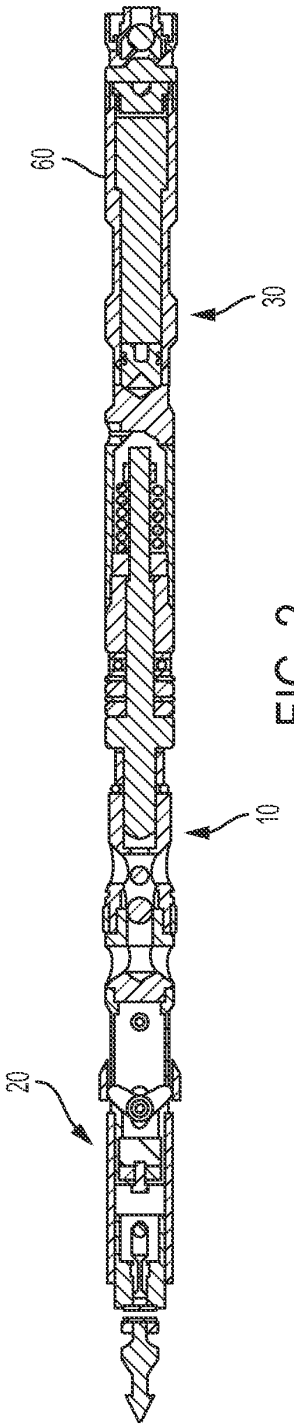

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FIG. 2

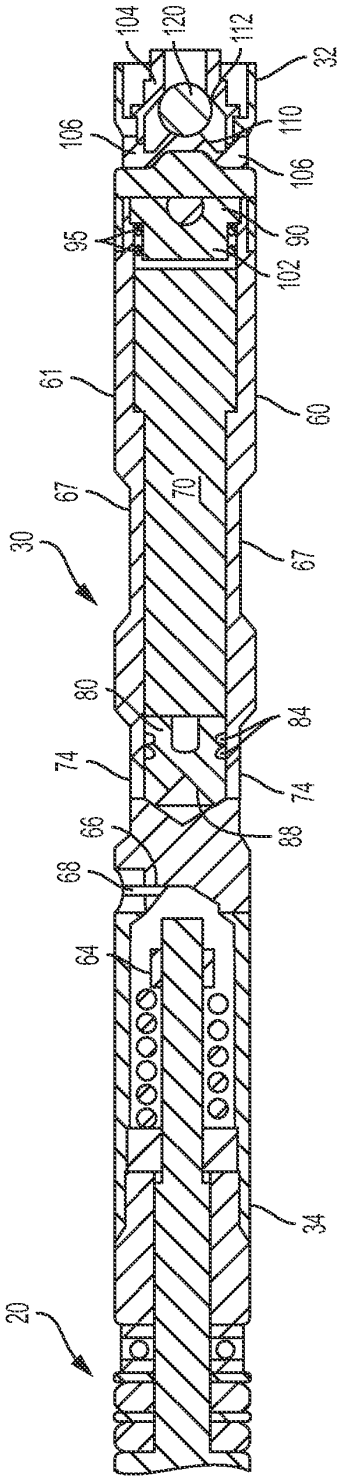

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FIG. 3

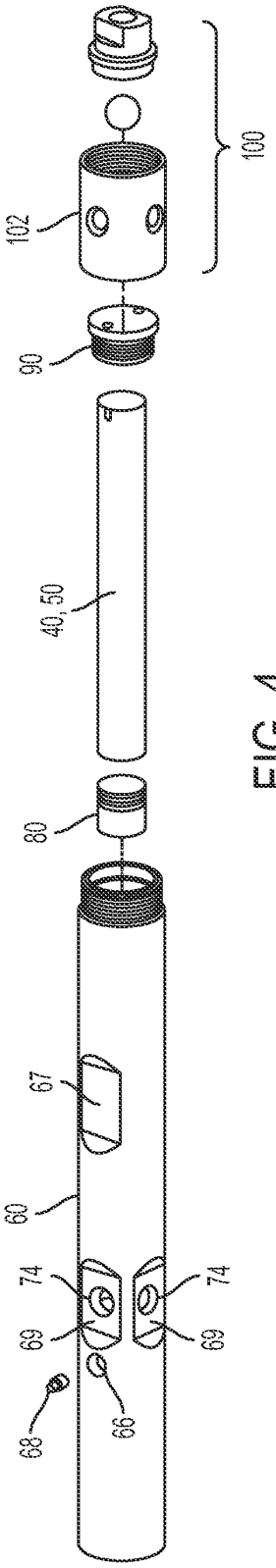

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FIG. 4

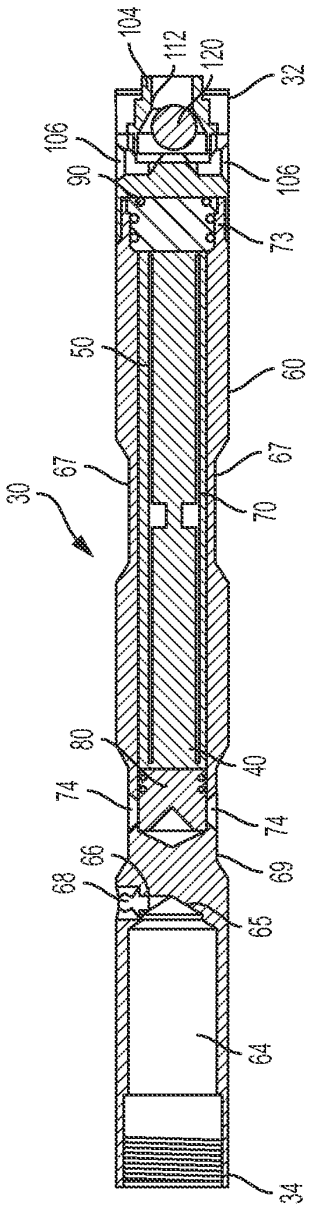

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FIG. 5

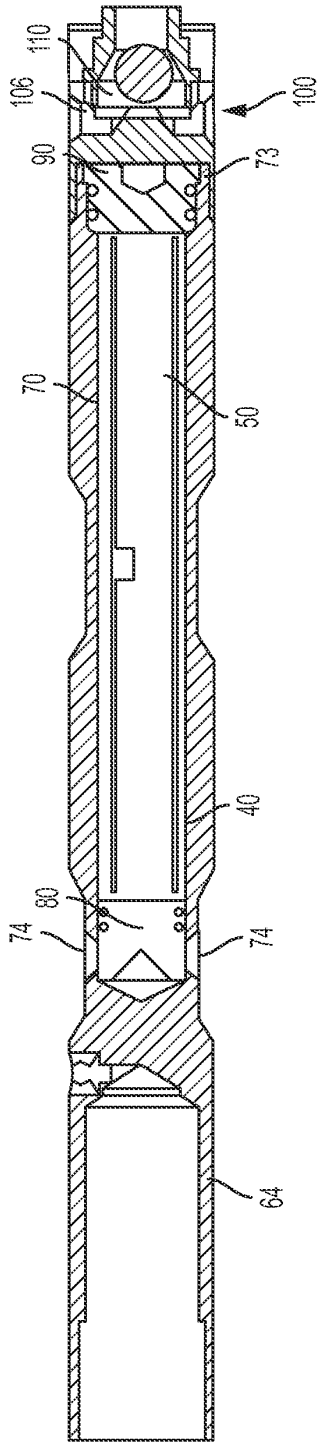


FIG. 6

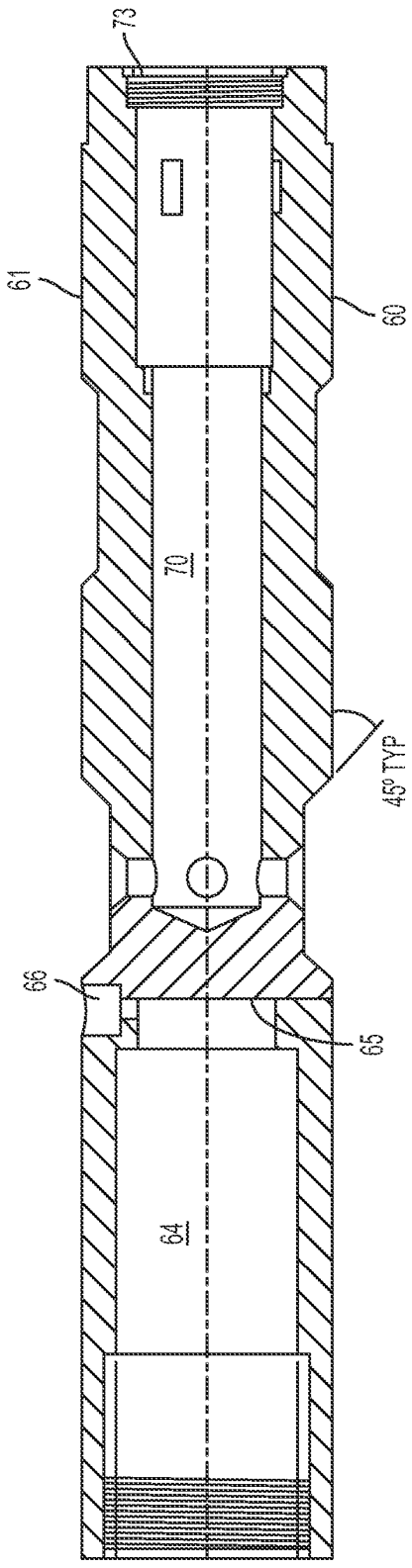


FIG. 7

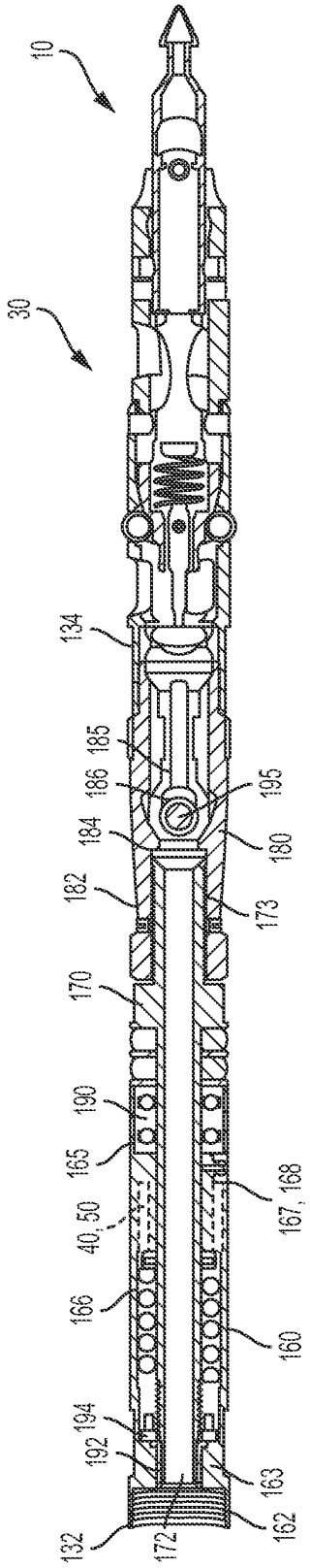

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FIG. 8

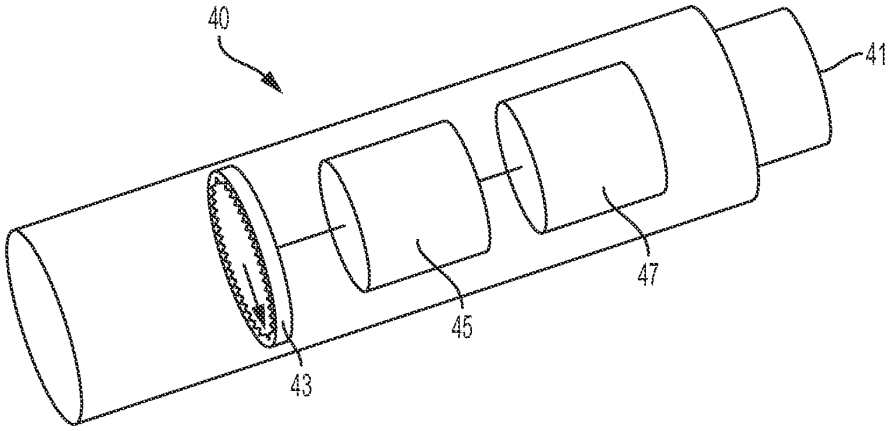


FIG. 9

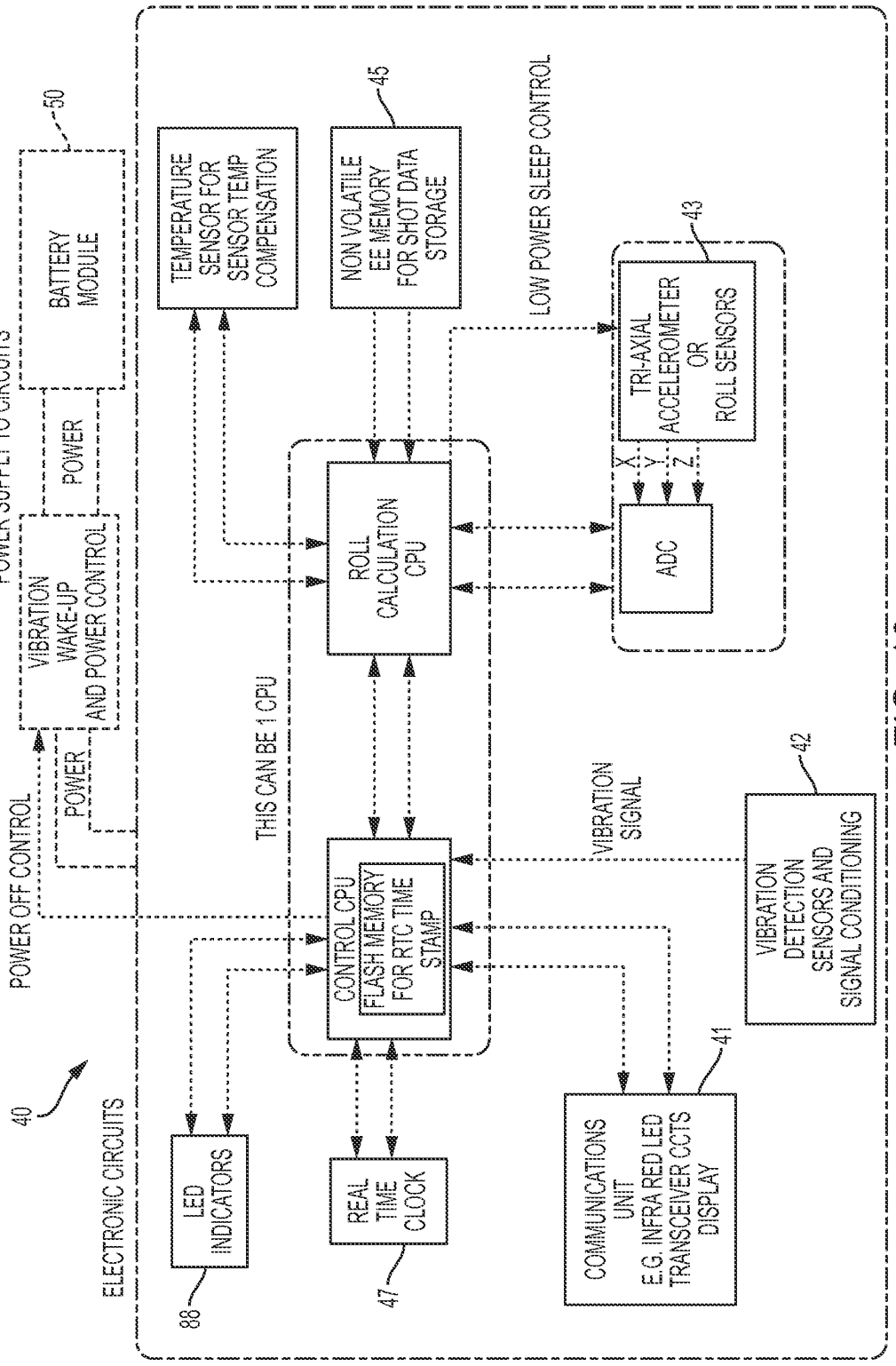

40
ELECTRONIC CIRCUITS
POWER OFF CONTROL
POWER SUPPLY TO CIRCUITS
POWER
VIBRATION WAKE-UP AND POWER CONTROL
BATTERY MODULE
50
THIS CAN BE 1 CPU
CONTROL CPU
FLASH MEMORY FOR RTC TIME STAMP
ROLL CALCULATION CPU
TEMPERATURE SENSOR FOR SENSOR TEMP COMPENSATION
NON VOLATILE EE MEMORY FOR SHOT DATA STORAGE
45
LOW POWER SLEEP CONTROL
TRI-AXIAL ACCELEROMETER OR ROLL SENSORS
43
X
Y
Z
ADC
VIBRATION SIGNAL
VIBRATION DETECTION SENSORS AND SIGNAL CONDITIONING
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LED INDICATORS
88
REAL TIME CLOCK
47
COMMUNICATIONS UNIT
E.G. INFRA RED LED TRANSCEIVER CCTS
DISPLAY
41

FIG. 10

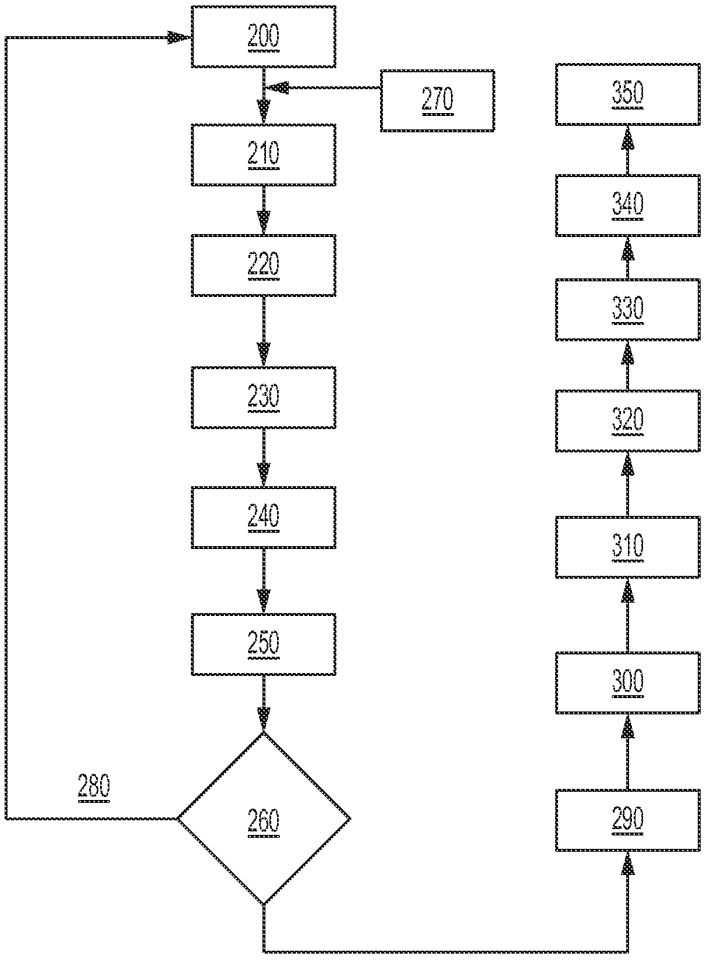


FIG. 11

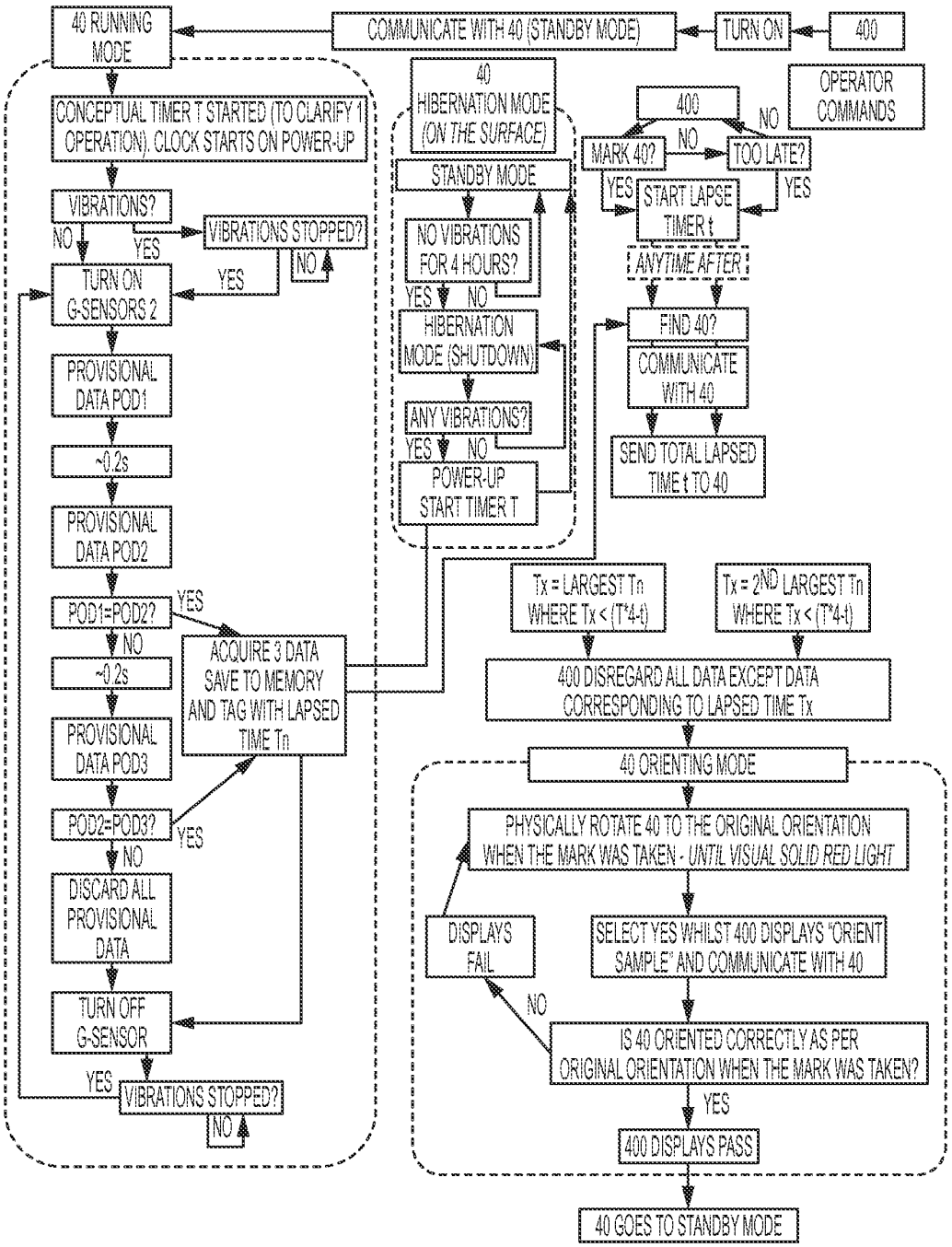

40 RUNNING MODE
COMMUNICATE WITH 40 (STANDBY MODE)
TURN ON
400
CONCEPTUAL TIMER T STARTED (TO CLARIFY 1 OPERATION). CLOCK STARTS ON POWER-UP
40 HIBERNATION MODE (ON THE SURFACE)
OPERATOR COMMANDS
400
NO
MARK 40?
NO
TOO LATE?
YES
START LAPSE TIMER t
YES
VIBRATIONS?
NO
YES
VIBRATIONS STOPPED?
NO
YES
STANDBY MODE
NO VIBRATIONS FOR 4 HOURS?
YES
NO
HIBERNATION MODE (SHUTDOWN)
ANY VIBRATIONS?
YES
NO
POWER-UP START TIMER T
ANYTIME AFTER t
FIND 40?
COMMUNICATE WITH 40
SEND TOTAL LAPSED TIME t TO 40
TURN ON G-SENSORS 2
PROVISIONAL DATA POD1
~0.2s
PROVISIONAL DATA POD2
POD1=POD2?
YES
NO
~0.2s
PROVISIONAL DATA POD3
POD2=POD3?
YES
NO
DISCARD ALL PROVISIONAL DATA
TURN OFF G-SENSOR
YES
VIBRATIONS STOPPED?
NO
ACQUIRE 3 DATA SAVE TO MEMORY AND TAG WITH LAPSED TIME Tn
Tx = LARGEST Tn WHERE Tx < (T*4-t)
Tx = 2ND LARGEST Tn WHERE Tx < (T*4-t)
400 DISREGARD ALL DATA EXCEPT DATA CORRESPONDING TO LAPSED TIME Tx
40 ORIENTING MODE
PHYSICALLY ROTATE 40 TO THE ORIGINAL ORIENTATION WHEN THE MARK WAS TAKEN - UNTIL VISUAL SOLID RED LIGHT
DISPLAYS FAIL
SELECT YES WHILST 400 DISPLAYS "ORIENT SAMPLE" AND COMMUNICATE WITH 40
NO
IS 40 ORIENTED CORRECTLY AS PER ORIGINAL ORIENTATION WHEN THE MARK WAS TAKEN?
YES
400 DISPLAYS PASS
40 GOES TO STANDBY MODE

FIG. 12

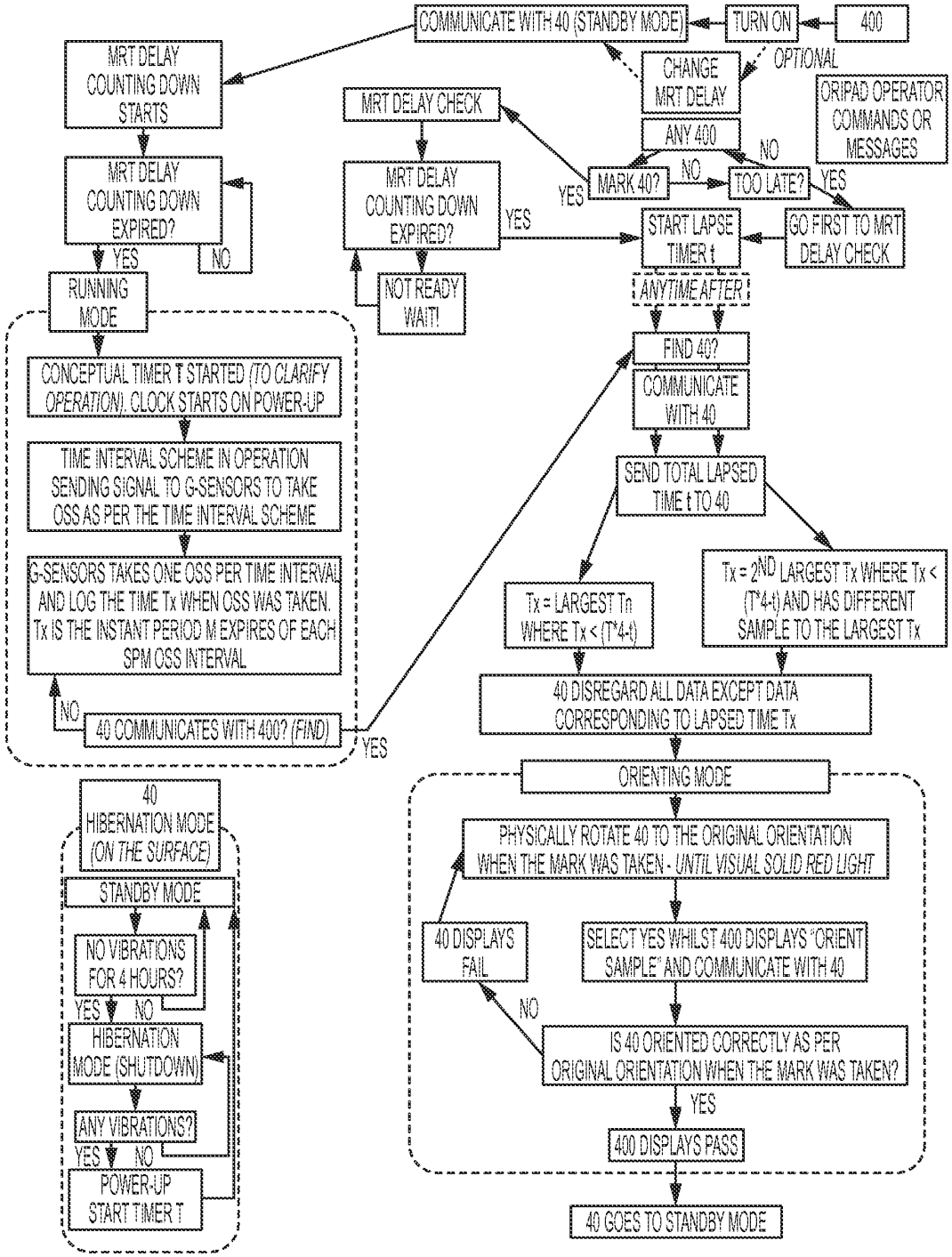

COMMUNICATE WITH 40 (STANDBY MODE)
TURN ON
400
OPTIONAL
CHANGE MRT DELAY
ORIPAD OPERATOR COMMANDS OR MESSAGES
MRT DELAY COUNTING DOWN STARTS
MRT DELAY CHECK
ANY 400
NO
MRT DELAY COUNTING DOWN EXPIRED?
MARK 40?
NO
TOO LATE?
YES
YES
MRT DELAY COUNTING DOWN EXPIRED?
YES
START LAPSE TIMER t
GO FIRST TO MRT DELAY CHECK
YES
NO
RUNNING MODE
NOT READY WAIT!
ANYTIME AFTER
FIND 40?
CONCEPTUAL TIMER T STARTED (TO CLARIFY OPERATION). CLOCK STARTS ON POWER-UP
COMMUNICATE WITH 40
TIME INTERVAL SCHEME IN OPERATION SENDING SIGNAL TO G-SENSORS TO TAKE OSS AS PER THE TIME INTERVAL SCHEME
SEND TOTAL LAPSED TIME t TO 40
G-SENSORS TAKES ONE OSS PER TIME INTERVAL AND LOG THE TIME Tx WHEN OSS WAS TAKEN. Tx IS THE INSTANT PERIOD M EXPIRES OF EACH SPM OSS INTERVAL
Tx = LARGEST Tn WHERE Tx < (T*4-t)
Tx = 2ND LARGEST Tx WHERE Tx < (T*4-t) AND HAS DIFFERENT SAMPLE TO THE LARGEST Tx
NO
40 COMMUNICATES WITH 400? (FIND)
YES
40 DISREGARD ALL DATA EXCEPT DATA CORRESPONDING TO LAPSED TIME Tx
ORIENTING MODE
40 HIBERNATION MODE (ON THE SURFACE)
PHYSICALLY ROTATE 40 TO THE ORIGINAL ORIENTATION WHEN THE MARK WAS TAKEN - UNTIL VISUAL SOLID RED LIGHT
STANDBY MODE
40 DISPLAYS FAIL
SELECT YES WHILST 400 DISPLAYS "ORIENT SAMPLE" AND COMMUNICATE WITH 40
NO VIBRATIONS FOR 4 HOURS?
YES
NO
NO
HIBERNATION MODE (SHUTDOWN)
IS 40 ORIENTED CORRECTLY AS PER ORIGINAL ORIENTATION WHEN THE MARK WAS TAKEN?
ANY VIBRATIONS?
YES
YES
NO
400 DISPLAYS PASS
POWER-UP START TIMER T
40 GOES TO STANDBY MODE

FIG. 13

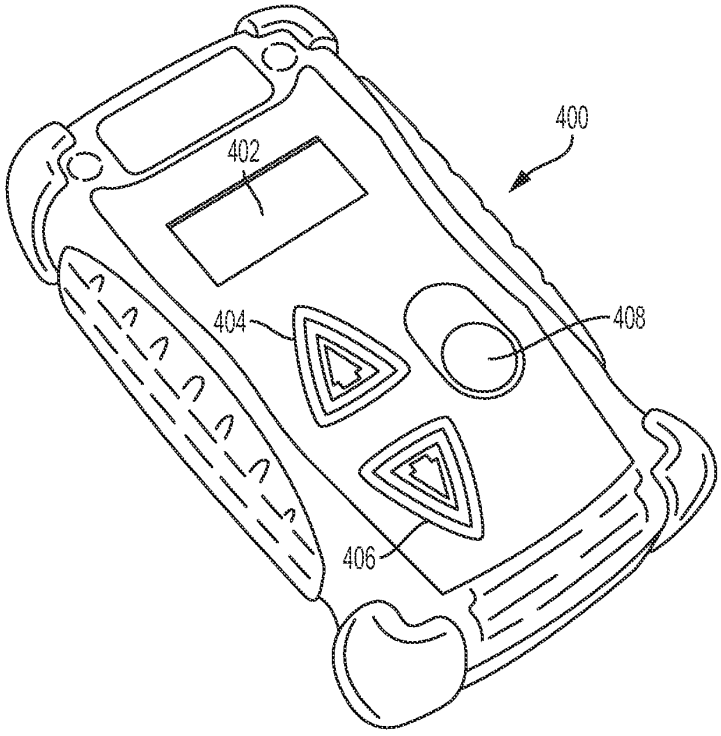


FIG. 14

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	CORE BARREL HEAD ASSEMBLY WITH AN INTEGRATED SAMPLE ORIENTATION TOOL AND SYSTEM FOR USING SAME
First Named Inventor/Applicant Name:	CHRISTOPHER L. DRENTH
Filer:	Kean J. DeCarlo/Sharon DeLee
Attorney Docket Number:	36362.0150U2-

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Utility application filing	1011	1	280	280
Utility Search Fee	1111	1	600	600
Utility Examination Fee	1311	1	720	720
Pages:				
Claims:				
Claims in Excess of 20	1202	13	80	1040
Miscellaneous-Filing:				
Late Filing Fee for Oath or Declaration	1051	1	140	140

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**2780**

Electronic Acknowledgement Receipt

EFS ID:	22127885
Application Number:	14692484
International Application Number:	
Confirmation Number:	3851
Title of Invention:	CORE BARREL HEAD ASSEMBLY WITH AN INTEGRATED SAMPLE ORIENTATION TOOL AND SYSTEM FOR USING SAME
First Named Inventor/Applicant Name:	CHRISTOPHER L. DRENTH
Customer Number:	23859
Filer:	Kean J. DeCarlo
Filer Authorized By:	
Attorney Docket Number:	36362.0150U2-
Receipt Date:	21-APR-2015
Filing Date:	
Time Stamp:	17:53:29
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$2780
RAM confirmation Number	4933
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Authorization for Extension of Time all replies	36362_0150U2_Authorization_to_Treat_Reply_Requiring_EOT.PDF	25461 1954acfb7bb4c00dc8a92b7e77c1aa414d09d202	no	1
Warnings:					
Information:					
2	Application Data Sheet	36362_0150U2_Application_Data_Sheet.PDF	1561560 1941755199998d9089baf8dabcda09fb6a2d6403a	no	7
Warnings:					
Information:					
3		36362_0150U2_Application.pdf	361330 0869d2120e834624bb43ae415d562cedd540bb53	yes	50

Multipart Description/PDF files in .zip description

Document Description	Start	End
Specification	1	32
Claims	33	37
Abstract	38	38
Drawings-only black and white line drawings	39	50

Warnings:					
Information:					
4	Fee Worksheet (SB06)	fee-info.pdf	38562 e75f993823901655bc38d64ca0301a5913b1aafb	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	1986913		

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

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

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