(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 161 405 A1**

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
10.03.2010 Bulletin 2010/10

(51) Int Cl.:
E21B 33/14 *(2006.01)*

(21) Application number: **08163842.1**

(22) Date of filing: **08.09.2008**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT RO SE SI SK TR
Designated Extension States:
AL BA MK RS

(71) Applicants:
- **Services Pétroliers Schlumberger**
  75007 Paris (FR)
  Designated Contracting States:
  FR
- **Schlumberger Holdings Limited**
  Tortola (VG)
  Designated Contracting States:
  GB NL
- **Schlumberger Technology B.V.**
  2514 JG The Hague (NL)
  Designated Contracting States:
  BG CZ DE DK GR HU IE IT LT NO PL RO SI SK TR
- **PRAD Research And Development Limited**
  Road Town, Tortola (VG)
  Designated Contracting States:
  AT BE CH CY EE ES FI HR IS LI LU LV MC MT PT SE

(72) Inventors:
- **Mauth, Kevin**
  92142 Clamart Cedex (FR)
- **Carrasquilla, Juan**
  92142 Clamart Cedex (FR)

(74) Representative: **Gabriel, Franck**
PROXIP
36 rue des Etats Généraux
78000 Versailles (FR)

(54) An assembly and method for placing a cement plug

(57) An assembly for placing a cement plug (1) in a well-bore comprises a landing and disconnecting collar (2), a shoe track (3), a circulation element (4), and a guide shoe (5), said elements forming an internal conduit (10), the circulation element (4) comprising side conduits (8) directed towards a well-bore wall (WBW). The assembly (1) diameter is such as to create a narrow annulus (AN2) in which a fluid pumped through the side conduits (8) circulates in the annulus according to a turbulent flow. The assembly (1) further comprises a sealing element (6) comprising a bottom sealing element (6A). The landing and disconnecting collar (2), shoe track (3), circulation element (4), and guide shoe (5) are made of material that are drillable, the elements forming the cement plug when a cement slurry (CS) is set into the annulus (AN2) and the internal conduit (10).

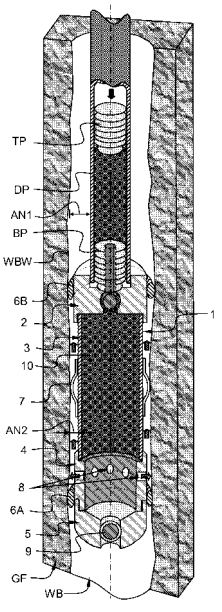

FIG. 2

EP 2 161 405 A1

Description

FIELD OF THE INVENTION

[0001] An aspect of the invention relates to an assembly for placing a cement plug in a well-bore. Another aspect of the invention also relates to a corresponding cement plug placing method.

[0002] A particular application of the invention relates to the oilfield industry, for example in cementing operation.

BACKGROUND OF THE INVENTION

[0003] During a hydrocarbon well drilling operation and after a hydrocarbon well has been drilled, various fluid injecting operations are generally carried out. The fluid injecting operations serves various purposes, for example delivering a cement slurry for borehole cementing operation. These operations are well known in the oilfield industry.

[0004] Typically, cement plug placement techniques recommend the use of a stinger for the section of the drill pipe immersed in the fluid in the borehole, the stinger having a diameter substantially smaller than the well-bore diameter. In this condition, the preferred mud removal technique, namely turbulent flow is nearly impossible to achieve due to the important gap (annulus) existing between the stinger and the well-bore wall. Further, there is also a risk that the cement sets with the drill pipe immersed in the well-bore. Furthermore, after a cement plug has been placed, the drill pipe is pulled through the cement plug which may result in contamination. Finally, the plug placement assembly must be completely pull out of the well-bore before resuming any further operation to be conducted in the well-bore, which leads to a loss in rig time.

SUMMARY OF THE INVENTION

[0005] It is an object of the invention to propose an assembly for placing a cement plug in a well-bore that overcomes one or more of the limitations of the existing cementing apparatus or method for well-bore.

[0006] According to an aspect, the invention relates to an assembly for placing a cement plug in a well-bore comprising a landing and disconnecting collar, a shoe track, a circulation element, and a guide shoe, said elements forming an internal conduit, the circulation element comprising side conduits directed towards a well-bore wall. The assembly diameter is such as to create a narrow annulus in which a fluid pumped through the side conduits circulates in the annulus according to a turbulent flow. The assembly further comprises a sealing element comprising a bottom sealing element. The landing and disconnecting collar, shoe track, circulation element, and guide shoe are made of material that are drillable, said elements forming the cement plug when a cement slurry is set into the annulus and the internal conduit.

[0007] The assembly may further comprise a top sealing element.

[0008] The material may be chosen among the group of material comprising Aluminum, fiberglass, cement, plastic, and carbon fiber reinforced material.

[0009] The assembly may further comprise a centralizer.

[0010] The guide shoe may further comprise a differential pressure valve for reducing any piston effect on a geological formation surrounding the well-bore.

[0011] The sealing element may be a flexible cup-like packer or an external casing packer.

[0012] According to a further aspect, the invention relates to a method of placing a cement plug in a well-bore comprising the steps of:

- assembling a cement plug placing assembly and coupling said assembly to a drill pipe at the surface,
- running the cement plug placing assembly to a desired depth,
- cleaning the well-bore wall by circulating fluid in said assembly by producing a jetting effect towards the well-bore wall and a turbulent flow in a limited annulus portion defined between the cement plug placing assembly and the well-bore wall,
- mixing and pumping a cement slurry into the drill pipe,
- displacing the cement slurry towards the cement plug placing assembly and into the annulus portion, and
- disconnecting the drill pipe after a pressure bump at the end of the displacing step.

[0013] The length of the cement plug may be defined by coupling casing joints during the assembling step.

[0014] The drill pipe may be rotated for sweeping a whole circumference of the well-bore wall during the cleaning step.

[0015] The invention enables enhancing the safety and the quality of the cement plug placement operation.

[0016] Further, the invention allows high pump rates throughout the operation, and avoids having to balance the plug.

[0017] Furthermore, the invention eliminates contamination caused by pulling the drill pipe through the plug after placement, and reduces the risk of cementing the drill pipe in the well-bore.

[0018] In addition, it is not necessary anymore to create a bottom support for the plug cement.

[0019] These and other aspects of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] The present invention is illustrated by way of example and not limited to the accompanying figures, in

which like references indicate similar elements:

Figure 1 schematically shows an onshore hydrocarbon well location;
Figure 2 schematically shows the assembly for placing a cement plug in a well-bore; and
Figures 3 to 7 schematically and partially illustrate the cement plug placement method and the fluid displacement during the cement plug placement operation.

DETAILED DESCRIPTION OF THE INVENTION

[0021] Figure 1 schematically shows an onshore hydrocarbon well location and equipments WE above a hydrocarbon geological formation GF after drilling operation has been carried out and after a drill pipe DP has been run. At this stage, the well-bore WB is an open-hole OH generally filled with various fluid mixtures (e.g. the drilling mud or the like). The well-bore WB may also be partially cased CH. The equipment WE comprises a drilling rig DR for running the drill pipe DP in the well-bore, cementing equipment comprising cement silo CR and pumping arrangement CP, and a well head and stuffing box arrangement WH providing a sealing for deploying the drill pipe DP or pumping down the cement into the generally pressurized well-bore WB.

[0022] Subsequently, cementing operations are generally undertaken to seal the annulus AN (i.e. the space between the well-bore WB and the casing where fluid can flow). A first application is primary cementing which purpose is to achieve hydraulic isolation around the casing. Other applications are remedial cementing which purposes are to stabilize the well-bore, to seal a lost circulation zone, to enable deflecting a subsequent drilling assembly into a different path than that previously drilled, to set a plug in an existing well or to plug a well so that it may be abandoned. The cement may be pumped into the drill pipe DP through a plug placement assembly 1 near the bottom of the bore-hole after the assembly has been positioned at the desired location.

[0023] Cementing engineers prepare the cementing operations by determining the volume and physical properties of cement slurry and other fluids pumped before and after the cement slurry. In many situations, chemical additives are mixed with the cement slurry in order to modify the characteristics of the slurry or set cement. Cement additives may be broadly categorized as accelerators (i.e. for reducing the time required for the set cement to develop sufficient compressive strength to enable further operations to be carried out), retarders (i.e. for increasing the thickening time of cement slurries to enable proper placement), dispersants (i.e. for reducing the cement slurry viscosity to improve fluid-flow characteristics), extenders (i.e. for decreasing the density or increasing the yield of a cement slurry), weighting agents (i.e. for increasing or lightening the slurry weight), fluid-loss or lost-circulation additives (i.e. for controlling the loss of fluid to the formation through filtration) and special additives designed for specific operating conditions.

[0024] Figure 2 schematically shows the assembly 1 for placing a cement plug in a well-bore WB according to a cross-section view. The plug placement assembly 1 comprises a landing and disconnecting collar 2, a shoe track 3, a circulation element 4, a guide shoe 5 and a sealing element 6. All these elements have a cylindrical section and define an internal conduit 10.

[0025] The landing collar and disconnecting 2 is installed immediately under the bottom of the casing string or the drill pipe DP. The landing and disconnecting collar is a component on which the cementing plugs BP, TP land during the cementing operation. The landing and disconnecting collar is coupled to the drill pipe via a releasing mechanism (not shown), for example through a known shear-pinned coupling. The landing and disconnecting collar may be disconnected from the drill pipe by means of a downstream pressure bump, for example by breaking the shear-pinned coupling of the releasing mechanism. The landing and disconnecting collar may comprise a valve arrangement (not shown). The landing and disconnecting collar is made of plastics, cement, carbon fiber reinforced material or other high strength and drillable material.

[0026] The shoe track 3 is a closed space between the landing and disconnecting collar 2 and the guide shoe 5. The principal function of this space is to ensure that the guide shoe is surrounded in high-quality cement such that any contamination that may bypass the top plug is safely contained within the shoe track. The shoe track may be a casing portion, namely a casing joint, made of fiber glass, carbon fiber reinforced material, aluminum or any other high strength and drillable material. The shoe track may comprise a plurality of casing joint coupled together. The shoe track may be fitted with one or more centralizer 7 for keeping the bottom hole assembly in the center of the tubing, casing or well-bore (Figure 2 only show an embodiment comprising one centralizer). The centralizer comprises bow-spring profile made of plastic or light metal like aluminum.

[0027] The circulation element 4 is a component that allows a direct communication between the shoe track 3 and the annulus AN. The circulation element may comprise a circulation valve (not shown) that may be operated to open and close on demand. The circulation element 4 comprises side conduits 8 extending radially from the internal conduit 10 towards the annulus AN2 and disposed all around the circulation element. The circulation element enables the circulation of fluids, namely pumping of fluid or cement slurry from the casing string or drill pipe directly into the annulus for well-bore wall cleaning purposes or for placing a cement plug, respectively. Though, the side conduits 8 are represented as round holes in the Figures, they may have other shapes. As an example, the side conduits 8 forming helical slots may be more efficient in distributing the fluid around the circumference of the cement plug placement assembly. The circulation

element is made of plastics, cement, carbon fiber reinforced material or other high strength and drillable material.

[0028] The guide shoe 5 is a tapered, e.g. having bullet-nosed element installed on the bottom of the assembly 1, immediately under the circulation element 4. The guide shoe function is to guide the drill pipe DP toward the center of the hole of the well-bore and minimizes problems associated with hitting rock ledges or washouts in the well-bore as the drill pipe is lowered into the well. The external face of the guide shoe is made from steel, generally matching the assembly in size. The inside part of the guide shoe is made of cement, plastic, carbon fiber reinforced material or other high strength and drillable material. It can be drilled out if the well is to be deepened beyond the cement plug point. The guide shoe 5 may be replaced by a float shoe comprising an additional check valve. The guide shoe 5 may comprise a differential pressure valve 9 that allows circulation of fluid through the guide shoe port reducing any piston effect on the formation GF. The assembly may be sealed downwards by means with either a rubber wiper plug or a ball that seats in the guide shoe at the bottom of the assembly (not shown). When sealed downwards, the downward flow is shut off and the fluid flow is forced to flow out of the assembly via the side conduits 8 of the circulation element 4.

[0029] The sealing element 6 comprises a bottom sealing element 6A that seals the communication at the end of the casing shoe in order to prevent downward flow in the annulus behind the plug placement assembly. The sealing element is a ring positioned around the casing shoe and/or the circulation element and contacting the well-bore wall WBW. Advantageously, the sealing element is a flexible cup-like packer that may slide down the well-bore wall during running operations. As an example, the sealing element may be made of Hydrobonder™ manufactured by the company Weatherford. As another example (not shown), the sealing element may be an external casing packer which offers self support to the assembly and hydraulic isolation in the annulus. The use of such sealing elements eliminates the need for viscous pills or other supporting means to support the cement plug. In an alternate embodiment, the sealing element 6 may also comprise a top sealing element 6B, similar to the bottom sealing element 6A, that seals the communication at the top of the shoe track or at the landing collar in order to prevent upward flow in the annulus AN1 above the plug placement assembly. Thus, the cement slurry pumped into the annulus AN2 tends to be contained between the bottom 6A and top 6B sealing elements. This is also practical for placement of cement plugs in horizontal wells.

[0030] The cement plug placement assembly 1 diameter is such as to create a narrow annulus portion AN2 compared to the standard annulus AN1 defined by the drill pipe DP. Thus, a fluid pumped through the side conduits 8 circulates in the narrow annulus portion AN2 according to a turbulent flow.

[0031] The method of the invention will now be described in relation with Figures 3 to 7 schematically illustrating certain steps of the method and the fluid displacement during the cement plug placement operation.

[0032] Figure 3 illustrates the assembly 1 as hereinbefore described after having been assembled and run at the desired depth, and during cleaning step.

[0033] In a first step S1, the cement plug placing assembly 1 is assembled at the surface. In particular, as many standardized casing joints as desired plug length are assembled to form the shoe track 3. The assembly is coupled to the drill pipe DP. The sealing elements are also made up as part of the assembly prior to running into the well-bore. The sealing elements slide down the well-bore wall. When the assembly also comprises the top sealing element 6B, the assembly is more difficult to run because it would prevent upwards circulation of the fluids. Thus, this particular embodiment is preferably used on open-hole squeeze cementing applications.

[0034] In a second step S2, the cement plug placing assembly 1 is run to the desired depth by means of the drill pipe DP of the corresponding length.

[0035] In a third step S3, a cleaning process may begun by closing the circulation through the casing shoe 5 and circulating fluid F1 through the side conduits 8 of the circulation element 4. The produced jetting effect towards the bore-hole wall WBW and turbulent flow TF in the annulus helps in removing the mud cake MC formed on the well-bore wall WBW. The drill pipe DP may be rotated RT for sweeping the whole circumference of the well-bore wall WBW. Pumping fluids in turbulent flow allows better removal of the mud cake MC and thus will improve the cement bond with the well-bore wall WBW.

[0036] Figure 4 illustrates the assembly 1 during a first displacement phase.

[0037] In a fourth step S4, the cement slurry CS is mixed and pump into the drill pipe. The bottom plug BP is launched upstream of the cement slurry CS to minimize contamination by fluids inside the drill pipe prior to cementing. The top plug TP is launched downstream the cement slurry CS. The top TP and bottom BP plugs are rubber or plastics plugs separating the cement slurry from other fluids present on the drill pipe. The top and bottom plugs are usual cementing plug typically used in cementing operation. The top plug comprises a solid core. The bottom plug comprises a hollow core and a rupture diaphragm RD. The plugs prevent the slurry from depositing on the internal wall of the drill pipe, reduce contamination and maintain predictable slurry performance. Shorter thickening time cement slurry could be utilized to reduce the time waiting on cement (WOC). Other kind of cement slurries may be used for specific applications.

[0038] Figure 5 illustrates the assembly 1 during a second displacement phase.

[0039] In a fifth step S5, the bottom plug BP, cement slurry CS and top plug TP are displaced through the drill pipe DP towards the cement plug placement assembly

1. In Figure 5, the bottom plug BP already landed in the landing and disconnecting collar 2. The cement slurry CS is pushed downwards by the top plug TP which is pushed by a fluid F2, e.g. a mud pumped downwards from the surface. The diaphragm RD in the plug body ruptures to allow the cement slurry CS to pass through after the plug reaches the landing and disconnecting collar 2. The cement slurry CS flows through the bottom plug BP, the internal conduit of the assembly 10. Then the cement slurry CS flows through the side conduits 8 into the annulus AN2 between the shoe track 3, the sealing element 6A, 6B and the wall WBW of the well-bore.

[0040] Figure 6 illustrates the assembly 1 at the end of the displacement phase.

[0041] In a sixth step S6, at the end of the displacement, the top plug TP lands onto the bottom plug BP. This provides a sudden pressure bump PU giving a positive indication of contact with the landing and disconnecting collar 2 and the bottom plug BP. The increase in pump pressure may be detected by an appropriate detector (not shown) at the surface.

[0042] The drill pipe DP is also disconnected from the landing and disconnecting collar 2 of the cement plug placement assembly 1. The disconnection of the drill pipe DP from the landing and disconnecting collar 2 is triggered by the pressure bump.

[0043] Figure 7 illustrates the assembly 1 during disconnection.

[0044] In a seventh step S7, the drill pipe DP is at least partially pulled out of the hole POOH of the well-bore. Since the whole assembly 1 is drillable, it is not necessary to pull the drill pipe DP completely out of the hole. Thus, the chance of contamination and the risk of the cement setting with the drill pipe DP immersed are also reduced. With the invention, there is no time spent in plug balancing.

[0045] A fluid may be circulated through the drill pipe for cleaning purpose.

[0046] Once the cement is set, the cement plug PG is formed by the cement filled in landing and disconnecting collar 2, shoe track 3, circulation element 4, guide shoe 5, internal conduit 10 and annulus portion AN2. The cement plug CP may be used for a variety of applications including hydraulic isolation, provision of a secure mechanical platform, and in window-milling operations for sidetracking a new well-bore, or a horizontal or deviated well-bore.

FINAL REMARKS

[0047] It is to be mentioned that the invention is not limited to onshore hydrocarbon well and can also be used in relation with offshore hydrocarbon well. Further, though a vertical well-bore has been depicted in the drawings, the invention may also apply in a horizontal or deviated well-bore.

[0048] Furthermore, though, the invention has been presented with a particular cementing application, it is not limited to the placement of a cement plug which purpose is to achieve hydraulic isolation at a particular location in the well-bore. The invention may serve other purposes, for example in remedial cementing through the placement of drillable casing patch which purpose is to stabilize the well-bore or to seal a lost circulation zone, or to set a plug in an existing well so that it may be abandoned.

[0049] Also, a particular application of the invention relating to the oilfield industry has been described. However, the invention is also applicable to other kind of industry, e.g. the construction industry or the like.

[0050] The drawings and their description hereinbefore illustrate rather than limit the invention.

[0051] Any reference sign in a claim should not be construed as limiting the claim. The word "comprising" does not exclude the presence of other elements than those listed in a claim. The word "a" or "an" preceding an element does not exclude the presence of a plurality of such element.

Claims

1. An assembly for placing a cement plug (1) in a well-bore comprising a landing and disconnecting collar (2), a shoe track (3), a circulation element (4), and a guide shoe (5), said elements forming an internal conduit (10), the circulation element (4) comprising side conduits (8) directed towards a well-bore wall (WBW),
   wherein the assembly (1) diameter is such as to create a narrow annulus (AN2) in which a fluid pumped through the side conduits (8) circulates in the annulus according to a turbulent flow,
   wherein the assembly (1) further comprises a sealing element (6) comprising a bottom sealing element (6A), and
   wherein the landing and disconnecting collar (2), shoe track (3), circulation element (4), and guide shoe (5) are made of material that are drillable, said elements forming the cement plug when a cement slurry (CS) is set into the annulus (AN2) and the internal conduit (10).

2. An assembly for placing a cement plug (1) according to claim 1, wherein the assembly further comprises a top sealing element (6B).

3. An assembly for placing a cement plug (1) according to claim 1 or 2, wherein the material is chosen among the group of material comprising Aluminum, fiberglass, cement, plastic, and carbon fiber reinforced material.

4. An assembly for placing a cement plug (1) according to any one of the preceding claims, wherein the assembly further comprises a centralizer (7).

5. An assembly for placing a cement plug (1) according to any one of the preceding claims, wherein the guide shoe (5) further comprises a differential pressure valve (9) for reducing any piston effect on a geological formation (GF) surrounding the well-bore (WB).

6. An assembly for placing a cement plug (1) according to any one of the preceding claims, wherein the sealing element (6) is a flexible cup-like packer or an external casing packer.

7. A method of placing a cement plug in a well-bore comprising the steps of:

- assembling (S1) a cement plug placing assembly (1) and coupling said assembly to a drill pipe (DP) at the surface,
- running (S2) the cement plug placing assembly (1) to a desired depth,
- cleaning (S3) the well-bore wall (WBW) by circulating fluid in said assembly by producing a jetting effect towards the well-bore wall and a turbulent flow in a limited annulus (AN2) portion defined between the cement plug placing assembly (1) and the well-bore wall (WBW),
- mixing and pumping (S4) a cement slurry into the drill pipe,
- displacing (S5) the cement slurry towards the cement plug placing assembly (1) and into the annulus (AN2) portion, and
- disconnecting (S6) the drill pipe after a pressure bump at the end of the displacing step.

8. A method of placing a cement plug according to claim 7, wherein a length of the cement plug is defined by coupling casing joints during the assembling step.

9. A method of placing a cement plug according to claim 7, wherein the drill pipe (DP) is rotated for sweeping a whole circumference of the well-bore wall (WBW) during the cleaning step.

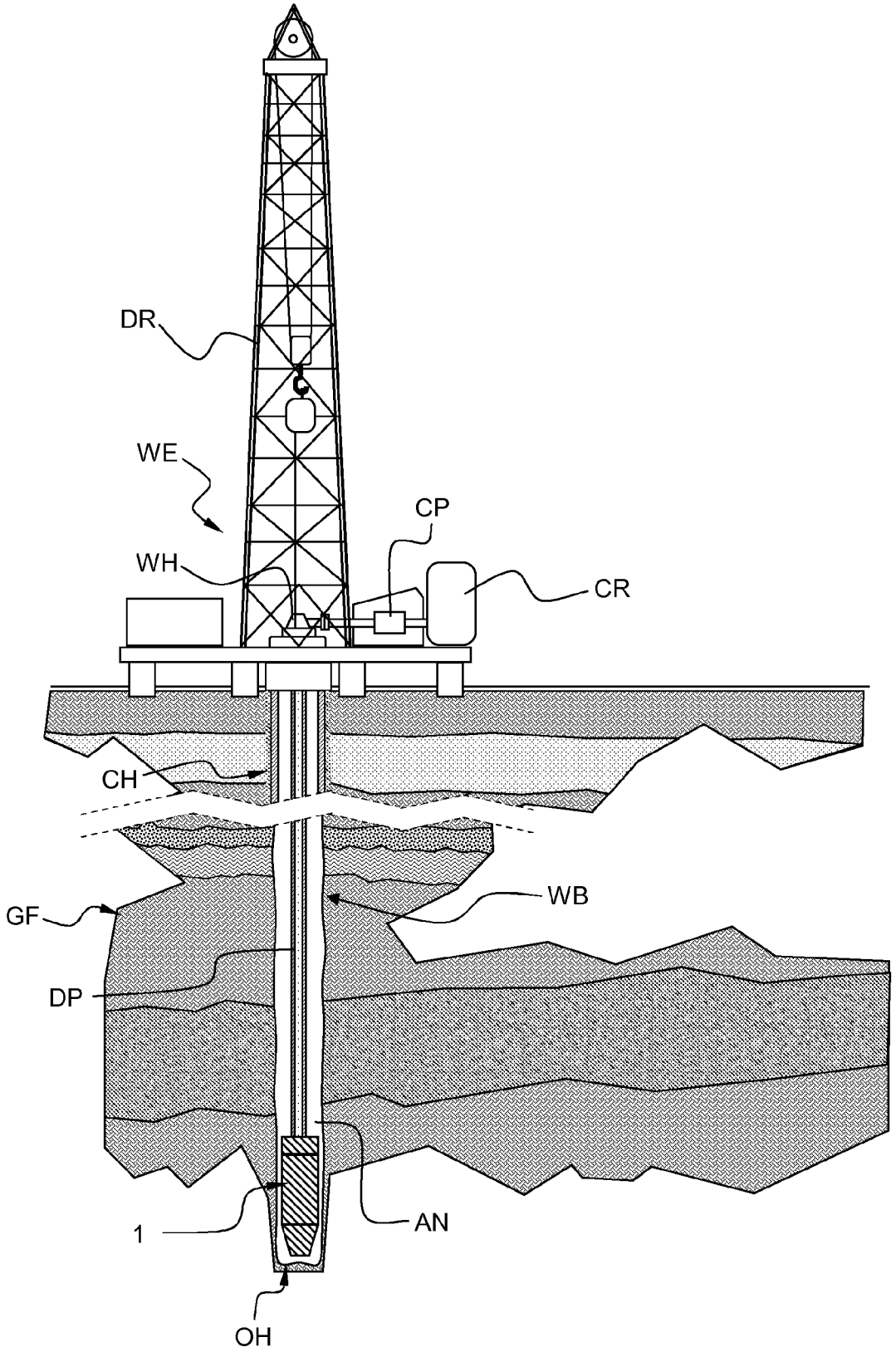

FIG. 1

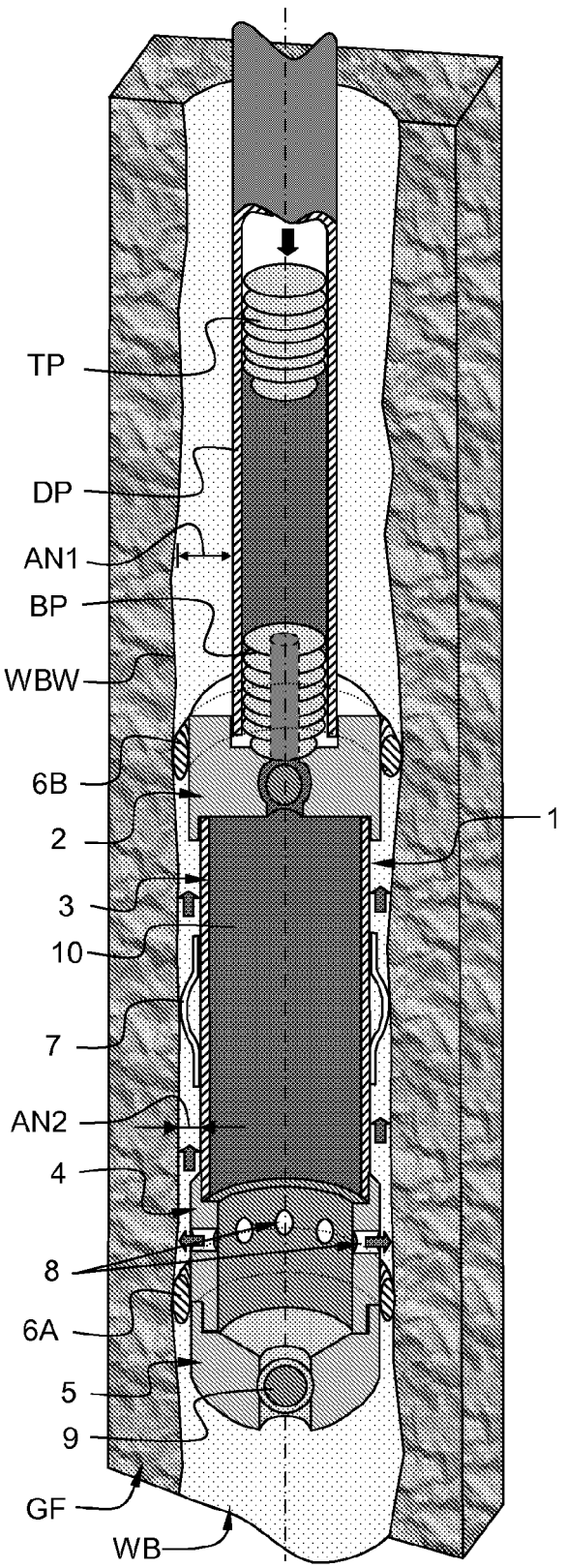

FIG. 2

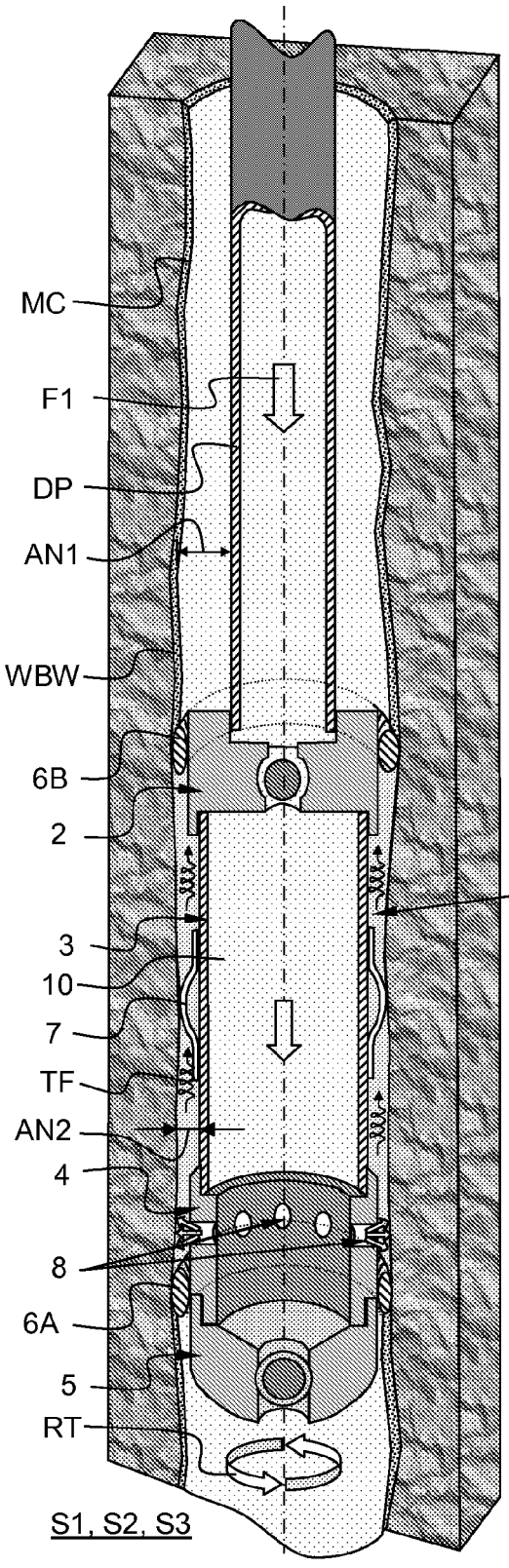
MC
F1
DP
AN1
WBW
6B
2
3
10
7
TF
AN2
4
8
6A
5
RT
S1, S2, S3

FIG. 3

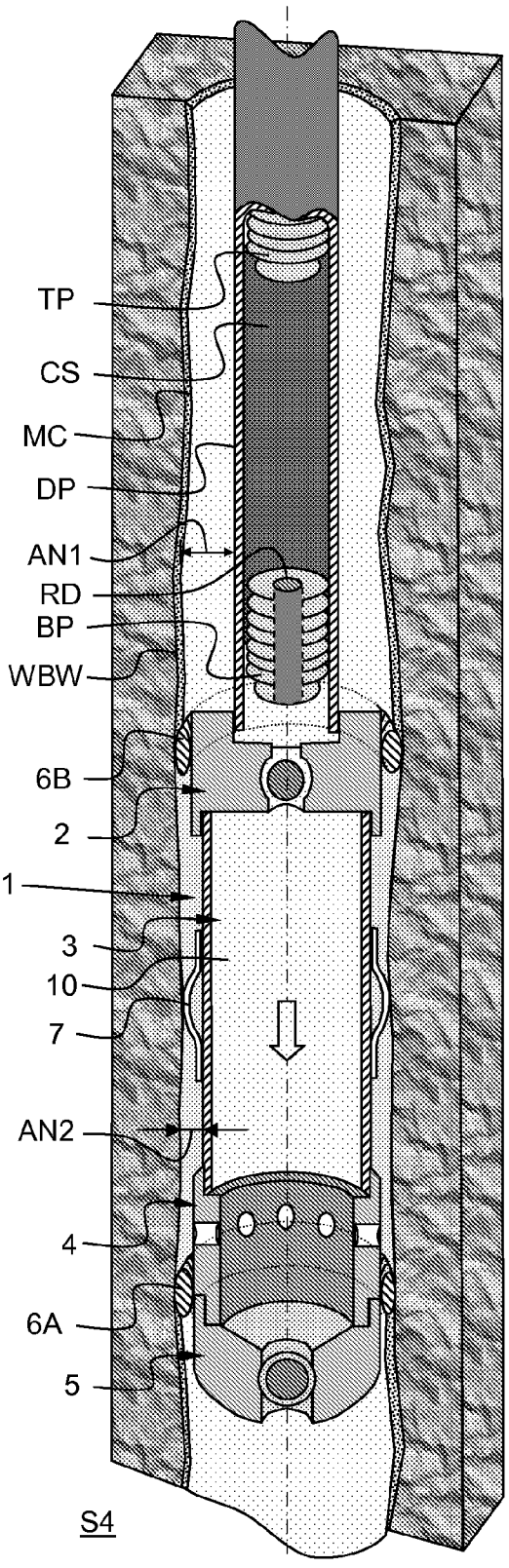
TP
CS
MC
DP
AN1
RD
BP
WBW
6B
2
1
3
10
7
AN2
4
6A
5
S4

FIG. 4

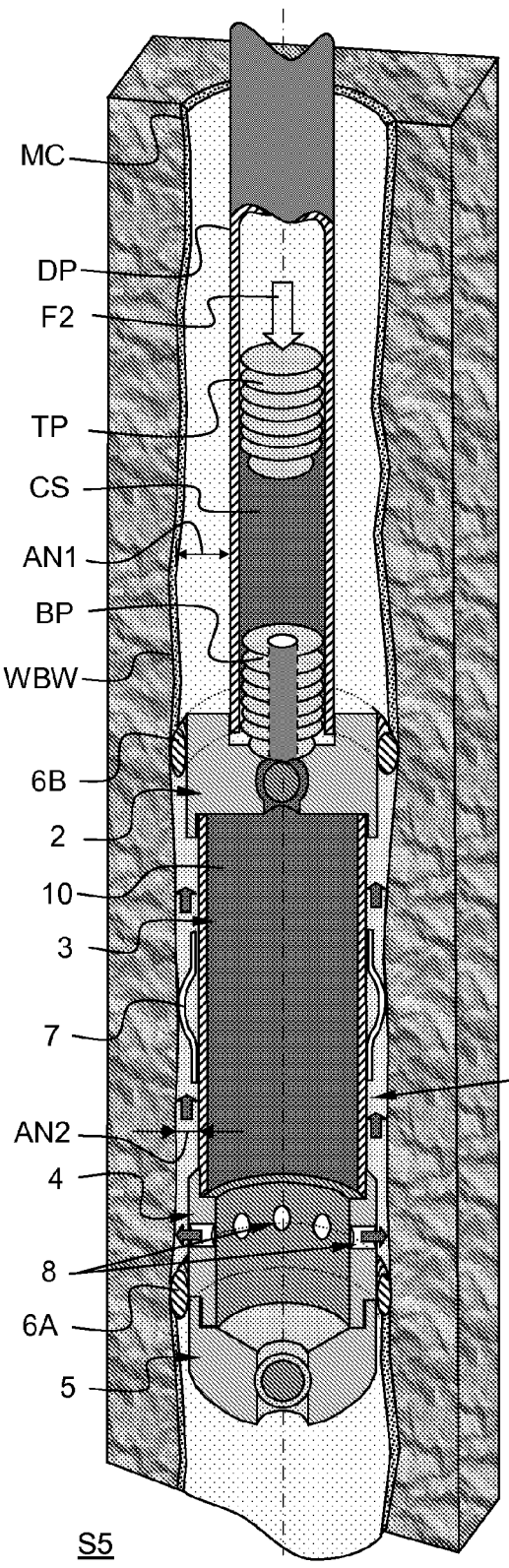
MC
DP
F2
TP
CS
AN1
BP
WBW
6B
2
10
3
7
AN2
4
8
6A
5
S5

FIG. 5

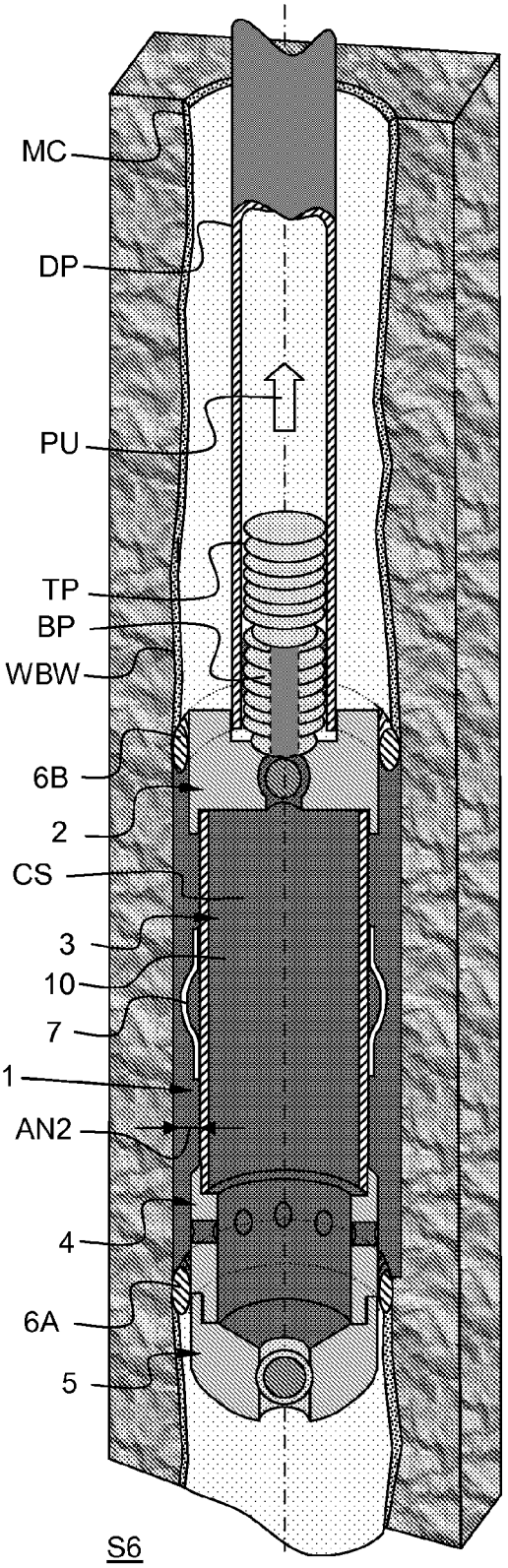
MC
DP
PU
TP
BP
WBW
6B
2
CS
3
10
7
1
AN2
4
6A
5
S6

FIG. 6

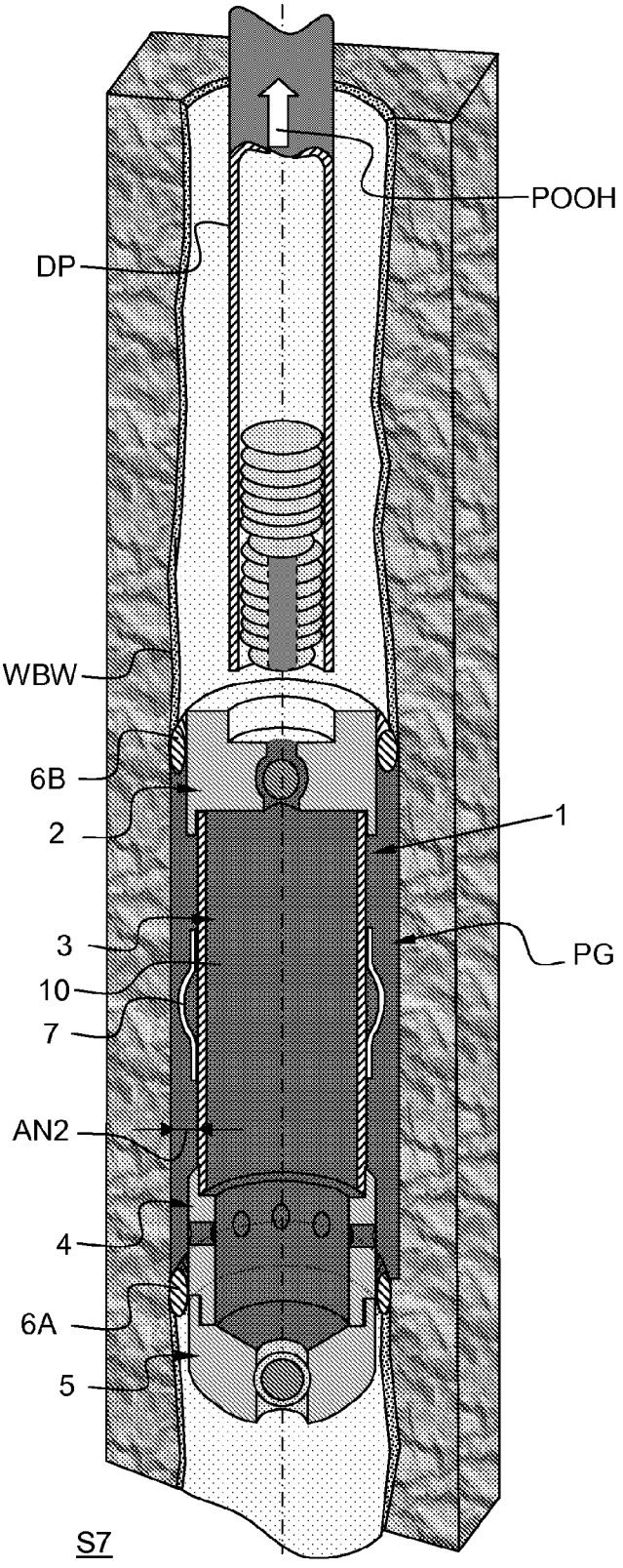

FIG. 7

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 08 16 3842

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	WO 2004/038172 A (DOWNHOLE PRODUCTS PLC [GB]; KIRK IAN ALASTAIR [GB]; BARRON WILLIAM [GB) 6 May 2004 (2004-05-06) * page 19 - page 22; figure 10 *	1-9	INV. E21B33/14
A	US 2006/237186 A1 (MONDELLI JUAN C [US] ET AL MONDELLI JUAN CARLOS [US] ET AL) 26 October 2006 (2006-10-26) * page 4, paragraph 37; figure 4a *	1-9	
A	US 2001/003314 A1 (CABOT BERNARD [CA]) 14 June 2001 (2001-06-14) * the whole document *	1-9	
A	US 5 437 330 A (GAMBERTOGLIO LOUIS M [US]) 1 August 1995 (1995-08-01) * the whole document *	1-9	
A	EP 0 969 183 A (WEATHERFORD LAMB [US]) 5 January 2000 (2000-01-05) * the whole document *	1-9	TECHNICAL FIELDS SEARCHED (IPC)
A	US 6 082 451 A (GIROUX RICHARD L [US] ET AL) 4 July 2000 (2000-07-04) * the whole document *	1-9	E21B
A	US 3 111 171 A (FARRAR WILLIE W ET AL) 19 November 1963 (1963-11-19) * the whole document *	1-9	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	6 February 2009	Morrish, Susan

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 08 16 3842

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

06-02-2009

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2004038172 A	06-05-2004	AT 371802 T	15-09-2007
		AU 2003276393 A1	13-05-2004
		EP 1554461 A1	20-07-2005
		US 2006000993 A1	05-01-2006
US 2006237186 A1	26-10-2006	NONE	
US 2001003314 A1	14-06-2001	GB 2375555 A	20-11-2002
US 5437330 A	01-08-1995	CA 2149261 A1	28-01-1996
		GB 2292160 A	14-02-1996
		NO 951928 A	29-01-1996
EP 0969183 A	05-01-2000	NONE	
US 6082451 A	04-07-2000	NONE	
US 3111171 A	19-11-1963	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82