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- (71) Applicant (for all designated States except US): **AKER SUBSEA LIMITED** [GB/GB]; Unit 59, Clivemont Road, Corwallis Industrial Estate, Maidenhead, Berkshire SL6 7BZ/GB (GB).
- (72) Inventor; and
- (75) Inventor/Applicant (for US only): **OSWALD, Walter** [GB/GB]; 6 Newburgh Road, Bridge of Don, Aberdeen AB22 8SQ/GB (GB).
- (74) Agent: **HORTON, Andrew, Robert, Grant**; Bowles Horton, Felden House, Dower Mews, High Street, HP4 2BL (GB).
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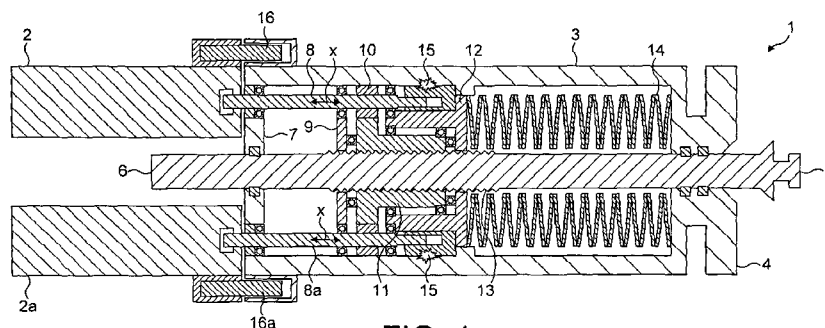


FIG. 1

(57) Abstract: A subsea electric actuator comprises an electric motor and a telescopic drive connection (8) from the motor to a drive unit (10, 11, 12) which can be moved to and fro and converts rotary motion of the connection to linear motion of an actuating stem (5). A return spring (14) is operable on the drive unit to urge the actuating stem towards a datum state. An electromagnetic latch (15) is operative when set to maintain the drive unit in a predetermined position so as to decouple the action of the return spring whereby the stem can be advanced and retracted relative to the drive unit free from the action of the return spring. De-energisation of the latch allows the return spring to operate on the drive unit to return the actuating stem to the datum state. Various forms of electromagnetic latch are described.



INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER

INV. E21B41/00 E21B33/035 F16K31/04
ADD.

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 F16K

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)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 1 141 082 A (ACF IND INC) 22 January 1969 (1969-01-22)	1,2,6,7
Y	figures 1,2	5
X	GB 2 383 627 A (ABB OFFSHORE SYSTEMS LTD [GB]) 2 July 2003 (2003-07-02) page 2, line 3 - line 5; figures 1-6 page 2, line 10 - line 26 page 5, line 14 - line 21	1-3,6,7
X	US 4 796 708 A (LEMBCKE JEFFREY J [US]) 10 January 1989 (1989-01-10) column 9, line 42 - line 59; figure 4	1-4,6,7
X	US 2009/127485 A1 (WESSEL JORGEN [NO] ET AL) 21 May 2009 (2009-05-21) abstract; figure 1	1-4,7
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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

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Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

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International application No
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2011/006519 A1 (CAMERON INT CORP [US]; BIESTER KLAUS [DE]; LENZ NORBERT [DE]) 20 January 2011 (2011-01-20) page 3, line 25 - page 4, line 4; figure 1 page 7, line 11 - line 16 -----	5
A	US 2005/247900 A1 (MARSH JEREMY L [US] ET AL) 10 November 2005 (2005-11-10) paragraph [0057] paragraph [0063]; figure 2 -----	1-7
A	US 5 497 672 A (APPLEFORD DAVID E [GB] ET AL) 12 March 1996 (1996-03-12) abstract; figure 3 -----	1-7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB2012/000225

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 additional 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 an 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.:

1-7

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.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

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

1. claims: 1-7

A subsea electric actuator comprising an electric motor, a telescopic drive connection (8) from the motor to a drive unit (10, 11, 12) which can be moved to and fro and converts rotary motion of the connection to linear motion of an operating member (5), a return spring (14) operable on the drive unit to urge the operating member towards a datum state and a latch (15), which is operative when set to maintain the drive unit in a predetermined position so as to decouple the action of the return spring, whereby the operating member can be advanced and retracted relative to the drive unit free from the action of the return spring, and is operative on release to allow the return spring to operate on the drive unit to return the operating member to the datum state.

2. claims: 8-10

A subsea electric actuator comprising an electric motor, a telescopic drive connection (8) between the motor and a drive unit (10, 11, 12) which can move to and fro and couples rotary motion of the drive connection to a drive nut (11) on a screw (13) which is disposed for axial movement without rotation and is connected to an operating member (5).

3. claims: 11-14, 25-29

A latch for maintaining a unit (12) in a predetermined position so as to prevent movement of that unit (12) away from that piston but to allow such movement on release of the latch, comprising:
 at least one locking shoe (45) positioned for engagement with a surface (46) which inhibits movement of the shoe, said locking shoe (45) being inwardly displaceable from said surface and mounted to the said unit (12);
 a member (48) mounted for movement within said unit (12);
 a lever coupling (49) between the member and the shoe;
 a spring-loaded hammer (42) which is operative by means of a driving spring to strike the member (48) whereby to pivot the lever coupling to allow disengagement of the shoe from the said surface; and
 an electromagnet (44) for holding the hammer against the spring loading of the hammer.

4. claims: 15-17, 30-33

A latch for maintaining a unit (12) in a predetermined

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

position within an enclosure so as to prevent movement of that unit away from that position but to allow such movement on release of the latch, comprising: an electromagnet (62) disposed on said unit (12); an armature (63) which is held by the electromagnet while the electromagnet is sufficiently energised; a spring (64) for causing movement of the armature away from the electromagnet on deenergisation of the electromagnet; and a linkage (65-68) including a roller (68) which locates in a datum recess (70) to support the unit (12) against the action of the return spring, said linkage being arranged to withdraw the roller from the recess in response to movement of the armature away from the electromagnet.

5. claims: 18-20, 34-37

A latch for maintaining a moveable unit (12) against movement in a particular direction away from a predetermined position, comprising: a rod (109) pivoted to the unit (12) and extending therefrom in the said direction; a fixed support (101, 107); a linkage (105, 106) which includes an arm (106) which is pivoted to the support and includes a shoulder (108) for the reception of a distal end of the rod (109), whereby movement of the unit (12) towards said support is prevented; a movable operating member (102) which is connected to the linkage and movable by an operating spring (104) to collapse the linkage to free the said distal end of the rod (109) from the shoulder (108) and thereby to allow the movement of the unit (12); and an electromagnet (111) for holding the actuating member (102) in a position against the action of the operating spring and preventing collapse of the linkage.

6. claims: 21-24, 38-42

A latch for maintaining a moveable unit (12) against movement in a particular direction away from a predetermined position, comprising:
 a bracket (145) pivoted to the unit (12), the bracket carrying a first roller (149);
 an arm (151) pivoted to a fixed position and carrying a second roller (150) for engagement with the first roller;
 means for biasing the bracket to an angular position wherein a force on the said unit (12) in the said direction is transmitted to the fixed member when the unit (12) is in the predetermined position; and
 a hammer (142) which is disposed to be held against the force of an operating spring (143) by an electromagnet (141) and is moveable by the operating spring on de-energisation of the electromagnet to strike the bracket to rotate the bracket, this rotation causing relative rolling movement rotation of the roller (149, 150) and disengagement thereof.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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