(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
29 August 2013 (29.08.2013)

WIPO | PCT

(10) International Publication Number
WO 2013/125995 A1

(51) **International Patent Classification**:
A01D 34/00 (2006.01) *A01D 75/20* (2006.01)
A01D 75/18 (2006.01)

(21) **International Application Number**:
PCT/SE2012/050197

(22) **International Filing Date**:
22 February 2012 (22.02.2012)

(25) **Filing Language**: English

(26) **Publication Language**: English

(71) **Applicant** *(for all designated States except US)*: **HUSQVARNA AB** [SE/SE]; S-561 82 Huskvarna (SE).

(72) **Inventors; and**
(75) **Inventors/Applicants** *(for US only)*: **BJÖRN, Jonathan** [SE/SE]; Boktryckargatan 8, S-553 24 Jönköping (SE). **ELONSSON, Martin** [SE/SE]; Gestra 24, S-561 92 Huskvarna (SE).

(74) **Agent**: **ROMEDAHL, Anna**; c/o Husqvarna AB, Intellectual Property Dept, EM-LPH, S-561 82 Huskvarna (SE).

(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, 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, KM, 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, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, 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, MD, 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, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *of inventorship (Rule 4.17(iv))*

Published:

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

WO 2013/125995 A1

(54) **Title**: ROBOTIC LAWNMOWER

(57) **Abstract**: A lift detection arrangement (100, 200) in a robotic lawnmower for detecting a lift of a body (110, 210) relative a chassis (105, 205) of the robotic lawnmower is provided. The lift detection arrangement (100, 200) comprises a connection between the chassis (105, 205) and the body (110, 220). The connection comprises a joystick element (115, 215) 5 arranged to allow a displacement of the body (1110, 210) relative the chassis (105, 205) in a collision plane during a collision, and a lift element (120, 220) arranged to provide a flexibility between the chassis (105, 205) and the body (110, 210) in a lift direction during the lift. The lift detection arrangement (100, 200) further comprises a lift sensor configured to detect a displacement over a predetermined threshold of the lift element (120, 220) 10 during the lift by detecting a change in spacing between two sensor parts (125, 126, 225, 226). One of the two sensor parts (125, 126, 225, 226) is arranged on the lift element and the two sensor parts (125, 126, 225, 226) are arranged to be relatively displaceable only in the lift direction.

ROBOTIC LAWNMOWER

TECHNICAL FIELD

Embodiments herein relate to a lift detection arrangement in a robotic lawnmower. In particular, embodiments herein relate to a lift detection arrangement for detecting a lift of a body of the robotic lawnmower relative a chassis of the robotic lawnmower.

BACKGROUND

A robotic lawnmower is a device configured to autonomously move across a lawn to cut grass by means of a rotating cutting blade. The robotic lawnmower comprises a chassis to which ground engaging wheels and the cutting blade are attached. The robotic lawnmower further comprises a body arranged above the chassis. A function of the body is to prevent people from being injured by the cutting blade, as well as to protect the chassis and cutting blade from rain, dirt and clippings which may cause clogging and malfunction of the robotic lawnmower.

The body may be flexibly attached relative the body in the travelling plane or collision plane, such that a relative displacement of the body relative the chassis is possible if the body collides with an obstacle. This is to enable the robotic lawnmower to detect the obstacle and move away from it.

For this purpose, the connection between the body and the chassis may be arranged to allow relative movement between the body and the chassis in the collision plane, i.e. in a plane essentially parallel to the lawn that is being cut.

A further feature of the robotic lawnmower is an arrangement for lift detection.

This is important for protecting people from being injured by the cutting blade when the robotic lawnmower is lifted during operation, and lift detection arrangements are therefore usually arranged to automatically stop rotation of the cutting blade when a lift is detected.

By having a lift detection arrangement for detecting a lift of the body relative the chassis, it is possible to quickly stop rotation of the cutting blade. Such detection requires a connection of the body to the chassis which allows flexibility in a lift direction.

A problem is that it is difficult to distinguish a lift from a collision, since both lifts and collisions cause the body to flex relative the chassis.

This may cause false lift detections and unnecessary stops of the robotic lawnmower.

SUMMARY

In view of the discussion above, it is an object for embodiments herein to provide an improved lift detection arrangement in a robotic lawnmower.

According to a first aspect, the object is achieved by a lift detection arrangement in a robotic lawnmower for detecting a lift of a body of the robotic lawnmower relative a chassis of the robotic lawnmower. The lift detection arrangement comprises a connection between the chassis and the body. The connection comprises a joystick element and a lift element. The joystick element is arranged to allow a displacement of the body relative the chassis in a collision plane during a collision of the robotic lawnmower. The lift element is arranged to provide flexibility between the chassis and the body in a lift direction during the lift. The lift detection arrangement further comprises a lift sensor. The lift sensor is configured to detect a displacement over a predetermined threshold of the lift element during the lift by detecting a change in spacing between two sensor parts. One of the two sensor parts is arranged on the lift element and the two sensor parts are arranged to be relatively displaceable only in the lift direction.

Thanks to the two sensor parts being arranged to be relatively displaceable only in the lift direction, false lift detections during collisions can be avoided while the lift detection arrangement still allows for flexibility in the collision plane.

This provides an improved lift detection arrangement.

According to some embodiments herein, the lift element is a sliding member which is slidingly arranged relative the joystick element in the lift direction to provide the flexibility during the lift. In such embodiments, one of the two sensor parts may then be arranged on the joystick element and the other one of the two sensor parts may be arranged on the sliding member.

By slidingly arranged relative the joystick element in the lift direction it is understood that the sliding member is interconnected with the joystick element in such a way that it may slide, or move transversally, along the joystick element in the lift direction. Thereby the sliding member provides flexibility in the connection between the chassis and the body in the lift direction.

Thanks to one of the two sensor parts being arranged on the lift element and the other sensor part being arranged on the joystick member, the sensor parts are only movable relative each other in the lift direction, thereby preventing false lift detections during collisions.

The sliding member may be telescopically extendable from the joystick element in the lift direction.

This may facilitate the arrangement of the sensor parts on the sliding member and on the joystick member.

The two sensor parts may be arranged on respective downwardly protruding end portions of the joystick element and the lift element, which are arranged at a distance from a pivot connection between the joystick element and the chassis.

The two sensor parts may also be arranged on respective upwardly protruding end portions of the joystick element and the lift element, which are arranged at a distance from a pivot connection between the joystick element and the chassis.

This may facilitate assembly of the sensor parts and prevent unnecessary ware due to pivotations during collisions.

According to some embodiments herein, the lift element is a link arm supporting the joystick element, which link arm is rotatably connected to the chassis to provide the flexibility during the lift by being rotatable in the lift direction. In such embodiments, one of the two sensor parts may be arranged on the chassis and the other sensor part may be arranged on arranged on the link arm.

The link arm may then further be arranged to rest on a support extending from the chassis when it is not lifted.

According to some embodiments herein one of the two sensor parts is a Hall Effect sensor and the other one of the two sensor parts is a magnet.

According to some embodiments herein the magnet is arranged on the lift element. This may be advantageous since wires associated with the Hall Effect sensor can be kept shorter if the Hall Effect sensor is not arranged on the lift element because the Hall Effect sensor does not then move in the lift direction during the lift.

According to some embodiments herein the joystick element is arranged to be held in a neutral position relative the chassis by means of a spring element.

PCT / SE 2012 / 0 5 0 1 9 7
PCT/SE2012/050197
2 2 -02- 2012

According to some embodiments herein the connection is a front suspension of the robotic lawnmower.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1A is a schematic illustration of embodiments of a lift detection arrangement.

Figure 1B is a schematic illustration of the lift detection arrangement illustrated in figure 1A during a lift.

Figure 1C is a schematic illustration of the lift detection arrangement illustrated in figure 1A and 1C during a collision.

Figure 2A is a schematic illustration of embodiments of a lift detection arrangement.

Figure 2B is a schematic top view illustration of the lift detection arrangement in figure 2A.

Figure 2C is a schematic illustration of the lift detection arrangement illustrated in figures 2A and 2B during a lift.

Figure 2D is a schematic illustration of the lift detection arrangement illustrated in figure 2A and 2B during a collision.

DETAILED DESCRIPTION

Figure 1A depicts, schematically and by way of example, a side view of **a lift detection arrangement 100** in a robotic lawnmower according to some embodiments herein. The lift detection arrangement 100 comprises a connection between **a chassis 105**, of which only an attachment portion is shown in the figure 1A, and **a body 110** of the robotic lawnmower. The connection comprises **a joystick element 115**. The joystick element 115 is pivotably attached to the chassis 105, by means of **a pivot connection 140**, to be pivotable in a collision plane relative the chassis 105. This is to allow flexibility to the body 110 relative the chassis 105 during a collision. The collision plane may be essentially parallel to the travelling plane of the robotic lawnmower. It is to be understood that the part of the chassis 105 that is illustrated in the figure 1 may form an integrated part of the chassis 105 or be a separate part for fixing the joystick element to the chassis 105.

The connection further comprises **a lift element 120,** which in the illustrated embodiment in figure 1 is **a sliding member 120** which is arranged to be slideable, i.e. transversally displaced, relative the joystick element 115 in a lift direction during a lift of the body 110. The sliding member 120 hence provides flexibility between the body 110

and the chassis 105 during a lift. The sliding member 120 is in the illustrated example telescopically extendable from the joystick member. The sliding member 120 is at a top portion thereof attached to the body 110.

The lift detection arrangement 100 further comprises a lift sensor. The lift sensor comprises two sensor parts 125, 126. The lift sensor is configured to detect a displacement over a predetermined threshold of the lift element 120 during the lift by detecting a change in spacing between the two sensor parts 125, 126. One of the two sensor parts, the sensor part 125 in this example, is arranged on the sliding member 120 and the other sensor part, the sensor part 126, is in this example arranged on the joystick member 115. The two sensor parts 125, 126 are hence arranged to be relatively displaceable only in the lift direction since the sliding member 120 is only displaceable relative the joystick member 115 in the lift direction. The figure 1A illustrates the lift detection arrangement 100 in a neutral position, when there is no lift and no collision. Then, the sensor parts 125, 126 are arranged to be situates essentially opposite each other such that the spacing between them is as small as possible. The two sensor parts 125, 126 may be for example a Hall Effect sensor and a magnet.

If the two sensor elements are placed tight together, a Hall Effect sensor and a magnet can be used, while keeping the total travel of the lift member small. It also makes it possible to remove the magnet and replace the Hall Effect sensor with a micro switch, where the micro switch is actuated by the lift member.

Figure 1B illustrates, in a side view, how the lift detection arrangement 100 as described in relation to figure 1A operates during a lift. During the lift, the body 110 is lifted relative the chassis 110 thanks to the lift element 120, i.e. the sliding member 120 in this example being attached to the body 110 and slidable attached to the joystick member 115 which in turn is attached to the chassis 105. As the sliding member 120 is displaced in the lift direction during the lift, sliding along the joystick member 115, there is a change in the spacing between the two sensor parts 125, 126. As the sensor part 125 in this example, slides upward with the sliding member 120, it is displaced relative the other sensor part 126. When the displacement is over a certain predetermined threshold, as small as possible, for example 5-10 mm, the lift sensor detects the displacement and determines that there is a lift. In response to the lift detection, the lift sensor may trigger a stop of the robotic lawnmower. This may be done by the lift sensor sending a trigger signal to a not shown control device handling the operation of the robotic lawnmower. It is to be understood, that “sliding” is not limiting, and that the “sliding” movement between the

joystick member 115 and the sliding member 120 may be any translational movement in the lift direction, provided for by various ways.

Figure 1C illustrates, in a side view, how the lift detection arrangement 100 as described in relation to figure 1A and 1B operates during a collision of the robotic lawnmower. During the collision, the body 110 is displaced relative the chassis 105 thanks to the pivotal connection 140 between the joystick element 115 and the chassis 105, which allows pivotation of the joystick element 115 relative the chassis 105 in the collision plane.

Further, the sliding member 120, on which one sensor part 125 is arranged, pivotates along with the joystick member 115 on which the other sensor part 126 is arranged. Hence, thanks to the two sensor parts 125, 126 being arranged such that they are only displaceable in the lift direction, the collision do not cause a change in the spacing between the two sensor parts 125, 126, and false lift detection by the lift sensor can be avoided.

According to some embodiments herein, as previously mentioned, one of the two sensor parts 125, 126 is a Hall Effect sensor and the other one of the two sensor parts 125, 126 is a magnet. As also previously mentioned, the magnet may then be arranged on the lift element, i.e. the sliding member 120 in this example.

This may be advantageous since wires associated with the Hall effect sensor can be kept shorter if the Hall effect sensor is not arranged on the lift element 120 because the Hall effect sensor does not then move in the lift direction during the lift.

According to some embodiments herein the joystick element 115 is arranged to be held in a neutral position relative the chassis 105 by means of not shown a spring element.

According to some embodiments herein the connection is a front suspension of the robotic lawnmower. This may be advantageous for example if one or more rear suspensions are used which have the same, or a similar, joystick elements as the joystick element 115, such that all suspensions provide a stable and desired neutral position during operation of the robotic lawnmower.

Figure 2A depicts, schematically and by way of example, a side view of **a lift detection arrangement 200** in a robotic lawnmower according to some embodiments herein. The lift detection arrangement 200 comprises a connection between **a chassis**

205, of which only an attachment portion is shown in the figure, and **a body 210** of the robotic lawnmower. The connection comprises **a joystick element 215**. The joystick element 215 is pivotably attached to the chassis 205, by means of **a pivot connection 240** to the supporting link arm 220, to be pivotable in a collision plane relative chassis 205. This allows flexibility to the body 210 relative the chassis 205 during a collision.

The connection further comprises **a lift element 220** which in the illustrated embodiment in figure 2A is **a link arm 220**. The link arm 220 carries the joystick element 115 in **a first end portion 250** thereof, and is rotatably arranged on the chassis 205 at a **second end portion 245** thereof to be rotatable relative the chassis 205 in a lift direction. Thanks to the link arm 220 being rotatable relative the chassis 205 in the lift direction flexibility between the chassis 205 and the body 210 in the lift direction during a lift is provided.

The first end portion 250 may be arranged to rest on a not shown support extending from the chassis 205, when there is no lift.

The lift detection arrangement 200 further comprises a lift sensor. The lift sensor comprises two sensor parts 225, 226, which are not shown in the figure 2A, but which are illustrated in the figure 2B that will be discussed further down in this document.

The lift sensor is configured to detect a displacement over a predetermined threshold of the lift element 220 during the lift by detecting a change in spacing between the two sensor parts 225, 226. One of the two sensor parts, the sensor part 225 in this example, is arranged on the link arm 220 and the other sensor part, the sensor part 226, is in this example arranged on the joystick element 215, at a distance from the rotational connection to the chassis 205, for example at the first end portion 250. The two sensor parts 225, 226 are hence arranged to be relatively displaceable only in the lift direction since the link arm 220 is only is only rotatable relative the chassis 205 in the lift direction.

Figure 2B schematically depicts a top view of the lift detection arrangement 200 depicted in figure 2A. In the view in figure 2B, it is illustrated how the two sensor parts 225, 226 may be arranged on the lift detection arrangement 200. In the illustrated example, the sensor part 225 arranged on the link arm 220 is a magnet, and the sensor part 225 arranged on the chassis is a Hall Effect sensor. In other embodiments the sensor parts 225, 226 may be arranged in the opposite way. In some embodiments, the sensor parts 225, 226 may be of other types. The figure 2B illustrates the lift detection arrangement in a normal state, where there is no lift and no collision. The two sensor

parts 225, 226 are then positioned opposite each other and there is a small spacing between them.

Figure 2C illustrates, in a side view, how the lift detection arrangement 200 as described in relation to figure 2A and 2B operates during a lift. During the lift, the body 210 is lifted relative the chassis 210 thanks to the lift element 220 i.e. the link arm 220 in this example being rotatable relative the chassis 205 in the lift direction. As the link arm 220 is rotated, or displaced, in the lift direction during the lift, there is a change in the spacing between the two sensor parts 225, 226, since as the sensor part 225 attached to the link arm 220 in this example, moves upward with the link arm 220, it is displaced relative the other sensor part 226. When this displacement is over a certain predetermined threshold, as small as possible, for example 5-15 mm, the lift sensor detects the displacement and determines that there is a lift. In response to the lift detection, the lift sensor may trigger a stop of the robotic lawnmower. This may be done by the lift sensor sending a trigger signal to a not shown control device handling the operation of the robotic lawnmower.

Figure 2D illustrates, in a side view, how the lift detection arrangement 200 as described in relation to figure 2A, 2B and 2C operates during a collision of the robotic lawnmower. During the collision, the body 210 is displaced relative the chassis 205 thanks to the pivot connection 240 thanks to which the joystick element 115 is pivotable relative the chassis 105 in the collision plane.

The link arm 220, on which one sensor part 225 is arranged, remains still and does not move relative the chassis 205 on which the other sensor part 126 is arranged. Hence, thanks to the two sensor parts 225, 226 being arranged such that they are only displaceable relative each other in the lift direction, the collision does not cause a change in the spacing between the two sensor parts 225, 226, and false lift detection by the lift sensor is avoided.

According to some embodiments herein, one of the two sensor parts 225, 226 is a Hall effect sensor and the other one of the two sensors 225, 226 parts is a magnet If the two sensor elements are placed tight together, a Hall effect sensor and a magnet can be used, while keeping the total travel of the lift member small. It also makes it possible to remove the magnet and replace the Hall Effect sensor with a micro switch, where the micro switch is actuated by the lift member.

According to some embodiments herein the magnet is arranged on the lift element, i.e. on the link arm 220 in this example. This may be advantageous since wires associated with the Hall effect sensor can be kept shorter if the Hall effect sensor is not arranged on the lift element 220 because the Hall effect sensor does not then move in the lift direction during the lift.

According to some embodiments herein, the joystick element 215 is arranged to be held in a neutral position relative the chassis 205 by means of a not shown spring element.

According to some embodiments herein the connection is a front suspension of the robotic lawnmower. This may be advantageous for example if one or more rear suspensions are used which have the same, or a similar, joystick elements as the joystick element 115, such that all suspensions provide a stable and desired neutral position when there during operation of the robotic lawnmower.

When using the word "comprise" or “comprising” it shall be interpreted as non-limiting, i.e. meaning "consist at least of".

The term “arranged to” used herein may also be referred to as “configured to”.

The embodiments herein are not limited to the above described embodiments. Various alternatives, modifications and equivalents may be used. Therefore, the above embodiments should not be taken as limiting the scope of the invention, which is defined by the appending claims.

CLAIMS

1. A lift detection arrangement (100, 200) in a robotic lawnmower for detecting a lift of a body (110, 210) of the robotic lawnmower relative a chassis (105, 205) of the robotic lawnmower, characterised by

   a connection between the chassis (105, 205) and the body (110, 220), comprising a joystick element (115, 215) and a lift element (120, 220), which joystick element (115, 215) is arranged to allow a displacement of the body (110, 210) relative the chassis (105, 205) in a collision plane during a collision of the robotic lawnmower, and which lift element (120, 220) is arranged to provide a flexibility between the chassis (105, 205) and the body (110, 210) in a lift direction during the lift, and

   a lift sensor configured to detect a displacement over a predetermined threshold of the lift element (120, 220) during the lift by detecting a change in a spacing between two sensor parts (125, 126, 225, 226) of which one is arranged on the lift element (120, 220), wherein the two sensor parts (125, 126, 225, 226) are arranged to be relatively displaceable only in the lift direction.

2. The lift detection arrangement (100) according to claim 1, wherein the lift element is a sliding member (120) which is slidingly arranged relative the joystick element (115) in the lift direction to provide the flexibility during the lift, and wherein one of the two sensor parts (125, 126) is arranged on the joystick element (115) and the other of the two sensor parts (125, 126) is arranged on the sliding member (120).

3. The lift detection arrangement (100) according to claim 2, wherein the sliding member (120) is telescopically extendable from the joystick element (115) in the lift direction.

4. The lift detection arrangement (100) according to any one of claims 2 and 3, wherein the sensor parts (125, 126) are arranged on respective downwardly protruding end portions (130, 135) of the joystick element (115) and the sliding member (120), which end portions (130, 135) are arranged at a distance from

a pivot connection (140) between the joystick element (115) and the chassis (105).

5. The lift detection arrangement (200) according to claim 1, wherein the lift element is a link arm (220) supporting the joystick element (215), which link arm (220) is rotatably connected to the chassis (205) to provide the flexibility during the lift by being rotatable in the lift direction, and wherein one of the two sensor parts (225, 226) is arranged on the chassis (205) and the other of the two senor parts (225, 226) is arranged on the link arm (220).

6. The lift detection arrangement (200) according to claim 5, wherein the link arm (220) is further arranged to rest on a support extending from the chassis (205) when it is not lifted.

7. The lift detection arrangement (100, 200) according to any one of the preceding claims, wherein one of the two sensor parts (125, 126, 225, 226) is a Hall Effect sensor and the other of the two sensor parts (125, 126, 225, 226) is a magnet.

8. The lift detection arrangement (100, 200) according to claim 7, wherein the magnet is arranged on the lift element (120, 220).

9. The lift detection arrangement (100, 200) according to any one of the preceding claims, wherein the joystick element (115, 215) is arranged to be held in a neutral position relative the chassis by means of a spring element.

10. The lift detection arrangement (100, 200) according to any one of the preceding claims, wherein the connection is a front suspension of the robotic lawnmower.

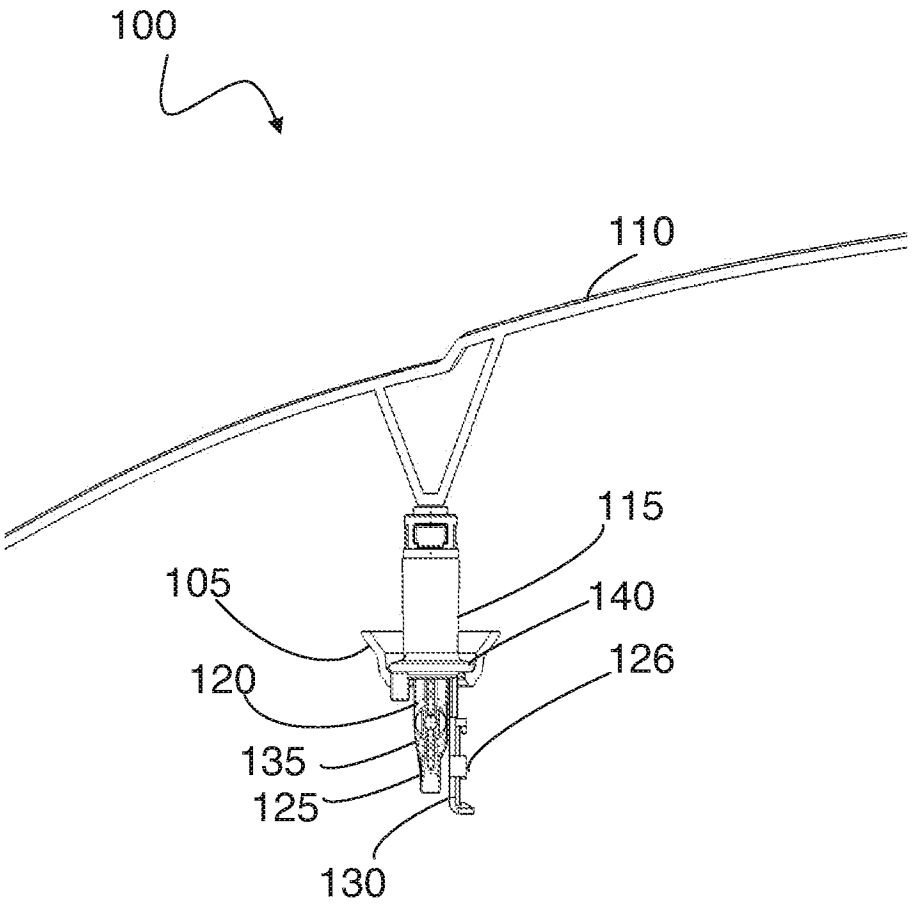

FIG 1A

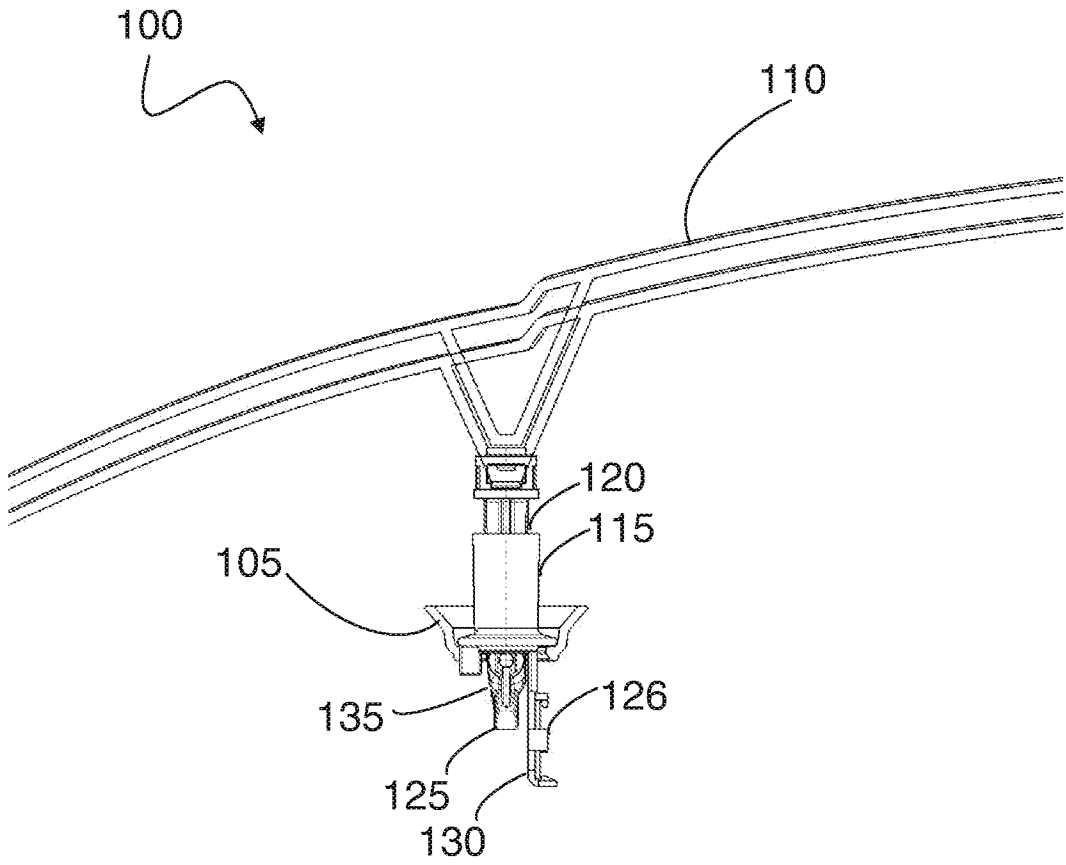

FIG 1B

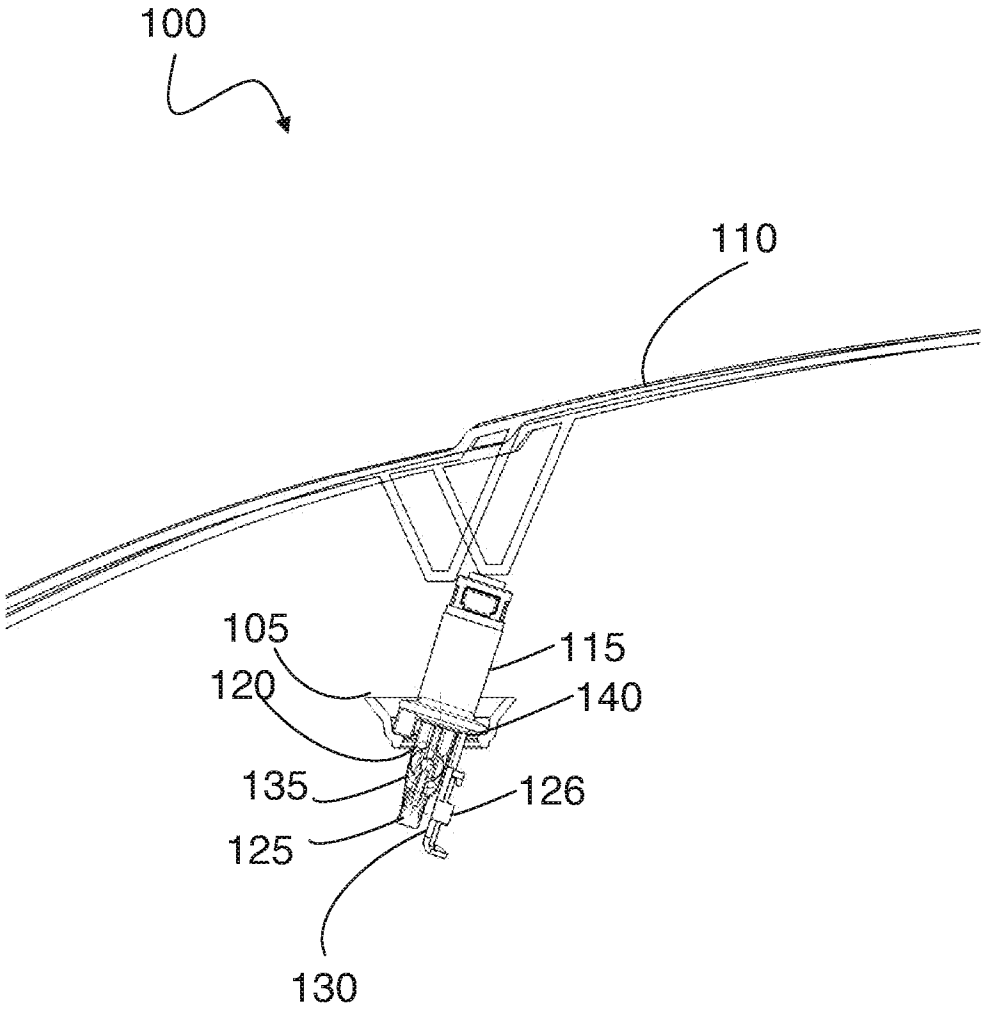

FIG 1C

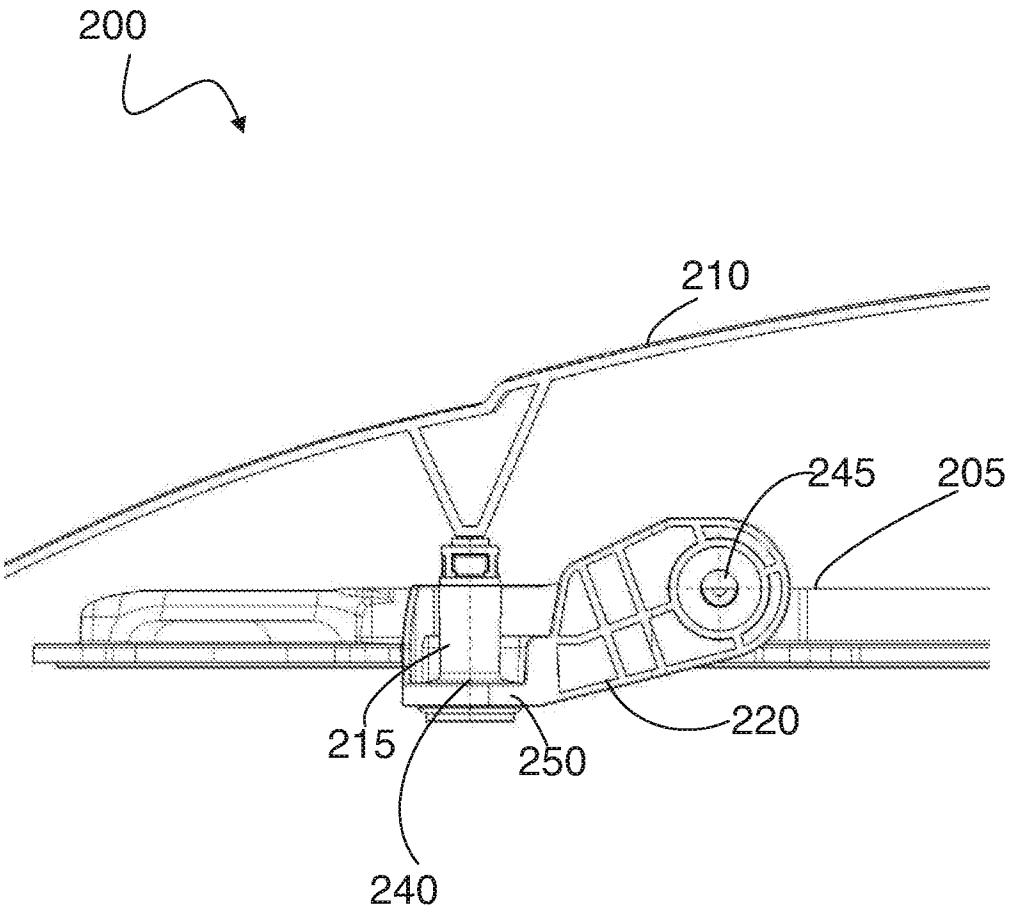

FIG 2A

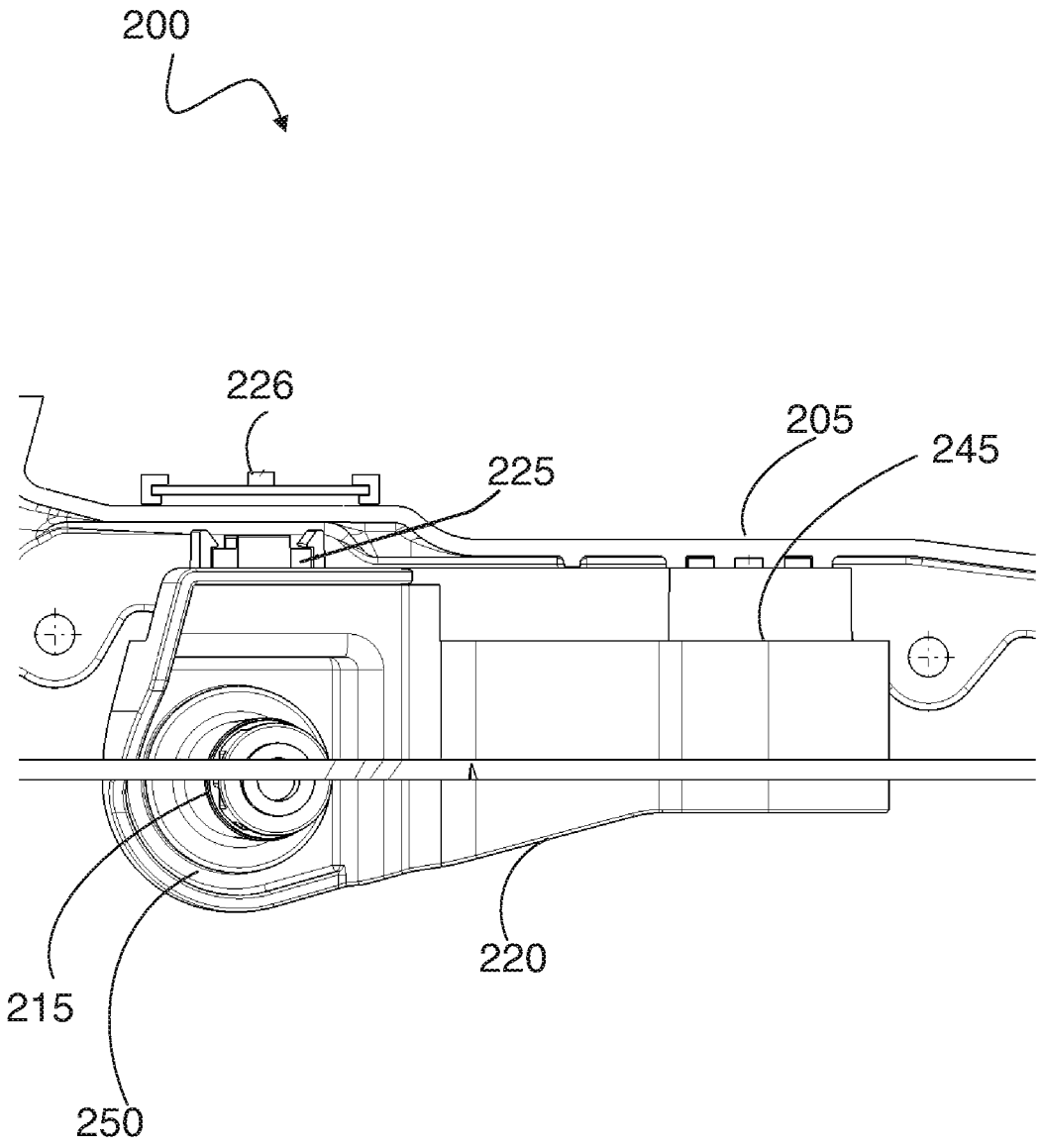

FIG 2B

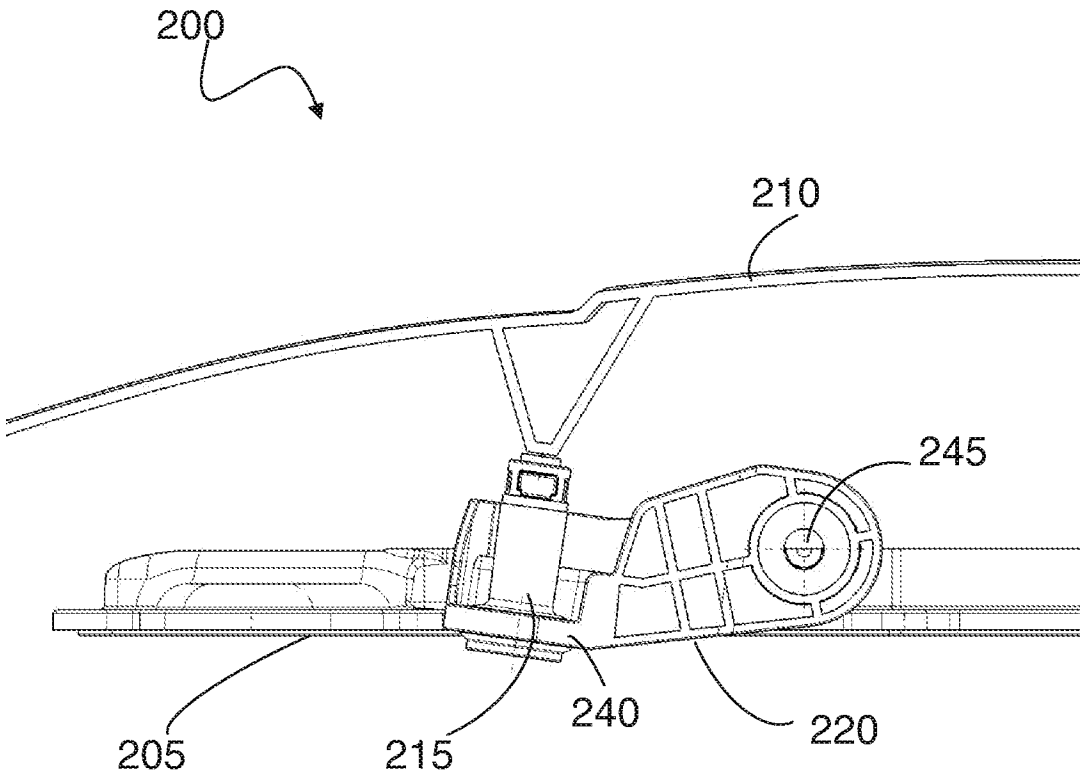

FIG 2C

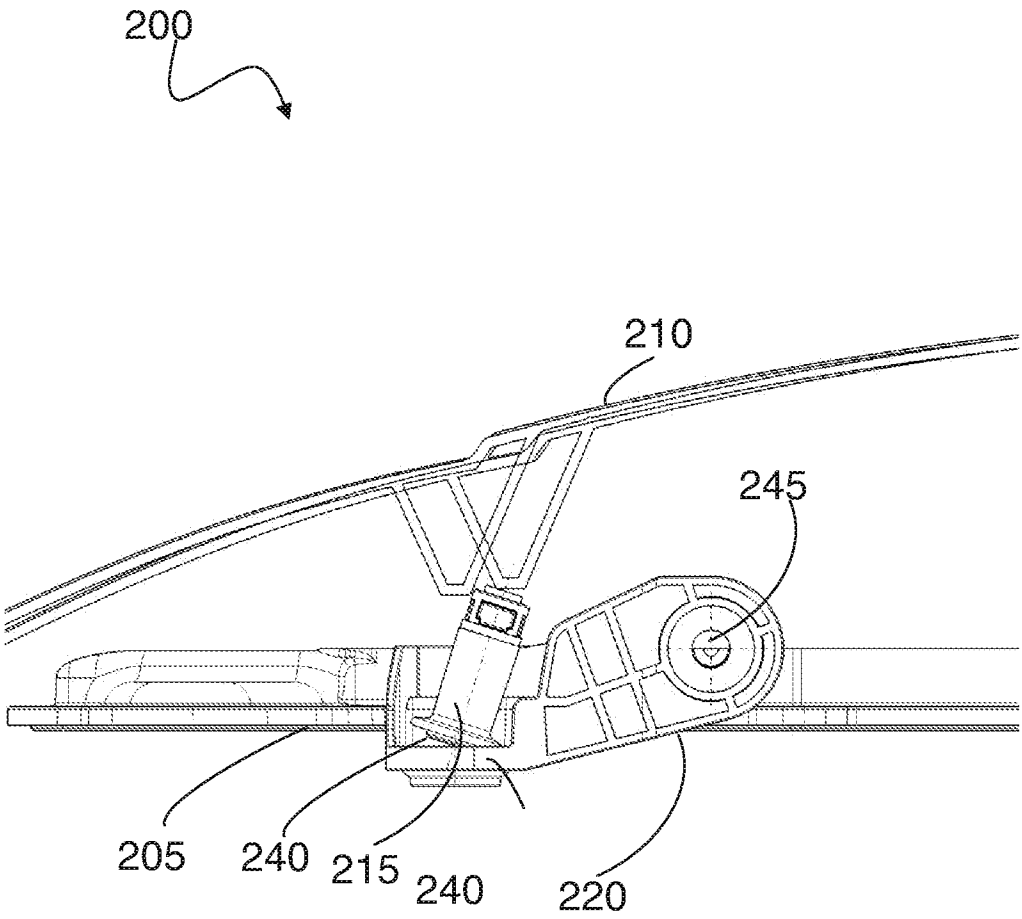

FIG 2D

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2012/050197

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

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: A01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, PAJ, WPI data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E	EP 2425700 A2 (GGP ITALY S P A), 7 March 2012 (2012-03-07); paragraphs [0003]-[0005], [0043]-[0045]; figures 3-5; claim 1	1-3, 7-9
	--	
A	WO 03103375 A1 (ELECTROLUX AB ET AL), 18 December 2003 (2003-12-18); page 6, line 24 - page 7, line 29; figures 11-13	1-10
	--	
A	CN 201557392 U (HANGZHOU NORMAN INNOVATION & TECHNOLOGY CO LTD), 25 August 2010 (2010-08-25); abstract; EPODOC/EPO abstract	1
	--	

☒ 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	Date of mailing of the international search report
11-10-2012	15-10-2012

Name and mailing address of the ISA/SE	Authorized officer
Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. + 46 8 666 02 86	Magnus Thorén Telephone No. + 46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2012/050197

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EPODOC/EPO ---	1
A	WO 2011035691 A1 (JIAXING YAT GARDEN MACHINERY RES INST ET AL), 31 March 2011 (2011-03-31); abstract; figure 1 ---	10
A	DE 3814582 A1 (AKAD WISSENSCHAFTEN DDR), 10 November 1988 (1988-11-10); column 3, line 8 - column 3, line 19; figure 1 --- --------	7, 8

International application No.
PCT/SE2012/050197

Continuation of: second sheet

International Patent Classification (IPC)

A01D 34/00 (2006.01)
A01D 75/18 (2006.01)
A01D 75/20 (2006.01)

Cited literature, if any, will be enclosed in paper form.

EP	2425700	A2	07/03/2012	DE	102010044276	A1	08/03/2012
WO	03103375	A1	18/12/2003	AU	2003244285	A1	22/12/2003
CN	201557392	U	25/08/2010	NONE			
WO	2011035691	A1	31/03/2011	CN	201601993	U	13/10/2010
DE	3814582	A1	10/11/1988	DD	260029	A1	14/09/1988