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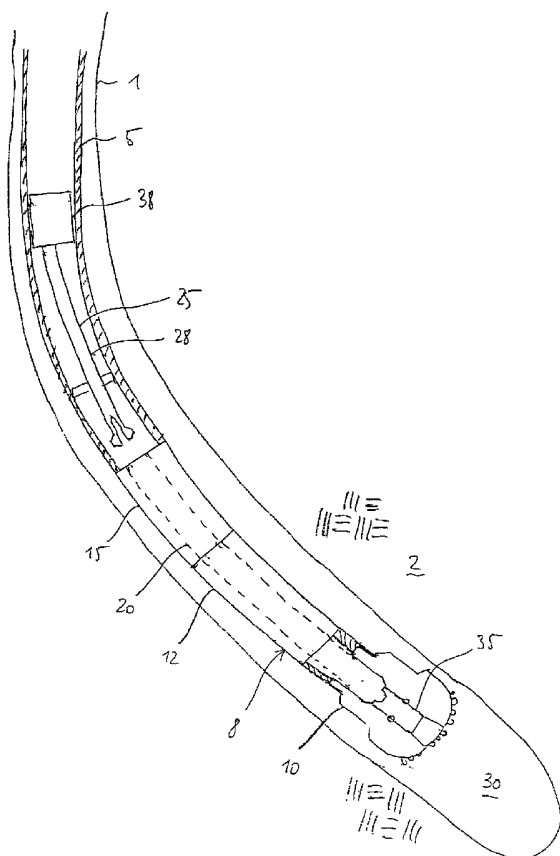
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[Continued on next page]

(54) Title: BOTTOMHOLE ASSEMBLY



(57) Abstract: A method of drilling a borehole into a subsurface earth formation, using a tubular drill string which includes at its lower end a bottom hole assembly comprising a drill bit, a drill steering system, and a surveying system, wherein the drill string includes a passageway for an auxiliary tool from a first position interior of the drill string above the bottom hole assembly to a second position wherein at least part of the auxiliary tool is exterior of the drill string below the bottom hole assembly, which passageway can be selectively closed, and which method comprises drilling so as to progress the drill string into the earth formation, until a tool operating condition is met; opening the passageway; passing an auxiliary tool from the first position through the passageway to the second position, and operating the auxiliary tool at the second position.



MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW.

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## INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 03/50823

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 E21B47/00 E21B10/18 E21B10/62 E21B4/02

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

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 E21B

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 practical, search terms used)

EPO-Internal

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category ° | Citation of document, with indication, where appropriate, of the relevant passages                                                                 | Relevant to claim No. |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| A          | US 6 269 891 B1 (RUNIA DOUWE JOHANNES)<br>7 August 2001 (2001-08-07)<br>cited in the application<br>column 1, line 50 - column 2, line 27<br>----- | 1,8,15                |
| A          | US 5 244 050 A (ESTES ROY D)<br>14 September 1993 (1993-09-14)<br>cited in the application<br>column 1, line 26 - column 2, line 15<br>-----       | 1,8,15                |
| A          | US 6 233 524 B1 (DUBINSKY VALDIMIR ET AL)<br>15 May 2001 (2001-05-15)<br>abstract; figures<br>-----                                                | 1,8,15                |
| A          | US 5 560 437 A (DICKEL UDO ET AL)<br>1 October 1996 (1996-10-01)<br>abstract; figures<br>-----                                                     | 1,8,15                |
|            | -/--                                                                                                                                               |                       |

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

° Special categories of cited documents :

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"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

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"&amp;" document member of the same patent family

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International Application No

PCT/EP 03/50823

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

| Category ° | Citation of document, with indication, where appropriate, of the relevant passages                                               | Relevant to claim No. |
|------------|----------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| X          | US 4 391 547 A (JACKSON JR G C ET AL)<br>5 July 1983 (1983-07-05)<br>column 2, line 14 - column 2, line 39;<br>figure 2<br>----- | 16                    |
| X          | US 5 078 650 A (FOOTE DEAN)<br>7 January 1992 (1992-01-07)<br>column 2, line 56 - column 3, line 38;<br>figure 2<br>-----        | 16                    |
| A          | GB 232 521 A (MATVEY ALCUNOVITCH<br>CAPELIUSCHN) 23 April 1925 (1925-04-23)<br>the whole document<br>-----                       | 16                    |

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/EP 03/50823

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 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 II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

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

see additional sheet

As a result of the prior review under R. 40.2(e) PCT,  
no additional fees are to be refunded.

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 an additional fee, this Authority did not invite payment of any additional fee.
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.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-15

A method of drilling a borehole into a subsurface formation using a bottom hole assembly, a system utilising a bottom hole assembly for directionally drilling a borehole into a subsurface earth formation and the bottom hole assembly.

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2. claim: 16

A mud motor

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP 03/50823

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date      |
|-------------------------------------------|---------------------|----------------------------|--------------------------|
| US 6269891                                | B1                  | 07-08-2001                 | AU 751559 B2 22-08-2002  |
|                                           |                     | AU 6194399 A 10-04-2000    |                          |
|                                           |                     | BR 9913977 A 19-06-2001    |                          |
|                                           |                     | CA 2343947 A1 30-03-2000   |                          |
|                                           |                     | CN 1120285 B 03-09-2003    |                          |
|                                           |                     | DE 69913361 D1 15-01-2004  |                          |
|                                           |                     | DE 69913361 T2 27-05-2004  |                          |
|                                           |                     | EA 2063 B1 24-12-2001      |                          |
|                                           |                     | EG 22060 A 30-06-2002      |                          |
|                                           |                     | WO 0017488 A1 30-03-2000   |                          |
|                                           |                     | EP 1115961 A1 18-07-2001   |                          |
|                                           |                     | ID 28448 A 24-05-2001      |                          |
|                                           |                     | JP 2002525464 T 13-08-2002 |                          |
|                                           |                     | NO 20011407 A 20-03-2001   |                          |
|                                           |                     | TR 200100831 T2 21-08-2001 |                          |
| US 5244050                                | A                   | 14-09-1993                 | NONE                     |
| US 6233524                                | B1                  | 15-05-2001                 | US 6021377 A 01-02-2000  |
|                                           |                     | US 5842149 A 24-11-1998    |                          |
|                                           |                     | AU 5248598 A 15-05-1998    |                          |
|                                           |                     | CA 2269498 A1 30-04-1998   |                          |
|                                           |                     | GB 2334108 A ,B 11-08-1999 |                          |
|                                           |                     | WO 9817894 A2 30-04-1998   |                          |
|                                           |                     | US 6206108 B1 27-03-2001   |                          |
|                                           |                     | CA 2235134 A1 01-05-1997   |                          |
|                                           |                     | EP 0857249 A2 12-08-1998   |                          |
|                                           |                     | NO 981802 A 22-06-1998     |                          |
|                                           |                     | WO 9715749 A2 01-05-1997   |                          |
| US 5560437                                | A                   | 01-10-1996                 | DE 4129709 C1 03-12-1992 |
|                                           |                     | AU 2487392 A 05-04-1993    |                          |
|                                           |                     | DE 59206874 D1 12-09-1996  |                          |
|                                           |                     | WO 9305271 A1 18-03-1993   |                          |
|                                           |                     | EP 0601030 A1 15-06-1994   |                          |
|                                           |                     | ZA 9206583 A 09-03-1993    |                          |
| US 4391547                                | A                   | 05-07-1983                 | CA 1185895 A1 23-04-1985 |
|                                           |                     | DE 3242893 A1 09-06-1983   |                          |
|                                           |                     | FR 2517356 A1 03-06-1983   |                          |
|                                           |                     | GB 2111640 A ,B 06-07-1983 |                          |
| US 5078650                                | A                   | 07-01-1992                 | CA 1314863 C 23-03-1993  |
|                                           |                     | GB 2230316 A 17-10-1990    |                          |
| GB 232521                                 | A                   | 23-04-1925                 | NONE                     |