



(43) International Publication Date
6 March 2014 (06.03.2014)

- (51) International Patent Classification:
H03K 17/955 (2006.01) *B60R 25/20* (2013.01)
- (21) International Application Number:
PCT/EP2013/068103
- (22) International Filing Date:
2 September 2013 (02.09.2013)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
LU 92 069 3 September 2012 (03.09.2012) LU
- (71) Applicant: IEE INTERNATIONAL ELECTRONICS & ENGINEERING S.A. [—/LU]; Zone Industrielle, L-6468 Echternach (LU).
- (72) Inventor: STEIER, Andreas; Lindenstrasse 16, 54331 Pellingen (DE).
- (74) Agents: BEISSEL, Jean et al.; Office Freylinger S.A., 234, Route d'Arlon, BP 48, L-8001 Strassen (LU).
- (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, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, 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.

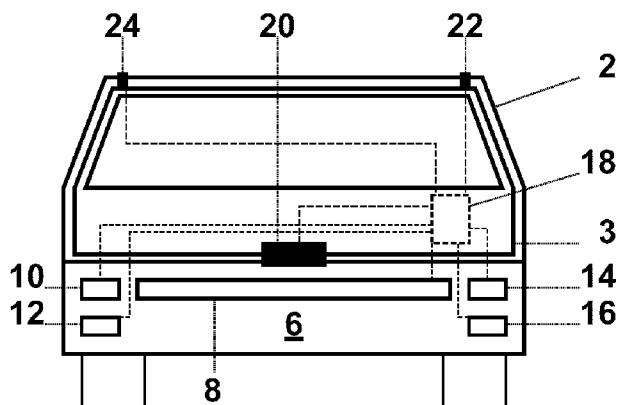
- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, 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))

(54) Title: CAPACITIVE SENSOR ARRANGEMENT FOR SWITCHING A HATCH OPENING ON A VEHICLE

Fig. 1



(57) Abstract: A vehicle (2) comprises a hatch (3), the hatch being operatively connected to a hatch opener, which includes a capacitive sensor arrangement operatively connected with a control and/or evaluation unit (18). The sensor arrangement comprises at least one central capacitive sensor electrode (8) having a main direction of extension corresponding with a width direction of the vehicle. At least two capacitive sensor electrodes (10, 12) are arranged on the left side of the central electrode (8) and at least two capacitive sensor electrodes (14, 16) are arranged on the right side of the central electrode (8). The left capacitive sensor electrodes (10, 12) are spaced one from the other in a direction transversal to the width direction of the vehicle. The right capacitive sensor electrodes (14, 16) are also spaced one from the other in a direction transversal to the width direction of the vehicle.



CAPACITIVE SENSOR ARRANGEMENT FOR SWITCHING A HATCH OPENING ON A VEHICLE

Technical field

[0001] The present invention generally relates to a device mounted on the rear of a car to trigger a contactless hatch opening by a movement gesture carried out by a person standing behind the car.

Background Art

[0002] It is well known that capacitive sensor arrangements may be used to trigger a contactless door opening of a vehicle by sensing a movement gesture executed by said person.

[0003] The disclosure of EP 1 902 912 relates to the basic design of a capacitive sensing device capable of triggering opening the hatch of a vehicle. In one of the embodiments of the disclosure, the sensor arrangement is mounted on the rear bumper of the vehicle, in a position, in which the sensor is capable of detecting a part of a human leg or foot carrying out a swinging or approaching motion. The triggering of the hatch opening can, however, result from the detection of another object than a human leg or foot, which is, of course, undesirable.

[0004] It has been tried to increase the reliability of such a contactless door-opening device. WO 2012/052210 discloses a sensor arrangement comprising at least two elongate sensor electrodes operatively connected to a control and evaluation unit. The electrodes extend substantially parallel to each other in the width direction of the rear bumper of the vehicle. One of the sensor electrodes is longer than the other. The longer sensor electrode extends beyond the shorter one on both sides of the vehicle. Due to the size difference of the sensor electrode arrangements, an object entering the sensing area from the side can be differentiated from an object entering the sensing area frontally. This allows reducing the risk of false positive opening commands. WO 2012/052210 further discloses that one or both of the sensor electrodes may be embodied as a segmented sensor electrode or as a plurality of separate electrode portion.

Technical problem

[0005] It is an object of the present invention to provide additional reliability for sensing a movement for switching a hatch opening on a vehicle. This object is achieved by a device as claimed in claim 1.

General Description of the Invention

[0006] The invention relates to a vehicle comprising a hatch at the rear of the vehicle, the hatch being operatively connected to a hatch opener, which includes a capacitive sensor arrangement operatively connected with a control and/or evaluation unit (such as, e.g., a processor, an application-specific integrated circuit and/or a field-programmable gate array, or the like). The sensor arrangement comprises at least one central capacitive sensor electrode having a main direction of extension corresponding with a width direction of the vehicle. Additionally, the sensor arrangement comprises at least two capacitive sensor electrodes (hereinafter referred to as "left electrodes") arranged on the left side of the central capacitive sensor electrode and at least two capacitive sensor electrodes (hereinafter referred to as "right electrodes") arranged on the right side of the central capacitive sensor electrode. As used herein, indications of position such as "left", "right", "vertical", "horizontal", "width direction", etc., are given with respect to the vehicle. The left electrodes are spaced one from the other in a direction transversal to the width direction of the vehicle. The right electrodes are also spaced one from the other in a direction transversal to the width direction of the vehicle. Due to the separate arrangement of the capacitive sensor electrodes, the central control and/or evaluation unit is able to estimate from which direction an object approaches the rear of the vehicle. An object approaching frontally results in a different change of capacitance (over time) in the different electrodes than an object approaching laterally. This differentiation of signals permits to distinguish between different patterns. Hence, it is possible to store a number of patterns of capacitance evolution in advance and compare them with patterns induced by the user and measured by the capacitive sensor arrangement.

[0007] Preferably, the central capacitive sensor electrode is arranged in a single row (i.e. without any further electrodes of the hatch opener arranged directly above or below it, between the side electrodes.)

[0008] Preferably, the control and/or evaluation unit is configured such that it can trigger the opening of the hatch by the hatch opener depending on a change of capacitance of the capacitive sensor electrodes.

[0009] Preferably, the central electrode comprises a plurality of capacitive sensor electrodes disposed (advantageously in a single line) along the direction of main extension. The sensor electrodes disposed along the direction of main extension are preferably arranged side by side. Thanks to such an arrangement it is possible not only to sense the position of an object, such as e.g. a foot or a leg, relative to the sensor, but also to estimate the width of the object in the same spatial direction as the width direction. Depending on the width of the object, a number of capacitive sensor electrodes are triggered simultaneously. By increasing the width of the object, the number of capacitive sensor electrodes sensing the object increases. Furthermore, thanks to the plurality of central electrodes, it is also possible to roughly estimate the position (in the width direction) of the sensed object. Any measured change of position may thus be taken into account by the control and/or evaluation unit when determining whether the hatch should be opened or not.

[0010] Preferably, the control and/or evaluation unit is configured to monitor evolution of capacitance sensed by the central sensor electrode, the left and/or right sensor electrodes. The control and/or evaluation unit can further be configured to compare the monitored evolution with a stored evolution pattern and to trigger opening of the hatch in case of the monitored evolution matching the stored evolution pattern. Each of the evolution patterns granting access to open the hatch has to be recorded in advance and stored in a memory of the control and/or evaluation unit. The recorded evolution pattern comprises a combination of changes of capacitance over time of the plurality of sensor electrodes. Access is granted depending on the degree of similarity recognized between the stored evolution pattern and the measured pattern.

[0011] Preferably, the stored evolution pattern is indicative of a predefined movement gesture prescribed for controlling opening of the hatch.

[0012] With the central capacitive sensing electrode comprising a plurality of capacitive sensing electrodes, the control and/or evaluation unit is preferably

configured to detect a direction of movement of an object (e.g. a user's leg or foot) capacitively coupling to the plurality of capacitive sensor electrodes along the main direction of extension. The control and/or evaluation unit may e.g. be configured to interpret a movement of the object from left to right or from right to left as a request to open or close the hatch and to control the hatch opener in accordance with the request. It is possible to associate each direction of movement with a specific action of the hatch opener. In this case, the control and/or evaluation unit may be configured to interpret a movement of the object from left to right as one of a request to open the hatch and a request to close the hatch and to interpret a movement of the object from right to left as the other one of the request to open the hatch and the request to close the hatch. The detection of the movement is preferably carried out by pattern matching. The control and/or evaluation unit is preferably configured to control actuators (one or more motors and/or a lock) of the hatch in accordance with the request recognized by interpretation of the detected movement.

[0013] The hatch opener can be coupled with a keyless entry system. This avoids opening of the hatch in the absence of the car driver, by non-authorized persons.

Brief Description of the Drawings

[0014] Preferred embodiments of the invention are described by way of example in the following detailed description and the corresponding drawings in which:

Fig. 1 is a schematic rear view of a vehicle in accordance with a first preferred embodiment of the invention.

Fig. 2 is a schematic rear view of a vehicle in accordance with a second preferred embodiment of the invention, wherein the central sensor electrode is divided into a plurality of capacitive sensor electrodes.

Description of Preferred Embodiments

[0015] Fig.1 illustrates the rear of a vehicle 2 according to a preferred embodiment of the invention. The vehicle 2 comprises a hatch 3 operatively connected to an automated hatch opener. The hatch opener includes a capacitive sensor arrangement mounted on the rear bumper 6 of the vehicle 2. The

capacitive sensor arrangement includes a central capacitive sensor electrode 8, a first and a second capacitive sensor electrodes 10, 12 on the left side, a third and a fourth capacitive sensor electrodes 14, 16 on the right side and a control and/or evaluation unit 18. The central capacitive sensor electrode 8 has a main direction of extension corresponding with the width direction of the vehicle 2. The two capacitive sensor electrodes 10, 12 on the left side of the central capacitive sensor electrode 8 are arranged spaced one from the other in the vertical direction. The two capacitive sensor electrodes 14, 16 arranged on the right side of the central capacitive sensor electrode 8 are also arranged spaced one from the other in a vertical direction. Each of the capacitive sensor electrodes 8, 10, 12, 14, 16 is operatively connected to the central control and/or evaluation unit 18. Depending on the readout of the capacitive sensor electrodes 8, 10, 12, 14, 16 the central control and/or evaluation unit 18 operates the hatch lock 20 and motors 22, 24. A number of different evolution patterns, indicative of a user's desire to open the hatch are stored in advance on the central control and/or evaluation unit 18. The stored evolution pattern may e.g. correspond to the changes of capacitance resulting when a user moves his leg or foot centrally under the rear bumper and thereafter withdraws his leg or foot again. The central control and/or evaluation unit 8 is configured to compare the evolution of the capacitance of the different electrodes with the stored evolution patterns. Access is granted to the user depending on the degree of similarity between the stored evolution pattern and the measured evolution pattern. Access to the hatch 3 is refused if the degree of similarity of the measured pattern and the stored pattern is below a critical value. If, however, the central control and/or evaluation unit 18 detects sufficient similarity between the readout of the capacitive sensor electrodes 8, 10, 12, 14, 16 and the stored evolution pattern, the central control and/or evaluation unit 18 unlocks the hatch 3 and operates the motors 22, 24.

[0016] Fig. 2 illustrates a second preferred embodiment of the invention. The second embodiment differs from the first embodiment in that the central capacitive sensor electrode is replaced by a plurality of capacitive sensor electrodes 26, 28, 30, 32, which are connected individually to the central control and/or evaluation unit 18'.

[0017] Thanks to this arrangement, the horizontal position of an object relative to the rear of the vehicle may be estimated. Additionally the width of an object in horizontal direction may be estimated as a function of the values of the capacitive coupling between the object and the individual electrodes. The horizontal width is estimated depending on the number of adjacent capacitive sensor electrodes simultaneously coupling to the object. If, for example, an object is in proximity of the vehicle and thereby changes the capacitance of two adjacent capacitive sensor electrodes, the width of the object may be estimated smaller than the total width of the two electrodes.

[0018] Besides estimating the width and the position of an object, the capacitive sensor electrode arrangement can further monitor a horizontal movement of an object along the capacitive sensor electrode arrangement. If an object moves either from the left or from the right side along the plurality of sensor electrodes, the capacitance of the electrodes changes according to the movement direction of the object. This may be used to define lateral movement gestures as requests for opening or closing the hatch. For instance, a capacitive coupling that (or whose maximum) moves from left to right may be interpreted by the control and/or evaluation unit as an expression of a user's desire to open the hatch (if the hatch is currently closed). A capacitive coupling traveling from right to left may be recognized as an expression of a user's desire to close the hatch (if the hatch is currently open).

[0019] By increasing the amount of capacitive sensor electrodes sensing an evolution pattern, the comparison with a stored evolution pattern may be more reliable since more supporting points are provided for the discretization of the evolution pattern.

[0020] In any other respect, the embodiment of Fig. 2 is identical with the embodiment of Fig. 1.

Legend:

- 2 Vehicle
- 3 Hatch
- 6 Bumper
- 8 Central capacitive sensor electrode
- 10 Left sensor electrode
- 12 Left sensor electrode
- 14 Right sensor electrode
- 16 Right sensor electrode
- 18 Central control and/or evaluation unit
- 18' Central control and/or evaluation unit
- 20 Hatch opener
- 22 Motor
- 24 Motor
- 26 Central capacitive sensor electrode
- 28 Central capacitive sensor electrode
- 30 Central capacitive sensor electrode
- 32 Central capacitive sensor electrode

Claims

1. A vehicle (2) comprising a hatch (3) at the rear of the vehicle (2),
said hatch (3) being operatively connected to a hatch opener,
said hatch opener comprising
 a capacitive sensor arrangement, which includes
 at least one central capacitive sensor electrode (8) having a main
 direction of extension corresponding with a width direction of said
 vehicle (2),
 a control and/or evaluation unit (18) operatively connected with
 said capacitive sensor arrangement,
said capacitive sensor arrangement being characterized by:
 at least two capacitive sensor electrodes (10, 12) arranged on the left side of
 said central capacitive sensor electrode (8), wherein said at least two
 capacitive sensor electrodes (10, 12) are arranged spaced one from the other
 in a direction transversal to said width direction, at least two capacitive sensor
 electrodes (14, 16) arranged on the right side of said central capacitive sensor
 electrode (8), wherein said at least two capacitive sensor electrodes (14, 16)
 are also arranged spaced one from the other in a direction transversal to said
 width direction.
2. A vehicle (2) according to claim 1, wherein said control and/or evaluation unit
(18) is configured to trigger opening of said hatch (3) by said hatch opener
depending on a change of capacitance of said capacitive sensor electrodes.
3. A vehicle (2) according to any one of claims 1 to 2, wherein said at least one
central electrode (8) comprises a plurality of capacitive sensor electrodes
disposed along said direction of main extension.
4. A vehicle (2) according to any one of claims 1 to 3, wherein said control and/or
evaluation unit (18) is configured to monitor evolution of capacitance sensed
by said central sensor electrode, said left (10, 12) and/or right sensor (14, 16)
electrodes, and wherein said control and/or evaluation unit (18) is further
configured to compare said monitored evolution with a stored evolution pattern

and to trigger opening of said hatch in case of said monitored evolution matching said stored evolution pattern.

5. A vehicle (2) according to claim 4, wherein said stored evolution pattern is indicative of a predefined movement gesture prescribed for controlling opening of said hatch (3).
6. A vehicle (2) according to claim 3, wherein said control and/or evaluation unit (18) is configured to detect a direction of movement of an object capacitively coupling to said plurality of capacitive sensor electrodes along said main direction of extension.
7. A vehicle (2) according to claim 6, wherein said control and/or evaluation unit (18) is configured to interpret a movement of said object from left to right or from right to left as a request to open or close said hatch and to control said hatch opener in accordance with said request.
8. A vehicle (2) according to claim 6, wherein said control and/or evaluation unit (18) is configured to interpret a movement of said object from left to right as one of a request to open said hatch and a request to close said hatch and to interpret a movement of said object from right to left as the other one of the request to open said hatch and the request to close said hatch.
9. A vehicle (2) according to any of the claims 1 to 8, wherein said hatch opener is coupled with a keyless entry system.

Fig. 1

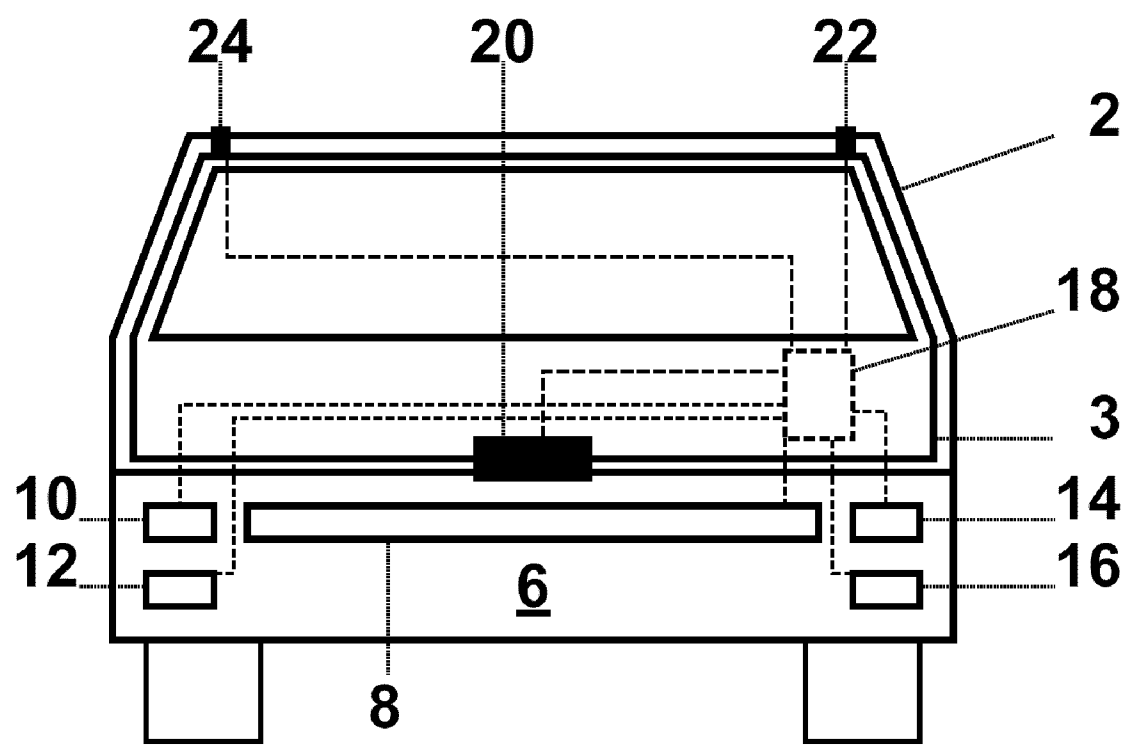
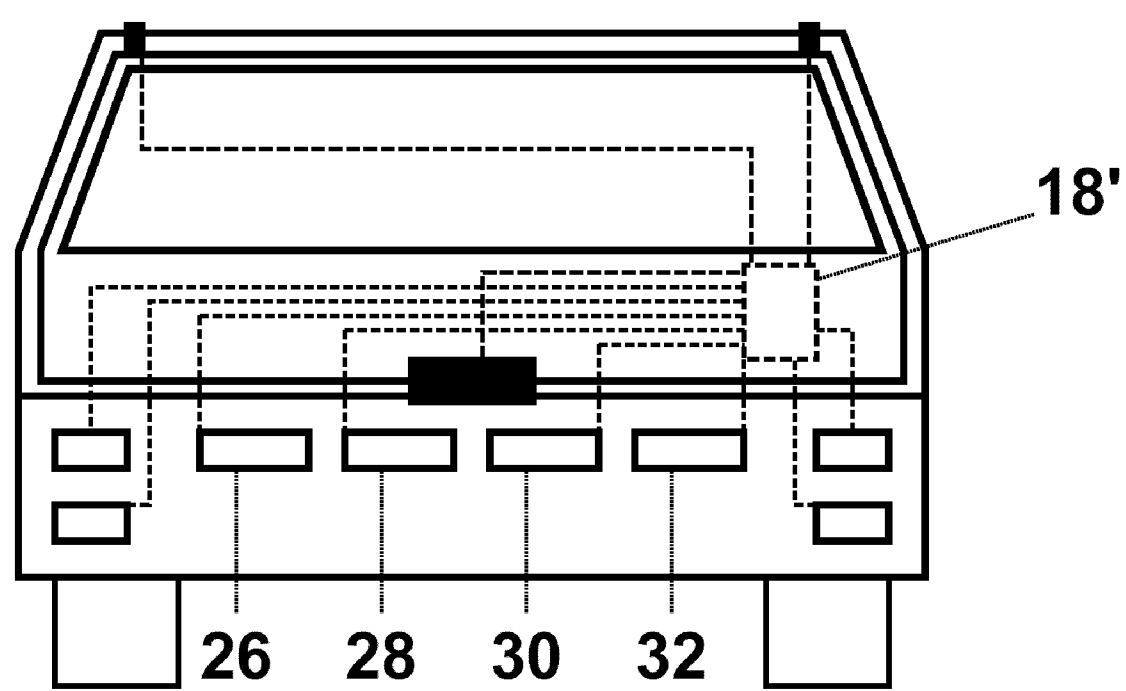


Fig. 2



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/068103

A. CLASSIFICATION OF SUBJECT MATTER
INV. H03K17/955 B60R25/20
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)
B60R H03K

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2010/079269 A1 (HAMMERSCHMIDT DIRK [AT] ET AL) 1 April 2010 (2010-04-01) paragraphs [0005], [0055] - [0068]; figures 17,20 abstract	1-9
X	DE 10 2010 002559 A1 (HUF HUELSBECK & FUERST GMBH [DE]) 8 September 2011 (2011-09-08) paragraphs [0001], [0005], [0012] - [0014], [0020], [0030] - [0039]; figures 1-4 abstract	1-9
	----- -/--	



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

23 September 2013

Date of mailing of the international search report

27/09/2013

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

Wauters, Jan

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/068103

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 10 2006 008281 A1 (IDENT TECHNOLOGY AG [DE]) 23 August 2007 (2007-08-23) paragraphs [0001], [0022] - [0044]; figures 1-4 abstract -----	1-9
X	US 2009/153151 A1 (CHO SEUNG WON [KR] ET AL) 18 June 2009 (2009-06-18) paragraphs [0003], [0045] - [0116]; figures 4-7 abstract -----	1-9
A	DE 10 2010 049400 A1 (BROSE FAHRZEUGTEILE [DE]) 26 April 2012 (2012-04-26) abstract; figures 1-4 -----	1-9
A	DE 10 2009 019673 A1 (HELLA KGAA HUECK & CO [DE]) 4 November 2010 (2010-11-04) abstract; figures 1-5 -----	1-9
A	WO 2012/084111 A1 (BROSE FAHRZEUGTEILE [DE]; RUSS DETLEF [DE]; WUERSTLEIN HOLGER [DE]; FU) 28 June 2012 (2012-06-28) abstract; figures 1-4 -----	1-9
A	DE 10 2010 060364 A1 (HUF HUELSBECK & FUERST GMBH [DE]) 10 May 2012 (2012-05-10) abstract; figures 1-22 -----	1-9

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2013/068103

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2010079269 A1	01-04-2010	US 2010079269 A1	01-04-2010
		US 2010079283 A1	01-04-2010
DE 102010002559 A1	08-09-2011	NONE	
DE 102006008281 A1	23-08-2007	DE 102006008281 A1	23-08-2007
		EP 1992070 A2	19-11-2008
		JP 2009527746 A	30-07-2009
		US 2009033342 A1	05-02-2009
		WO 2007096166 A2	30-08-2007
US 2009153151 A1	18-06-2009	JP 4698703 B2	08-06-2011
		JP 2009144498 A	02-07-2009
		KR 20090065028 A	22-06-2009
		US 2009153151 A1	18-06-2009
DE 102010049400 A1	26-04-2012	CN 103168317 A	19-06-2013
		DE 102010049400 A1	26-04-2012
		EP 2633502 A1	04-09-2013
		US 2013234828 A1	12-09-2013
		WO 2012055518 A1	03-05-2012
DE 102009019673 A1	04-11-2010	NONE	
WO 2012084111 A1	28-06-2012	DE 102010055297 A1	21-06-2012
		WO 2012084111 A1	28-06-2012
DE 102010060364 A1	10-05-2012	CN 103189245 A	03-07-2013
		DE 102010060364 A1	10-05-2012
		DE 112011104152 A5	02-10-2013
		EP 2635464 A2	11-09-2013
		WO 2012059100 A2	10-05-2012