



- (51) **International Patent Classification:**
H01H 33/66 (2006.01) *H01H 33/662* (2006.01)
- (21) **International Application Number:**
PCT/EP2015/001821
- (22) **International Filing Date:**
10 September 2015 (10.09.2015)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
14003156.8 12 September 2014 (12.09.2014) EP
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- (81) **Designated States** (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.
- (84) **Designated States** (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK,

[Continued on next page]

(54) **Title:** VACUUM INTERRUPTER POLE FOR HIGH PRESSURE ENVIRONMENT APPLICATION

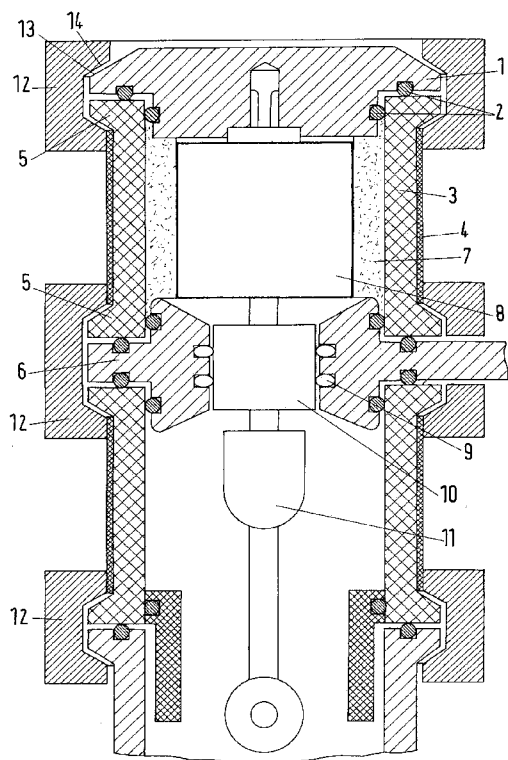


Fig.1

(57) **Abstract:** The invention relates to a pole part for high pressure environment application, with a pressure resistant insulating housing in which a vacuum interrupter is installed, wherein the vacuum interrupter is provided with at least one moving contact and one fixed contact inside the vacuum interrupter, according to the preamble of claim 1. In order to create a pole part with high environmental pressure withstand, the invention is that the pressure resistant insulating body is tubelike and at its ends provided with flanges formed at the insulating housing out of the same material, and that at least one of the flanges is closed with a metal cap, which is adapted to the aforesaid flange of the insulating housing by the same dimensions, and that with clamping means the metal cap is pressed tightly on the flange of the insulating housing by the introduced clamping fixation force.



SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG). **Published:**

— *with international search report (Art. 21(3))*

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

VACUUM INTERRUPTER POLE FOR HIGH PRESSURE ENVIRONMENT
APPLICATION

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The invention relates to a pole part for high pressure environment application, with a pressure resistant insulating body in which a vacuum interrupter is installed, according to the preamble of claim 1.

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Medium voltage vacuum interrupters are known to be used in high pressure environment, like in subsea application. The problem is a high pressure resistant housing of a normally ceramic vacuum interrupter.

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It is the object of the invention, to create a pole part with high environmental pressure withstand with easier but much more effective constructive means.

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In order to solve this requirement, the invention is, that the pressure resistant insulating housing is tubelike and at its ends provided with flanges formed at the insulating housing out of the same material, and that at least one of the flanges is closed with a metal cap, which is adapted to the aforesaid flange of the insulating housing by the same dimensions, and that with clamping means the metal cap is pressed tightly on the flange of the insulating housing by the introduced clamping fixation force.

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In a further advantageous embodiment, the flange of the insulating housing and the metal cap are provided with circumferential profiles in such, that the clamping fixation force of an at least two part clamp ring is diverted into an axial force pressing the flange and the cap tightly together. By that the housing is closed pressure tight with effective means.

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In order to introduce high fixing forces at the flanges, the circumferential profile of the flange and the cap is shaped in such, that the thickness of the flange and the thickness of the cap will decrease towards the edge of the flange and the cap, and that the inner surface of the clamp ring means are formed complementarily to the aforesaid circumferential profiles of the flange and the cap, so that by reduction of the resulting diameter of a two part clamp ring an increase of the fixation force is introduced.

In a very advantageous embodiment, the insulating housing is made of ceramic or porcelain material.

This is for the aforesaid use in high environmental pressure important. To use under such condition ceramic or porcelain is not trivial, because the pressure tight closing has to be realized. So with the help of the aforesaid special clamping means between parts of different material like metal and cerami or porcelain, this is possible.

A further advantageous embodiment is, that the tubelike insulating or ceramic housing is segmented into axial segments, which are fixed tightly together by aforesaid flanges with the aforesaid circumferential profiles and the clamping means. By that, diameter reducing forces of the clamp ring produces a axial force component between the flange-flange- and/or flange-cap-connection.

In a further advantageous embodiment is described, that concerning to the side, at which a moving stem of the moving contact extends out of the vacuum interrupter, the insulating or ceramic tubelike housing is devided into two axial segments, and that between these two segments of the housing a fixed contact ring of a sliding contact made of electrically conductive material is arranged, in order to electrically connect the moving contact of the vacuum interrupters moving contact with the fixed contact ring via a sliding contact.

Furthermore is described, that the fixed contact ring is provided with an integral ring, which extends in its diameter through the insulating housing arrangement in such, that it can be externally connected electrically.

- 3 -

In a further advantageous embodiment, the inner space of the housing, at least along the length of the vacuum interrupter is filled with potting material. This gives a further compensation of withstand of, that means against high pressure load from the environment.

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Further advantageous in this construction is an embodiment in such, that the vacuum interrupter is provided at its fixed contact side with a bolt, which is carried in an integral stud hole in the metal cap.

10

In order to result a good sealing, between the flanges and between the flange and the metal cap are arranged elastic sealing rings, which are positioned in sealing grooves in the flanges and/or in the housing surface in the area which comes into mechanical contact with the cap or the contact ring.

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Further advantageous embodiment is, that the insulating housing is covered with a rubber coating.

Advantageous are all features for the use in medium voltage.

20

Also useful is this in the use for low- or high voltage use.

The pressure tight construction of the pole part is advantageous for subsea use.

An embodiment of the invention is shown in figure 1 and described as follows.

25

Figure 1 shows an embedded pole part based on a ceramic housing as a high pressure withstand, wherein the vacuum interrupter 8 is installed and provided with at least one moving contact and one fixed contact inside the vacuum interrupter, and with externally ending contact rod or pushrod 11, going through the ceramic of the vacuum interrupter. For contacting the vacuum interrupter 8 from outside, there are on both sides of the ceramic housing of the vacuum interrupter metal parts installed, on the fixed contact side a cap from the ceramic housing to the connection where the vacuum interrupter is connected.

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- 4 -

At the other side of the housing there is a flange at the ceramic part provided which takes the connection between the movable side of the vacuum interrupter via a sliding contact system 9 to the middle part of the flange. Here the electrical connection takes place and the connection to the second insulation part, here the push rod will be
5 installed.

In order to develop ceramic housing pole parts for the use under high pressure conditions for application at outer side Subsea, the invention is, that the housing of the insulating ceramic provides flanges where the metal parts are connected on top of the pole the lid or the cup of the part. At the middle side the connection is a flange between
10 two ceramic parts and on the bottom side there is the connection to the breaker assembly. To keep both ceramics at the same length here a further plastic part can be installed and sealed to elongate especially at the movable side where the push rod is installed the insulation length. To get connection between the ceramic and the metal parts here are clamp rings installed. The vacuum interrupter can be kept in insulation
15 gas or can be embedded inside a potting material to close the gap between housing and the vacuum interrupter. Here to get sufficient dielectrical performance and to get in case of need enough mechanical performance.

Furthermore the ceramic housing can be covered by a rubber material to avoid damage at the outer side of the housing during the subsea installation getting service.
20

Important are the regions at the flanges. So shown is a segmented housing made of ceramic material. In that case several ceramic housing segments are arranged in axial direction, so that the tubelike housing is segmented in axial direction.

The upper segment 3 is closed with a metal cap 1 in that way, that the inner side of the metal cap is structured in such, that it extends into the inner space in the housing, so that concentric sealing 2 are positioned in sealing grooves inside the metal cap. So the metal cap 1 as well as the upper flange 5 are provided with thickness reduced areas at the edges. So the flanks of these thickness reduction are oriented in such, that
25 the clamp ring 12 with a complementary inner structure 14 according to the edges of the flange 5 and the cap 1, can introduce an axial force to both parts, so that the cap 1 and the flange 5 are pressed towards each, when the clamp will be closed and fixed radially.
30

- 5 -

For that, the clamp ring 12 is divided into two half rings, connected at one point with a hinge. If the clamp ring will be closed at its open end, then the resulting diameter is reduced. Along this movement of fixation of the open ends of the clamp ring, the outer
5 flanks of the flanges will be pushed strongly together by the complementary inner flanks of the clamp ring.

By that a high axial tightening force can be introduced.

The lower side of the upper housing segment is also provided with a flange. This flange
10 is pressed in the same way with a clamp ring corresponding to the edges with flanks to the counterpart, that means a further lower ceramic segment.

Important is, that between these flanges is positioned an extended metallic or electrically conductive ring, which is extended at least at one side over the outer surface of the ceramic segment, so that it can be contacted externally.

15 This conductive ring is a part of the inner sliding contact of the vacuum interrupter moving contact.

The lower ceramic housing segment has flanges at both ends, so that a further lower housing segment can be added, in order to surround the push rod and the drive of the
20 moving contact of the vacuum interrupter also pressure tightly.

So the lower end can also be closed by a metal cap, like shown at the upper end of the ceramic housing. Each further added housing segment is provided with the same flange-to-flange- and clamp-ring-arrangement like shown above. So the housing can be easily extended in its length, being adapted to each push-rod and/or drive construction.

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- 6 -

Position numbering:

- | | | |
|----|----|--|
| | 1 | metal cap |
| | 2 | sealing |
| 5 | 3 | insulating housing, ceramic or porcelain |
| | 4 | rubber coating or tube |
| | 5 | flange |
| | 6 | contact ring of the sliding contact |
| | 7 | potting material |
| 10 | 8 | vacuum interrupter |
| | 9 | sliding contact |
| | 10 | piston |
| | 11 | push rod |
| | 12 | clamping means |
| 15 | 13 | edge of the metal cap |
| | 14 | inner surface of the clamp ring |

20

Claims

- 5 1. Pole part for high pressure environment application, with a pressure resistant insulating housing in which a vacuum interrupter is installed, wherein the vacuum interrupter is provided with at least one moving contact and one fixed contact inside the vacuum interrupter,
characterized in
- 10 that the pressure resistant insulating housing (3) is tubelike and at its ends provided with flanges (5) formed at the insulating housing out of the same material, and that at least one of the flanges is closed with a metal cap (1), which is adapted to the aforesaid flange (5) of the insulating housing (3) by the same dimensions, and that with clamping means (12) the metal cap (1) is
15 pressed tightly on the flange (5) of the insulating housing by the introduced clamping fixation force.
2. Pole part according to claim 1,
characterized in
- 20 that the flange (5) of the insulating housing (3) and the metal cap (1) are provided with circumferential profiles in such, that the clamping fixation force of an at least two part clamp ring (12) is diverted into an axial force pressing the flange (5) and the cap (1) tightly together.
- 25 3. Pole part according to claim 2,
characterized in
- that the circumferential profile (13) of the flange (5) and the cap (1) is shaped in such, that the thickness of the flange (5) and the thickness of the cap (1) will decrease towards the edge of the flange and the cap, and that the inner surface
30 (14) of the clamp ring (12) means are formed complementarily to the aforesaid circumferential profiles of the flange (5) and the cap (1), so that by reduction of the resulting diameter of a two part clamp ring (12) an increase of the fixation force is introduced.

4. Pole part according to one of the aforesaid claims,

characterized in

that the insulating housing (3) is made of ceramic or porcelain material.

5. Pole part according to one of the aforesaid claims,

characterized in

that the tubelike insulating or ceramic housing (3) is segmented into axial segments, which are fixed tightly together by aforesaid flanges with the aforesaid circumferential profiles and the clamping means.

6. Pole part according to one of the aforesaid claims,

characterized in

that concerning to the side, at which a moving stem of the moving contact extends out of the vacuum interrupter (8), connected with a pushrod (11), the insulating or ceramic tubelike housing is divided into two axial segments, and that between these two segments of the housing a fixed contact ring of a sliding contact (9) made of electrically conductive material is arranged, in order to electrically connect the moving contact of the vacuum interrupter with the fixed contact ring (6) via a sliding contact (9).

7. Pole part according to claim 6,

characterized in

that the fixed contact ring (6) is provided with an integral ring, which extends in its diameter through the insulating housing arrangement in such, that it can be externally connected electrically.

8. Pole part according to one of the aforesaid claims,

characterized in

that the inner space of the housing, at least along the length of the vacuum interrupter (8) is filled with potting material.

- 9 -

9. Pole part according to one of the aforesaid claims,

characterized in

that the vacuum interrupter (8) is provided at its fixed contact side with a bolt, which is carried in an integral stud hole in the metal cap.

5

10. Pole part according to one of the aforesaid claims,

characterized in

that between the flanges and between the flange (5) and the metal cap are arranged elastic sealing rings, which are positioned in sealing grooves in the flanges and/or in the housing surface in the area which comes into mechanical contact with the cap or the contact ring.

10

11. Pole part according to one of the aforesaid claims,

characterized in

that the insulating housing is covered with a rubber coating.

15

12. Pole part according to one of the aforesaid claims,

characterized in

that the pole part is applied for medium voltage use.

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13. Pole part according to one of the aforesaid claims,

characterized in

that the pole part is applied for low- or high-voltage use.

25

14. Pole part according one of the aforesaid claims,

characterized in

that the pole part is applied for subsea use.

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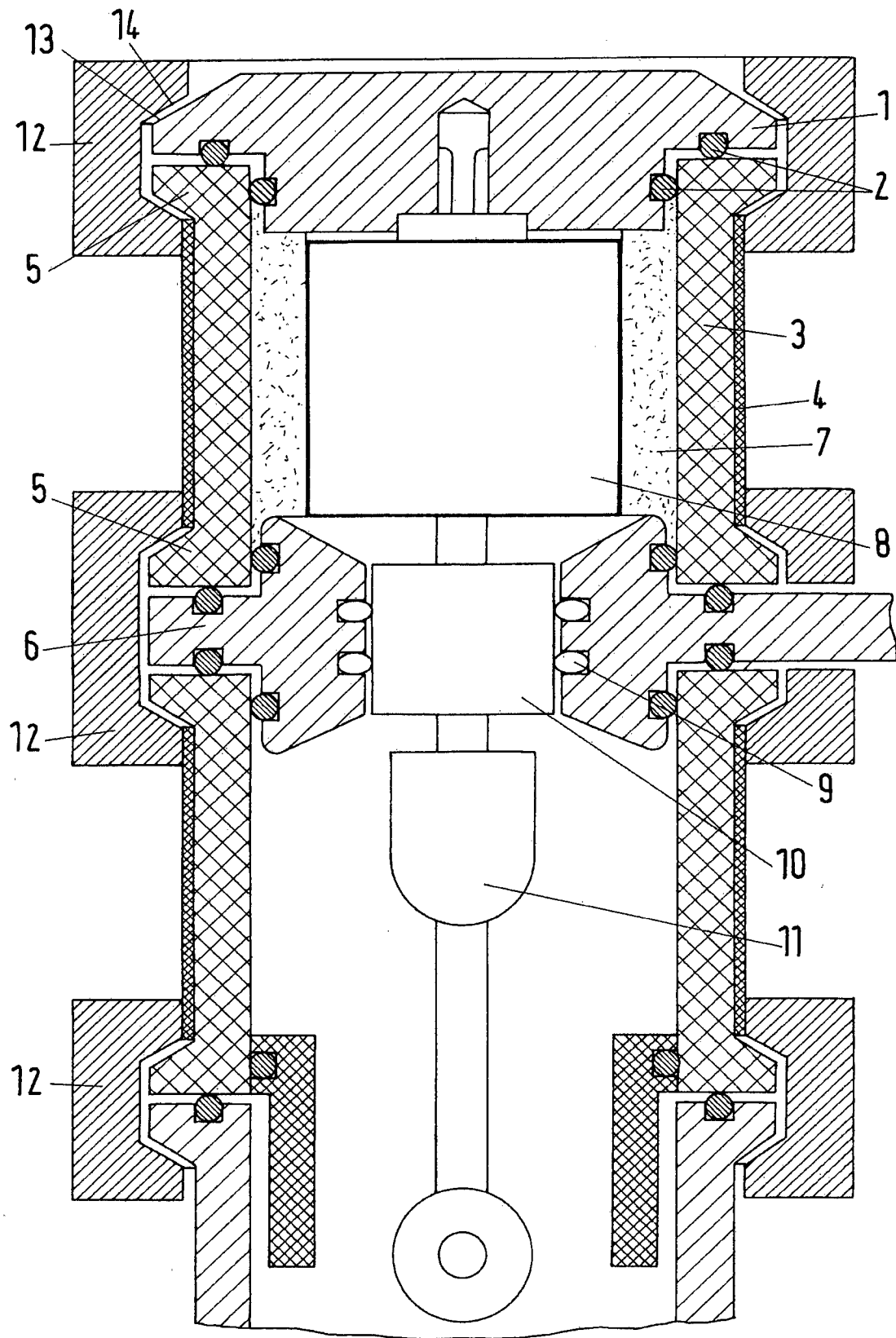


Fig.1

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2015/001821

A. CLASSIFICATION OF SUBJECT MATTER

INV. H01H33/66

ADD. H01H33/662

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)

H01H H02B F16L

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	US 3 626 123 A (PFLANZ HERBERT M ET AL) 7 December 1971 (1971-12-07)	1,4,9,13
Y	column 3, lines 3-36; figure 1	3,5-8, 10-12,14
X	----- GB 1 206 297 A (ASS ELECT IND [GB]) 23 September 1970 (1970-09-23) page 2, line 119 - page 3, line 39; figure 1	1,2,4
X	----- DE 569 123 C (BBC BROWN BOVERI & CIE) 30 January 1933 (1933-01-30) page 1, lines 26-42; figure 1	1
Y	----- US 2009/295155 A1 (KELLER-STAUß PIERIONO [CH] ET AL) 3 December 2009 (2009-12-03) paragraph [0036] - paragraph [0052]; figures 1-6	3
	----- -/-	



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

3 December 2015

Date of mailing of the international search report

09/12/2015

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2015/001821

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 3 787 649 A (ERNI H ET AL) 22 January 1974 (1974-01-22) column 3, line 19 - column 4, line 4; figure 1 -----	5-7
Y	EP 2 565 897 A1 (HITACHI LTD [JP]) 6 March 2013 (2013-03-06) paragraph [0024]; figure 2 -----	6
Y	US 6 172 317 B1 (WRISTEN CECIL C [US]) 9 January 2001 (2001-01-09) column 9, line 36 - column 10, line 16; figure 6 -----	8
Y	EP 1 331 655 A2 (SIEMENS AG [DE]) 30 July 2003 (2003-07-30) paragraphs [0027] - [0028]; figure 4 -----	10
Y	US 2005/063107 A1 (BENKE JAMES J [US]) 24 March 2005 (2005-03-24) paragraphs [0041] - [0042]; figures 1-3 -----	11,12
Y	US 2013/286546 A1 (HAZEL TERENCE GEORGE [FR] ET AL) 31 October 2013 (2013-10-31) paragraphs [0032] - [0034]; figure 1 -----	14

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2015/001821

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3626123	A	07-12-1971	CA 934797 A 02-10-1973 US 3626123 A 07-12-1971
GB 1206297	A	23-09-1970	NONE
DE 569123	C	30-01-1933	NONE
US 2009295155	A1	03-12-2009	CH 699688 A1 15-04-2010 CN 101713480 A 26-05-2010 DE 102009034579 A1 08-04-2010 US 2009295155 A1 03-12-2009
US 3787649	A	22-01-1974	AU 5861473 A 30-01-1975 CA 985725 A 16-03-1976 US 3787649 A 22-01-1974
EP 2565897	A1	06-03-2013	EP 2565897 A1 06-03-2013 JP 5452555 B2 26-03-2014 JP 2013048024 A 07-03-2013
US 6172317	B1	09-01-2001	US 6172317 B1 09-01-2001 US 6310310 B1 30-10-2001
EP 1331655	A2	30-07-2003	DE 10204217 A1 14-08-2003 EP 1331655 A2 30-07-2003 JP 2003223835 A 08-08-2003
US 2005063107	A1	24-03-2005	CA 2538557 A1 31-03-2005 CN 1856855 A 01-11-2006 EP 1665314 A1 07-06-2006 ES 2371915 T3 11-01-2012 US 2005063107 A1 24-03-2005 WO 2005029525 A1 31-03-2005
US 2013286546	A1	31-10-2013	US 2013286546 A1 31-10-2013 US 2013286547 A1 31-10-2013 US 2013286548 A1 31-10-2013 US 2013286549 A1 31-10-2013 US 2013286550 A1 31-10-2013