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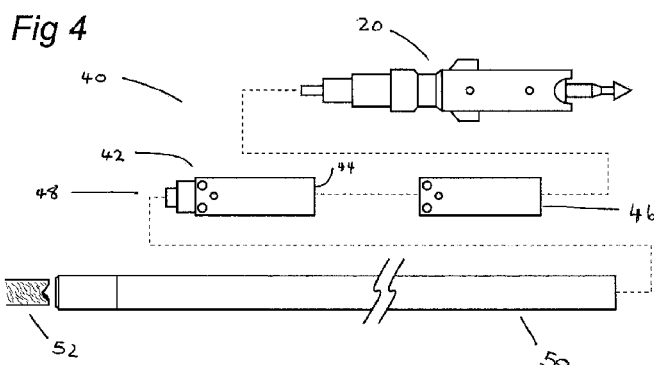
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(54) Title: CORE SAMPLE ORIENTATION SYSTEM, DEVICE AND METHOD



(57) **Abstract:** A core sample orientation system 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 recovered. A hermetically sealed core sample orientation data gathering device (42) is deployable as part of a downhole core sample assembly, the device including communication means arranged to communicate obtained core sample orientation data to a remote orientation data indication display device (60) having an orientation data display. The data gathering device can have visual indicators (74, 76), such as LED lights, which may light a reflector (86) to emit the indicating light through one or more apertures (84) in a sidewall of the assembly. Also disclosed is a method of obtaining core sample orientation data includes deploying a core sample orientation data gathering device as part of a core sample gathering system, obtaining a core sample from a subsurface body of material using the orientation data gathering device, using the orientation data gathering device to determine the orientation of the core sample relative to the subsurface body of material, and using a remote communication device to obtain from said orientation data gathering device data relating to the orientation of the core sample.

CORE SAMPLE ORIENTATION SYSTEM, DEVICE AND METHOD

TECHNICAL FIELD

The present invention relates to a system, device and method for use in determining the orientation of a core sample relative to a body of material from which the core sample has been obtained.

BACKGROUND

Core orientation is the process of obtaining and marking the orientation of a core sample from a drilling operation. The orientation of the sample is determined with regard to its original position in a body of material, such as rock or ore deposits underground.

Core orientation is recorded during drilling, and analysis is undertaken during core logging. The core logging process requires the use of systems to measure the angles of the geological features, such as an integrated core logging system.

Whilst depth and azimuth are used as important indicators of core position, they are generally inadequate on their own to determine the original position and attitude of subsurface geological features. Core orientation i.e. which side of the core was facing the bottom (or top) of a borehole and rotational orientation compared to surrounding material, enables such details to be determined.

Through core orientation, it is possible to understand the geology of a subsurface region and from that make strategic decisions on future mining or drilling operations, such as economic feasibility, predicted ore body volume, and layout planning. In the construction industry, core orientation can reveal geological features that may affect siting or structural foundations for buildings

Core samples are cylindrical in shape, typically around 3 metres long, and are obtained by drilling with an annular hollow core drill into subsurface material, such as sediment and rock, and recovering the core sample. A diamond tipped drill bit is used at the end of the hollow drill string. As the drill progresses deeper, more sections of hollow steel drill tube are added to extend the drill string. An inner tube assembly captures the core sample. This inner tube assembly

remains stationary while the outer tubes rotate with the drill bit. Thus, the core sample is pushed into the inner tube.

A 'back end' assembly connects to a greaser. This greaser lubricates the back end assembly which rotates with the outer casing while the greaser remains stationary with the inner tubing.

Once a core sample is cut, the inner tube assembly is recovered by winching to the surface. After removal of the back end assembly from the inner tube assembly, the core sample is recovered and catalogued for analysis.

Various core orientation systems have previously been used or proposed. Traditional systems use a spear and clay impression arrangement where a spear is thrown down the drill string and makes an impression in clay material at an upper end of the core sample. This impression can be used to vindicate the orientation of the core at the time and position the spear impacted the clay.

A more recent system of determining core orientation is proposed in Australian patent number 2006100113 (also as US patent number 7,584,055). This patent document describes a core orientation device for a core drill. The device provides signals associated with a physical orientation of a core orientation device for a particular moment in time. The device includes a memory for storing and providing the orientation data when required. The system described in AU 2006100113 provides a two unit replacement for the greaser described above. A first orientation system unit houses electronics and a battery used to record orientation data, and the second greaser unit is an extended greaser accommodating a physical screw on connector for the first unit as well as serving as the greaser. This combination forms part of the inner tube assembly with the core tube, orientation system 'first' unit and the connector/greaser 'second' unit. However, as a result of the now extended length of the combined orientation system and greaser units compared with a standard greaser only unit, the outer drill string casing now requires a matching extension piece to extend the outer casing an equal amount. The core orientation system has a display on one face which is used when setting up the unit prior to deployment, and to indicate core sample alignment when the core sample is recovered. At the surface before removing the core sample from the inner tube assembly, the operator views the display fitted on the system. The display indicates for the operator to rotate the

unit and the sample within the tube until the whole core tube and sample is oriented with the lower section of the core sample at the lower end of the tube. The core sample is marked (usually by pencil) before being removed from the core for future analysis.

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.

It has therefore been found desirable to provide an improved core orientation system, device and method that alleviates these problems whilst facilitating more reliable data recovery.

SUMMARY OF THE INVENTION

With the aforementioned in view, in one aspect the present invention provides a core sample orientation system configured to provide an indication of the orientation of a core sample relative to a body of material from which the core has been recovered, the system including a hermetically sealed core sample orientation data gathering device deployable as part of a downhole core sample assembly, the device including communication means arranged to communicate obtained core sample orientation data to a remote orientation data indication display device having an orientation data display.

A further aspect of the present invention provides a hermetically sealed core sample orientation data gathering device when deployed as part of a core sample orientation system for providing an indication of the orientation of a core sample relative to a body of material from which the core has been extracted, the

orientation data gathering device including communication means for providing core sample orientation data to a remote orientation data electronic device having an orientation data display.

Thus, the orientation data gathering device of the present system being hermetically sealed avoids risk of ingress of liquid when the downhole, thereby leading to more reliable data gathering operations without the need to recover the device prematurely in order to repair or replace a faulty device, or risk completing a core sampling operation but find at the surface that no data can be recovered and the core orientation cannot be accurately determined.

The orientation data gathering device may be connected to a standard greaser unit, thereby allowing known equipment to be used and avoiding the need for specialised greaser to be adopted. Because the orientation data gathering device is hermetically sealed to ensure no liquid gets in to the device when deployed downhole, and the device has communication means to send data signals to a remote display, no o-ring seal to the greaser is required. This saves on unreliable o-ring seals, reduces risk of damage through water ingress and loss of data, as well as the time saved in not having to recover the damaged device and redeploy a replacement.

The system may further include timer means to commence multiple time intervals for the device to obtain orientation data. A time interval may be synchronised at an orientation reading time and the time interval related to a predetermined time interval. This may be achieved by use of the remote orientation data electronic communication device.

System start up, setup, stop and data recovery functions may be carried out using the remote orientation data electronic communication device to operate the orientation data gathering device.

The orientation data gathering device may have one or more visual indicators to show an operator one or more required directions of rotation of a recovered core sample assembly for determining orientation of the core sample, and once a required core sample orientation has been established, the remote orientation data electronic communication device may interrogate the orientation data gathering device to obtain orientation data.

Communication between the orientation data gathering device and the remote orientation data electronic communication device is by wireless communication, such as infra red communication.

The remote orientation data electronic communication device may include a display to show visual information relating to the obtained orientation data, such as an indication that sufficient data has been obtained, that the data is correctly and safely stored and/or that data has been transferred from the orientation data gathering device to the remote orientation data electronic communication device.

The orientation data gathering device may include one or more visual and/or audible indicators relating to a direction of rotation of the device when determining core sample orientation and/or when a required core sample orientation has been determined. For example, illuminated indicators may be provided on the device, such as on an end of the exposed when the greaser is removed. A particular colour, number of lights or direction indication may illuminate to indicate that the device and the core sample need rotating in one direction, and a different colour, number of lights or direction indication may illuminate to show an opposite rotation direction is needed. These may be augmented by or replaced by audible indications, such as respective numbers of 'beeps'. An illuminated and/or audible indication may be given when a required core sample orientation is achieved. For example, both direction lights or audible signals may be given at the same time.

The remote orientation data communication device may also give an indication of the required direction of rotation and/or required core sample orientation.

The remote orientation data communication device may include or be a handheld unit. This unit may include a battery for power, which may be a rechargeable battery.

A further aspect of the present invention provides a method of obtaining core sample orientation data, the method including:

- a) deploying a core sample orientation data gathering device as part of a core sample gathering system;
- b) obtaining a core sample from a subsurface body of material using the apparatus;

- c) using the orientation data gathering device to determine the orientation of the core sample relative to the subsurface body of material; and
- d) using a remote communication device to obtain from said orientation data gathering device data relating to the orientation of the core sample.

The method may further include hermetically sealing the core sample orientation data gathering device prior to deployment.

Following recovery of the device, core orientation indications may be given by one or more illuminated and/or audible indications. Coloured indications may be used to determine a required orientation of the core sample. For example, the orientation data gathering device may include lights, such as LEDs, whereby an indication is given to rotate the core sample in a first direction or in a second opposite direction to obtain a required core sample orientation position, or lights may be used to indicate when a required orientation position has been obtained.

The method may include deploying the orientation data gathering device leading a greaser. The greaser device may preferably be a standard greaser.

Multiple time intervals may be measured by the device. These time intervals can be used to determine data gathering events, such as position, magnetic flux, gravity, velocity etc. A time interval can be synchronised to a specific downhole data gathering event.

Data may be obtained from the orientation data gathering device by communication with a remote device, such as by an infra red link or other wireless communication, such as radio link, between the orientation data gathering device and an orientation data communication device.

A data gathering device according to one or more forms of the present invention does not continuously take 'core orientation' readings while in use. Instead, such a device determines when the device is 'motionless' (through its in-built firmware algorithms and sensors) before taking orientation readings. This arrangement of orientation recording confirms that the device only records valid data, i.e. while motionless, as the in-built sensors would otherwise present faulty or indeterminate readings.

If an operator erroneously selects a time interval for 'core orientation' (via the handheld unit while the data gathering device is still in motion), after retrieving the core sample, algorithms programmed into the device will determine the 'best-approximate' time interval relative to the device being 'steady' or 'motionless' at a time before or after a time selection by the operator using a hand held unit to communicate with the device as part of an embodiment of the system. The event and time difference will also be reported to the operator to confirm acceptance of that recorded data.

After core retrieval, the data gathering device provides an indication, using one or more light emitting diodes (LEDs), used to determine correct orientation of the core sample after rotating the device and core tube assembly in either direction (no indication of left or right direction is required). The LEDs do not necessarily indicate direction, but provides 'multi-level-speed' LED flashing rates, followed by a steady ON state LED illumination to determine correct core orientation.

According to one or more embodiments of the present invention, before inserting the down-hole data gathering device into a drill hole, and after retrieving the same unit with the obtained core sample, the wireless handheld unit can start/stop or interrogate the down-hole device without having to remove or unscrew the unit from the drill-string or core tube sections. The handheld unit does not need to be attached, screwed in, mounted to or wedged to any part of the tubing or GCOU assembly during any operation).

Start/stop operations, setting the exact time for orientation, interrogating and recording 'confirmed-accurate' operator orientation procedure, may all be performed using a remote wireless hand-held unit communicating with the data gathering device unit that was down the drill hole.

Visual indication of core sample orientation may be provided through at least one aperture in a sidewall of a section of a downhole assembly. Core sample orientation indications may be as light through at least one aperture in the sidewall of a section of the downhole assembly, such as a greaser unit. Core sample orientation visual indications may be provided from one or more light emitters via at least one light reflector, and preferably reflecting that emitted light out through the at least one aperture.

BRIEF DESCRIPTION OF THE DRAWINGS

Figures 1 and 2 show features of a known core sample orientation system.

Figures 3 and 4 show features of an arrangement of a core sample orientation system according to an embodiment of the present invention.

Figure 5 shows a core sample orientation data gathering device according to an embodiment of the present invention.

Figure 6 shows a hand held device for interrogating the core sample orientation data gathering device according to an embodiment of the present invention.

Figure 7 shows an indicator window end of a core sample orientation device according to an embodiment of the present invention wherethrough indicator lights can show when illuminated.

Figures 8a and 8b show an alternative embodiment of a data gathering device of the present invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

In figures 1 and 2, a known prior art inner tube assembly 10 replaces a standard greaser with a two unit system 14,16 utilising a specialised greaser unit 14 and electronics unit 16 particular to the two unit system. The electronics unit 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 has an LCD display 18 at one end. This allows for setting up of the system prior to deployment and to indicate visually alignment of the core sample when retrieved to the surface. The greaser unit is connected to a backend assembly 20 and the electronics unit 16 is connected to a sample tube 22 for receiving a core sample 24. The electronics unit is arranged to record orientation data every few seconds during core sampling. The start time is synchronised with actual time using a common stop watch. The units are then 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 stops the stop watch and retrieves the core sample tube back to the surface. At the surface, before removing the core sample from the inner tube, the operator views the LCD display 18, if it is still working, which steps the operator through

instructions to rotate the core tube 22 until the core sample 24 lower section is at the core tube lower end 26 . The core sample is then marked and stored for future analysis.

Referring to figure 2, the known electronics unit 16 of figure 1 includes accelerometers 28, a memory 30, a timer 32 and the aforementioned display 18.

The system 40 according to an embodiment of the present invention will hereinafter be described with reference to figures 3 to 6.

An outer drilling tube 34 consisting of connectable hollow steel tubes 34a-n has an extension piece 36 connected inline between two adjacent tubes in order to compensate the length of the outer drilling tube in relation to the additional length gained by the inner tube assembly 40 due to the core sample orientation data gathering device 42.

The core sample orientation data gathering device 42 is a fully sealed cylindrical unit with screw threads at either end. A first end 44 connects to a standard length and size greaser unit 46 and a second end 48 connects to a core sample tube 50. The greaser unit connects to a standard backend assembly 20.

There are no LCD display panels, indicators or switches mounted on the device. LED indicators are provided at one end 44, the greaser end, that are used in determining correct orientation of the core sample once the core and the device are recovered back at the surface. Figure 7 shows an example of the indicator end 44 of the core sample orientation data gathering device 42.

In figure 5, the core sample orientation data gathering device 42 is shown in close up. The end 44 for connecting to the greaser unit 46 includes a window (not shown in figure 5 - see figure 7). One or more LED lights are provided sealed within the device 42 behind the window. A coloured light indication is given to indicate which way (clockwise or anti-clockwise) the device 42 must be rotated to obtain a desired orientation of the core sample still within the inner tube assembly that is connected to the core sample orientation data gathering device 42. For example, a red light may be given to indicate to rotate the device (and thus the core sample) anticlockwise or to the left, and a green light may be given to indicate to rotate the device clockwise or to the right. A combined red and green indication, or a white light indication, or other indication can be given, such

as flashing lights, to indicate that the core sample is correctly orientated and ready for marking.

Figure 6 shows an embodiment of the hand held device 60 which wirelessly receives data or signals from the core sample orientation data gathering device 42. The core sample orientation data gathering device 42 includes 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 60 can store the signals or data received from the core sample orientation data gathering device 42. The communication device 60 includes a display 62 and navigation buttons 64,66, and a data accept/confirmation button 68. Also, the hand held device is protected from impact or heavy use by a shock and water resistant coating or casing 70 incorporating protective corners of a rubberised material.

Setting up of the device is carried out before insertion into the drill hole. Data retrieval is carried out by infra red communication between the core sample orientation data gathering device 42 and a core orientation data receiver (see figure 6) or communication device 60. After recovering the core sample inner tube back at the surface, and before removing the core sample from the tube, the operator removes the 'back end assembly, and the attached greaser unit. The operator then uses the remote communication device to obtain orientation data from the core sample orientation data gathering device using an line of sight wireless infra red communication between the remote device and the core sample orientation data gathering device. However, it will be appreciated that communication of data between the core sample orientation data gathering device 42 and the communication device 60 may be by other wireless means, such as by radio transmission.

The whole inner tube 50, core sample 52 and core sample orientation data gathering device 42 are rotated as necessary to determine a required orientation of the core sample. The indicators on the greaser end of the core sample orientation data gathering device 42 indicate to the operator which direction, clockwise or anti-clockwise, to rotate the core sample. One colour of indicator is used to indicate clockwise rotation and another colour to indicate anti-clockwise rotation is required. This is carried out until the core sample is orientated 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.

As shown in figure 7, the indicator window end 44 of the core sample orientation data gathering device 42 includes a window 72. 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 74 (red) LED illuminates to indicate to a user to rotate the device 42 anti-clockwise. The right hand 76 (green) LED illuminates to indicate to a user to rotate the device 42 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).

The visual and/or audible indicators, under certain site and/or environmental conditions, may not be sufficiently visible or audible. They may be hard to see in bright light conditions or hard to hear in loud working environments. Thus, an additional or alternative means and/or method may be utilised to ensure that the core sample has been correctly orientated. The outer casing or body or an end of the core sample data gathering device 42 may have angular degree marks. These may be scribed, etched, machined, moulded or otherwise provided, such as by printing or painting, on the device 42. For example, as shown in figure 7 dashes equally spaced around the outside parameter (each representing 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. When the core is retrieved and the orientation device communicates with the hand held communicator 60, additional information is transmitted from the orientation device to the communicator 60, such as a number between Zero and 359 (inclusive) denoting an angular degree of rotation of the core sample orientation data gathering device and the core sample. When the core is oriented during one or more embodiments of the method of the present invention, scribing on the core sample orientation data gathering device 42 number on the top side should be the same as the number transmitted to the communicator 60, which re-confirms correct orientation. Thus, if the visual or audible means for indicating core orientation are not useful or available, then the core is oriented using the angular degree arrangement (top side) to match the

number transmitted, and then this would be audited using the communicator 60 as is the case now.

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. No additional or alternative sealing, such as separate o-ring seals between the greaser and core sample orientation data gathering device or between the inner core tube and the core sample orientation data gathering device are required. Thus, maintenance or risk of ingress of liquid are not of concern.

Additionally, only the greaser needs to be separated from the core sample orientation data gathering device in order to obtain access and communicate with the device to obtain core orientation data. Likewise, setup prior to deployment is improved in terms of time and ease of use by not requiring a specialised back end assembly, rather, a standard greaser and back end assembly is used. This also improves compatibility with standard systems.

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.

Confirmed correct core alignment is registered in the remote communication device 60. This provides for an audit trail, and the data can be readily transferred to computer for analysis and manipulation. This also provides reassurance of accuracy of sampling and orientation to operators, geologists and exploration/mining/construction companies.

In use, the core inner tube 50, data gathering device 42 and greaser 46 are connected together in that order and lowered into a core sampling outer tube having an annular diamond drill bit at the furthest end. Once a core sample is obtained, the inner tube assembly with the data gathering device and greaser are recovered back to the surface, the back end assembly 20 and greaser are 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 60. 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.

According to an alternative embodiment of the present invention shown in figures 8a and 8b, a data gathering device 80 houses the light emitters 74,76. Light from these emitters (e.g. LEDs) passes through the window 72 (shown in figure 7). Reference arrow A refers to the drill bit end direction, and reference arrow B refers to the backend assembly direction. An optical adapter 82 is provided at the end 42 of the device and which adapter extends into the greaser unit 46 when connected thereto. The optical adapter has a reflective material. The greaser unit 46 has apertures 84 that allow light therethrough. Light from the emitters is directed onto at least one reflector 86 of the adapter. The emitted and reflected light can be observed through the apertures 84 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 gathering device and the remote device, can also be effected by transmitting through the at least one aperture.

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.

CLAIMS:

1. A core sample orientation system configured to provide an indication of the orientation of a core sample relative to a body of material from which the core has been recovered, the system including a hermetically sealed core sample orientation data gathering device deployable as part of a downhole core sample assembly, the device including communication means arranged to communicate obtained core sample orientation data to a remote orientation data indication display device having an orientation data display.
2. A system as claimed in claim 1, including a connector arranged to releasably connect to a corresponding connector on a typical greaser.
3. A system according to claim 2, wherein the connector on the device is a screw thread arranged to threadingly engage with a corresponding screw thread of the greaser.
4. A system according to any one of the preceding claims, the data gathering device including one or more visual and/or audible indicators for indicating orientation of the core sample.
5. A system according to claim 4, wherein the indicators include colour light indicators.
6. A system according to claim 4, wherein the visual indicators are angular degree markings on an outer casing and/or end of the data gathering device.
7. A system according to any one of the preceding claims, including timing means to, in use, provide multiple time intervals for the device to obtain orientation data.
8. A system according to any one of the preceding claims, including the orientation data electronic communication device arranged to provide start up,

setup, stop and/or data recovery communication to operate the orientation data gathering device.

9. A system according to any one of the preceding claims, the orientation data gathering device and the remote orientation data electronic communication device being configured for wireless communication with each other.

10. A system according to claim 9, wherein the communication is by infra red communication.

11. A system according to any one of the preceding claims, wherein the orientation data gathering device includes a transmitter to transmit data to a remote device.

12. A system according to any one of the preceding claims, wherein the remote orientation data electronic communication device includes a display to show visual information relating to the obtained orientation data.

13. A system according to claim 12, wherein the visual display includes an indication that sufficient data has been obtained, that the data is correctly and safely stored and/or that data has been transferred from the orientation data gathering device to the remote orientation data electronic communication device.

14. A system according to any one of the preceding claims, the data gathering device including a light transmitter configured to direct light from at least one light emitter through at least one aperture of a section of a downhole assembly.

15. A system according to claim 14, wherein the at least one aperture is through a sidewall of a greaser unit connected to the data gathering device.

16. A system according to claim 14 or 15, wherein the light transmitter includes at least one light reflector arranged to redirect light from the at least one light emitter within the data gathering device through the at least one aperture.

17. A system according to claim 16, wherein the light reflector is provided on an extension portion from an end of the data gathering device to extend into an open end of the section to which the data gathering device is to connect.

18. A core sample orientation data gathering device as defined in any one of the preceding claims

19. A core sample orientation data gathering device deployable as part of a core sample orientation system according to any one of the preceding claims.

20. A core sample orientation data gathering device according to claim 18 or 19, including a hermetically sealed core sample orientation data gathering device deployable as part of a downhole core sample assembly, the device including communication means arranged to communicate obtained core sample orientation data to a remote orientation data indication display device having an orientation data display.

21. A method of obtaining core sample orientation data, the method including:

- a) deploying a core sample orientation data gathering device as part of a core sample gathering system;
- b) obtaining a core sample from a subsurface body of material using the orientation data gathering device;
- c) using the orientation data gathering device to determine the orientation of the core sample relative to the subsurface body of material; and
- d) using a remote communication device to obtain from said orientation data gathering device data relating to the orientation of the core sample.

22. A method according to claim 21, including hermetically sealing the core sample orientation data gathering device prior to deployment.

23. A method according to claim 22, including, following recovery of the device, obtaining core orientation indications by one or more illuminated and/or audible indications on the device.

24. A method according to claim 23, whereby coloured illuminated indications used to determine a required orientation of the core sample.

25. A method according to any one of claims 21 to 24, including synchronising a time interval to a specific downhole data gathering event.

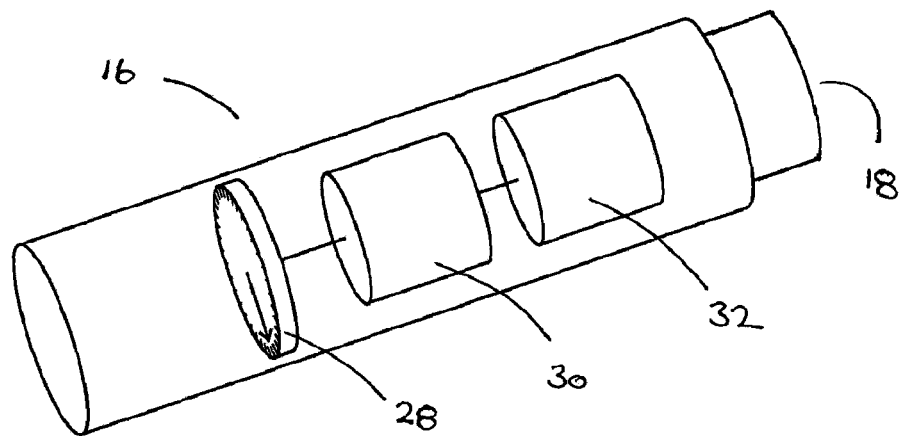
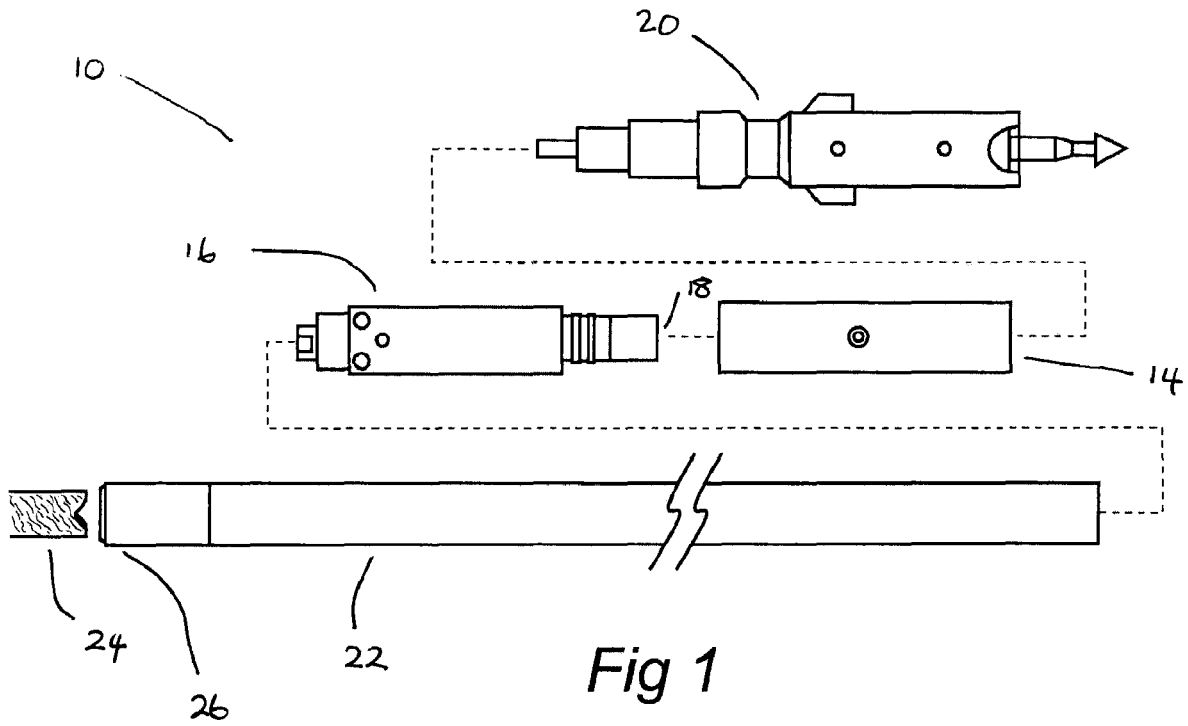
26. A method according to any one of claims 21 to 25, including transferring core sample orientation data from the orientation data gathering device by wireless communication with the remote communication device.

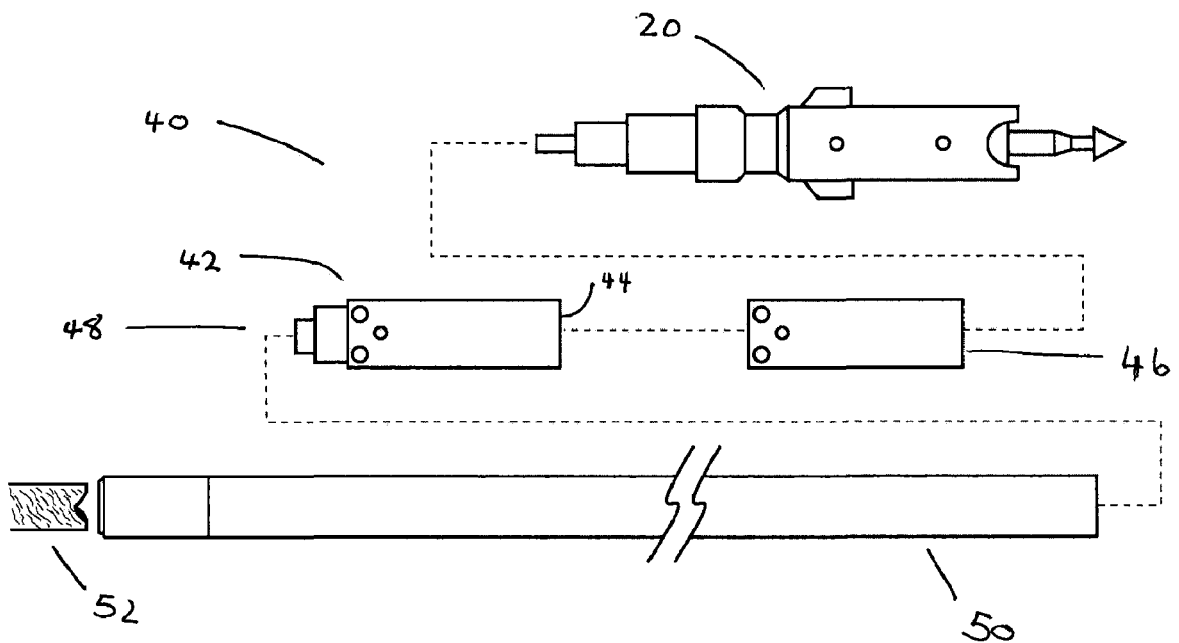
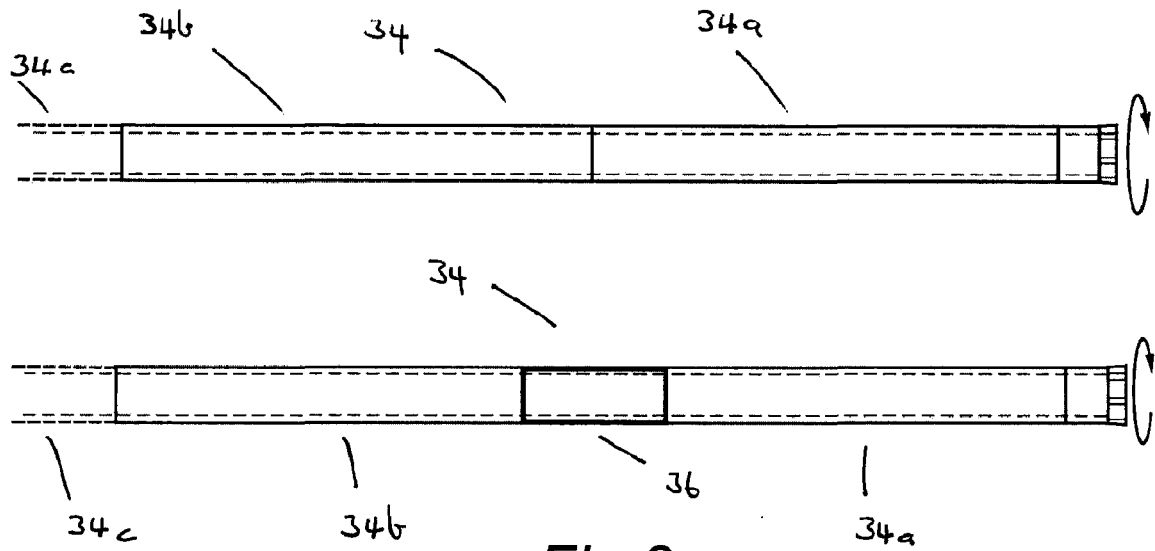
27. A method according to claim 26, where the transfer of data is achieved by infra red communication between the orientation data gathering device and the orientation data communication device.

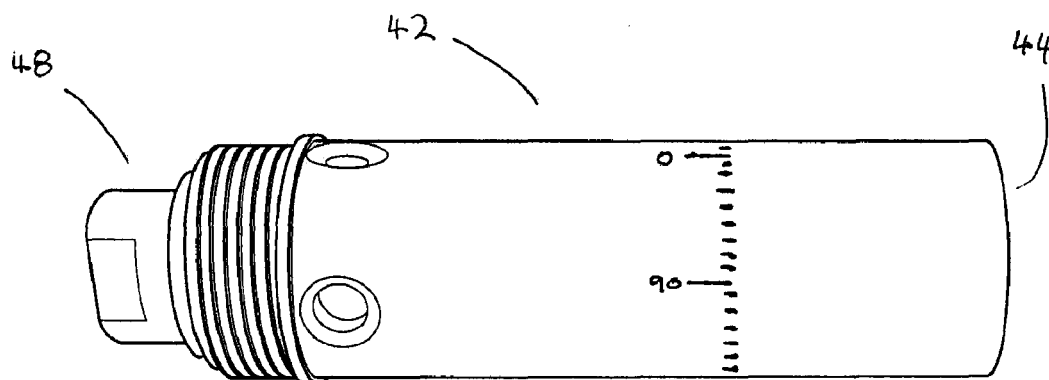
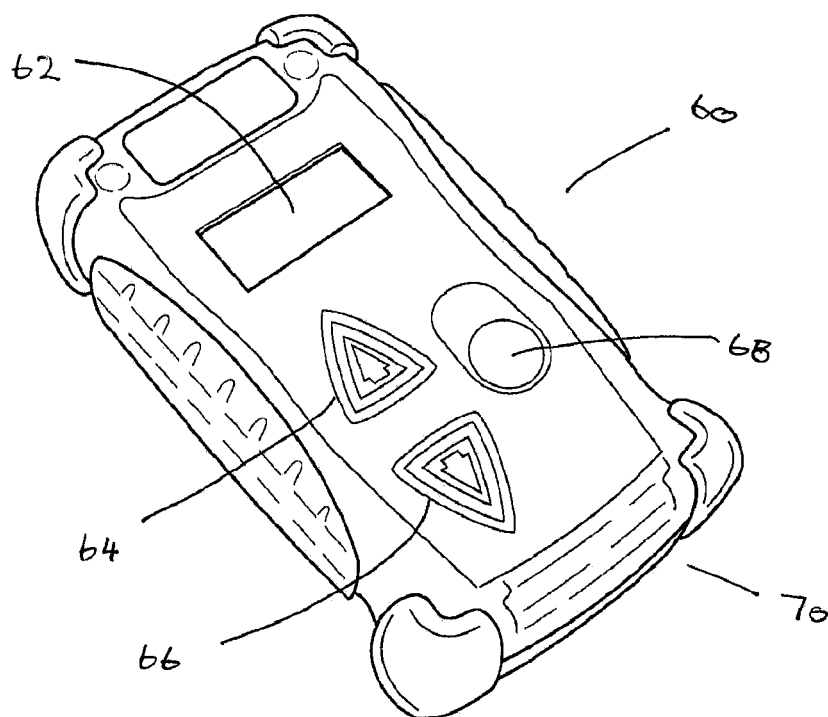
28. A method according to any one of claims 21 to 27, including providing a visual indication of core sample orientation through at least one aperture in a sidewall of a section of a downhole assembly.

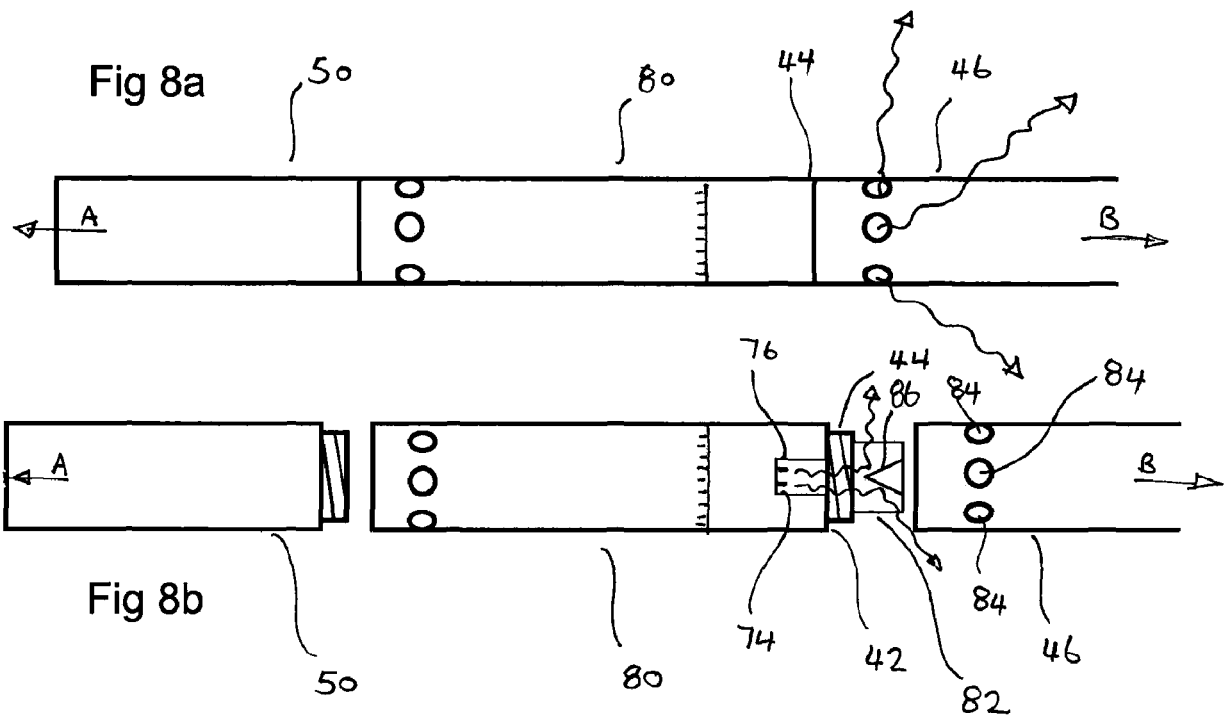
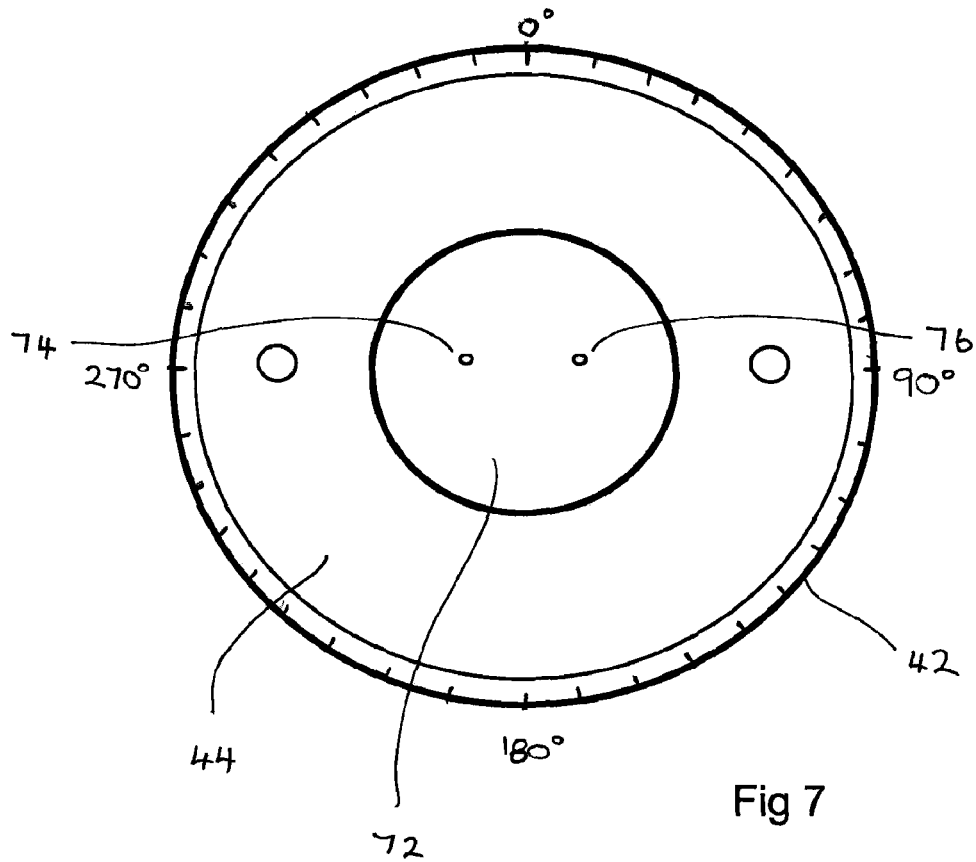
29. A method according to claim 28, including transmitting core sample orientation indications as light through at least one aperture in the sidewall.

30. A method according to claim 28 or 29, including emitting core sample orientation visual indications from one or more light emitters via at least one light reflector, and reflecting that emitted light out through the at least one aperture.





*Fig 5**Fig 6*



INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2011/000954

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

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)

WPI; EPODOC: IPC, ECLA, E21B 25/16, E21B 47/02/low & keywords (orientation, position, inclination, angle, seal, hermetically, insulation, barrier, ingress, water, dirt, core, drill, extract, module, log, transfer, record) and the like

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/0282533 A1 (PARFITT) 6 December 2007 Figures 2-4, 6, paragraph [0020], paragraph [0022], paragraph [0028], paragraph [0017], paragraph [0006]	21, 25, 28-30
Y	Figure 2	1-4, 7-8, 10, 14-20, 22, 24, 27
X	WO 2008/113127 A1 (2iC AUSTRALIA PTY LTD) 25 September 2008 Figures 1-6, page 2 lines 22-23, page 2 lines 16-19, page 2 lines 30-33, page 2 lines 23-25, page 20 lines 2-6, page 17 line 34	21, 25-26
Y	Figure 1	1-4, 6-13, 18-20, 22-24
X	WO 2007/137356 A1 (2iC AUSTRALIA PTY LTD) 6 December 2007 Figures 1-5, page 2 lines 19-20, page 2 lines 21-22, page 2 lines 31-32, page 2 lines 25-28, page 7 lines 19-21, page 6 line 28	21, 25-26
Y	Figure 1	1-2, 4-5, 7-13, 18-20, 22-24



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	"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	
"E" earlier application or patent but published on or after the international filing date	"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	
"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)	"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	
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family	
"P" document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search
22 September 2011Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2011/000954

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2009/0320604 A1 (PENMAN et al) 31 December 2009 page 1, paragraph [0011], page 2, paragraph [0030]	1, 5-6, 14-17, 20, 22, 27

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/AU2011/000954

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			
US	2007282533	AP	2142	AU	2005256104	AU	2006100113
		AU	2010101356	AU	2010200162	AU	2010249163
		BR	PI0515621	CA	2559030	MX	2007002643
		US	7584055	US	2009314545	US	2011088948
		WO	2006024111	ZA	200701750		
WO	2008113127	AU	2008100249	AU	2008229644	EP	2134921
WO	2007137356	AU	2007266335	CA	2653466		
US	2009320604	EP	2054581	WO	2008015430		
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001. END OF ANNEX							