



(43) International Publication Date
27 December 2012 (27.12.2012)

- (51) International Patent Classification:
H01R 13/436 (2006.01) *H01R 13/512* (2006.01)
- (21) International Application Number:
PCT/EP2012/061885
- (22) International Filing Date:
20 June 2012 (20.06.2012)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
PCT/IB2011/001670 20 June 2011 (20.06.2011) IB
- (71) Applicant (for all designated States except US): **FCI AUTOMOTIVE HOLDING** [FR/FR]; 18 Parc Ariane III, 3-5, rue Alfred Kastler, F-78280 Guyancourt (FR).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): **DUQUESNE, Arnaud** [FR/FR]; 19 Bis Rue de Caddy Bât A - Apt N°5, F-28230 Epernon (FR). **MULOT, Gérard** [FR/FR]; 26, rue du Général de Gaulle, F-28210 Nogent Le Roi (FR). **AESCHBACHER, Michel** [FR/FR]; 40, rue de la Gare, F-28300 Saint-Prest (FR).
- (74) Agent: **FCI AUTOMOTIVE HOLDING**; IP Department, 18 Parc Ariane III, 3/5, rue Alfred Kastler, F-78284 Guyancourt Cedex (FR).

(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, 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).

Published:

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

(54) Title: ELECTRICAL MULTICONTACT PLUG AND ASSEMBLY METHOD FOR CHARGING SYSTEM

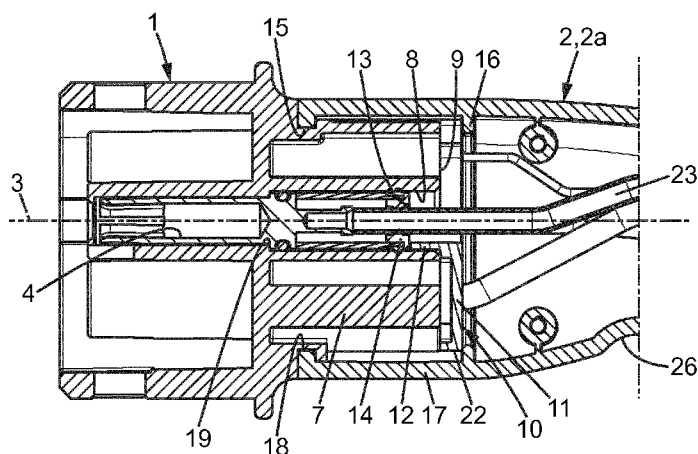


FIG. 2

(57) Abstract: The present invention relates to an electrical multicontact plug comprising: - a connector body (1) defining a forward direction of a mating axis (3) toward which the connector body (1) is adapted to mate with a complementary electrical connector device, - a plurality of electrical contacts (4) arranged to be electrically connected to a respective wire (23) of a multiwire electrical cable, - a back shell (2) attached to the connector body (1) and adapted to surround the electrical cable and to be grasped, and - a rear body (10) comprising for each electrical contact (4), an individual rearward axial stop (13) adapted to prevent said contact (4) from moving rearwards. The back shell (2) comprises a common rearward axial stop (16) cooperating with the rear body (10) to prevent the rear body from moving rearwards.

- 1 -

**ELECTRICAL MULTICONTACT PLUG AND ASSEMBLY METHOD
FOR CHARGING SYSTEM**

FIELD OF THE INVENTION

5 The present invention relates to an electrical multicontact plug, such as a plug used in an electrical power charging system.

 The invention further relates to a corresponding plug assembly method and to a charging system.

10 Electrical charging systems for instance those used for charging an electrical power vehicle, usually comprise an electrical power inlet which is attached to the vehicle. When the user wants to recharge the vehicle accumulators, a plug of an electrical power link is
15 connected to the vehicle power inlet. The other extremity of the power link is connected to an electrical power socket of an electrical power station. The user grasps an outer peripheric shell of the plug with one of his hands. So, the size of the outershell is a critical parameter to
20 take into account when designing such a plug.

 The electrical connections of the charging systems usually have a plurality of electrical contacts and the power link uses a multiwire cable. To prevent one of these contacts from being wrongly positioned inside the
25 multicontact plug, a common stopping element is used to collectively stop rearwards all the contacts. To secure all the contacts, the common stopping element is attached to the connector body. A drawback of such a securing technique is that attaching the stopping element to the
30 connector body increases the size of the plug.

 The invention provides an electrical multicontact plug, a plug assembly method and a charging system which

- 2 -

remedy to at least one of the above drawbacks.

A goal of the invention is to propose a plug provided with a securing system for the electrical contact positions, said plug being of a small size type.

5

SUMMARY OF THE INVENTION

According to one aspect, the electrical multicontact plug comprises:

- a connector body defining a forward direction of a mating axis toward which the connector body is adapted to mate with a complementary electrical connector device,

- a plurality of electrical contacts arranged to be electrically connected to a respective wire of a multiwire electrical cable,

15 - a back shell attached to the connector body and adapted to surround the electrical cable, and to be grasped by a user hand.

- a rear body comprising for each electrical contact, an individual rearward axial stop adapted to prevent said contact from moving rearwards,

The back shell comprises a common rearward axial stop cooperating with the rear body to prevent the rear body from moving rearwards.

In such a plug, the rearward stop of an electrical contact within the connector body requests two intermediate piece parts. First, the electrical contact is rearwardly stopped by the rear body. Second, the rear body is rearwardly stopped by the common stop of the outer shell. Third, the back shell is attached to the connector body. Such a rearward stopping technique uses the rear body and the back shell as two successive intermediate piece parts. Thanks to the indirect rearward

25
30

- 3 -

stopping technique, the common stop of the back shell can be positionned in an optimal location which does not request additional space in the radial direction. Therefore, the back shell can still be grasped in one
5 hand. That stopping technique is contrary to the normal design rules for which the best positioning of a contact inside the connector requests to stop it with the fewest intermediate piece parts as possible. The above particular arrangement of the plug overcomes a technical
10 prejudice for providing a secured plug of a small size.

According to another aspect, the assembly method for assembling an electrical multicontact plug comprises the step of:

- assembling a sub-assembly including a multiwire
15 electrical cable, a plurality of electrical contacts connected to wires extremities and a rear body provided with individual rearward axial stops for each electrical contact,

- introducing the electrical contacts into a
20 connector body, and

- stopping rearwardly and collectively all the electrical contacts which includes stopping rearwardly the rear body with respect to a back shell, and attaching the outer shell to the connector body.

25 In some other embodiments, one might also use one or more of the features as defined in dependant claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Other characteristics and advantages of the
30 invention will readily appear from the following description of some of its embodiments, provided as a non-limitative example, and of the accompanying drawings.

- 4 -

On the drawings:

- Figure 1 is a perspective view of one embodiment of the plug.
- Figure 2 is a sectional view according to the plane II-II of Figure 1.
- Figure 3 is a perspective view of a rear body of the plug of Figure 1.
- Figure 4 is a perspective view of a sub assembly of the plug of Figure 1.
- Figure 5 is a perspective view illustrating a second step of the plug assembly method.
- Figure 6 is a perspective view of a half outershell.

DETAILED DESCRIPTION

As illustrated in figure 1, the plug comprises a connector body 1 and a back shell 2, made of two substantially symmetrical half shells 2a, 2b. The plug has a forward direction of a mating axis 3, following which direction the plug can be mated with a complementary connector which is not illustrated. The half shells 2a, 2b can be assembled to one another by screws 6 along a direction transverse to the mating axis 3. The back shell 2 extends at a periphery of the connector body 1 and has a global curved shape adapted to make the plug easier to be grasped by a user hand. The back shell 2 further comprises hand gripping recess 26 which improve the axial retention in the grasped user hand.

The plug further comprises a plurality of electrical contacts 4 of a female type protected by individual front portions. Each of the front portions surrounds spring

- 5 -

tongues of one of the electrical contacts 4. Each of these electrical contacts 4 and the corresponding front portion have a contact axis 5. The contact axes 5 are parallel to each other and parallel to the mating axis 3.

5 In a variant, the electrical contact may be either male or female. The number of electrical contacts may be anyone superior or equal to two. Some of these electrical contacts 4 may be electrical power contacts, suitable for connecting electrical current having an intensity of
10 several ten Amperes. Other electrical contacts may be signal contacts.

As illustrated in Figure 2, the connector body 1 comprises a back portion 7 in which are formed cavities 8 shaped to receive a back portion of a respective contact
15 4. All the cavities 8 extend parallel to the mating axis 3 and open at a back end 9 of the back portion 7 of the connector body 1. Each of the cavities 8 of the connector body 1 is provided with a front stop 19 which stops the electrical contact 4 toward a forward direction.

20 As illustrated in figures 2 and 3, the plug further comprises a rear body 10 which comprises a flange 11 which is mounted adjacent to the back end 9 of the connector body 1 and extends substantially perpendicular to the mating axis 3. The rear body 10 further comprises
25 a plurality of individual chimneys, defined by walls 12 protruding forwardly from the flange 11. Each wall 12 of the chimneys is sized and shaped to be received inside a cavity 8. A forward extremity 13 of the wall 12 acts as a rear stop means for a corresponding electrical contact 4.

30 As illustrated in the figures 2 and 4, the plug comprises a plurality of sealing members 14, each of them surrounding radially the back end of the corresponding

- 6 -

electrical contact 4. The sealing devices 14 are axially sandwiched between the electrical contact 4 and the forward extremity 13 of the walls 12. Flexibility of the sealing devices 14 thus allows to provide a given axial tolerance for the position of the contact in the housing. The rear body 10 indirectly stops the electrical contact 4 toward the rear direction.

In a variant, the plug does not include such a sealing device 14. The wall 12 of the rear body 10 would directly stops the electrical contacts 4 towards the rear direction. A fixation portion of the electrical contact 4 would be axially sandwiched between the front stop 19 of the connector body and the rear body 10.

As visible in the figures 2 and 6, each of the half shells 2a, 2b, comprises a front rib 15 and a back rib 16 having each a half annular shape and protruding inwardly from a main portion 17 of the half shells 2a, 2b.

An annular groove 18 is provided on an outside surface of the back portion 7 of the connector body 1. The axial distance between the front rib 15 and the back rib 16 substantially corresponds to the addition of the distance from the annular groove 18 to the back end 9 of the connector body and of the thickness of the flange 11.

When the electrical contact 4 is correctly positioned inside the corresponding cavity 8, the flange 11 of the rear body 10 is located substantially adjacent to the back end 9 of the connector body 1. In such a case, each of the half shells 2a, 2b, can be introduced laterally such as the front rib 15 enters the annular groove 18 and the back rib 16 slides behind the flange 11 and maintains it in place. Such a mechanism provides the plug with a securing mechanism with checks in one action

- 7 -

whether the electrical contacts are all in place or not. The half shells are then fixed to one another.

As illustrated in the figures 3 and 4, the flange 11 of the rear body 10 comprises a plurality of reception zones 20 extending about of the contact axis 5. The flange 11 is provided with empty zones 21 each of them extending from one of the reception zones 20 to a periphery 22 of the flange 11. These empty zones 21 provide for, each of the wire 23 and electrical contact 4 assembly, an access to the reception zone 20 via a translation movement of the rear body 10 following a radial direction.

The walls 12 have a "C" cross section with an external diameter adjusted to that one of the cavities 8. The internal diameter of the chimney is smaller than the outside diameter of the corresponding electrical contact 4. The empty zone 21 provides a very interesting flexibility from the assembly stand point. The rear body 10 can be introduced in between the different wires 23 of a multiwire cable 24 after the electrical contacts 4 have been assembled with one of the wires 23.

Thanks to the figures 4, 5, 6, the plug assembly method is now described. In a first step, a sub-assembly 25 is assembled. The sub-assembly 25 includes the multiwire cable 24, the electrical contacts 4 and the rear body 10. In the illustrated embodiment, the first step may comprise a primary sequence wherein each of the sealing device 14 is slid on one of the individual wires 23. On a secondary sequence, each of the electrical contacts 4 is electrically and mechanically connected to the extremity of one of the wires 23. Then, the sealing device 14, is slid along the wire 23 up to a front

- 8 -

abutment with the electrical contacts 4. Finally, the rear body 10 is radially introduced in between the wires 23.

5 In a variant, the plug may not include the sealing device 14, or these devices may be overmoulded on the contact. So, only the above secondary and finally sequences are performed.

10 In another variant, the rear body 10 may not include such empty zones 21 within the periphery 22. The rear body only includes holes located at the contact zone 20. The wires 23 are each introduced in one of the holes before the connection with the electrical contact 4 being made.

15 Whatever the above variants, the plug assembly method comprises a second step wherein the above assembly 25 is introduced into the connector body 1 by introducing each of the electrical contacts into the connector body 1 (figure 5).

20 In a preferred embodiment, the chimney C-shaped wall 12 of the rear body 10 has a radial elasticity. The operator can press on the rear side of the rear body 10 to press fit the chimneys 12 into the cavities 8. This provides a temporarily retention of the sub-assembly 25 into the connector body 1.

25 In a third step, the operator can assemble the two half shells 2a, 2b on the lateral sides on the connector body 1. When the two half shells 2a, 2b are attached to each other, the back rib 16 provides the final rearward retention of the electrical contacts 4 inside the plug.

30 The fact to have an indirect mechanical rearward stop of the rear body 10 with respect to the connector body 1 allows that mechanical stop to be provided by a

- 9 -

feature that does not extend radially further the back portion 7 of the connector body 1. So, the main portion 17 of the back shell 2 can surround the back portion 7 without requesting extra radial space for the attachment 5 of the rear body 10 to the connector body 1.

- 10 -

CLAIMS

1. Electrical multicontact plug comprising:

- a connector body (1) defining a forward direction
5 of a mating axis (3) toward which the connector body (1)
is adapted to mate with a complementary electrical
connector device,
- a plurality of electrical contacts (4) arranged
to be electrically connected to a respective wire (23) of
10 a multiwire electrical cable (24),
- a back shell (2) attached to the connector body
(1) and adapted to surround the electrical cable (24) and
to be grasped, and
- a rear body (10) comprising for each electrical
15 contact (4), an individual rearward axial stop (13)
adapted to prevent said contact (4) from moving
rearwards,

characterised in that the back shell (2) comprises
a common rearward axial stop (16) cooperating with the
20 rear body (10) to prevent the rear body from moving
rearwards.

2. Plug according to claim 1, wherein the rear
body (10) comprises a flange (11) including a plurality
25 of reception zones (20), each of the reception zones (20)
receiving one of the electrical contacts (4).

3. Plug according to claim 2, wherein the rear
body (10) comprises a plurality of empty zones (21), each
30 of the empty zones extending radially from one of the
reception zones (20) up to the periphery (22) of the
flange (11) in order to provide the reception zone (20)

- 11 -

with a radial access for an electrical contact and wire assembly.

4. Plug according to any one of claims 1 to 3,
5 wherein the common rearward axial stop includes at least one rib (16) extending inwardly from a main portion (17) of the back shell (2) said at least one rib (16) receiving a periphery (22) of the rear body (10) for rearwardly stopping the rear body (10).

10

5. Plug according to any one of claims 1 to 4,
wherein the connector body (1) comprises a back portion (7) provided with cavities (8) receiving respective electrical contacts (4), at least a back end (9) of the
15 back portion (7) being surrounded by the back shell (2).

6. Plug according to any one of claims 1 to 5,
wherein the periphery (22) of the rear body (10) is axially sandwiched between the connector body (1) and
20 said common rearward axial stop (16).

7. Plug according to any one of claims 1 to 6,
wherein the common rearward axial stop (16) extends angularly along an angular sector about the mating axis
25 (3) which is greater than 180°.

8. Plug according to any one of claims 2 to 7,
wherein the rear body comprises a plurality of walls (12), each wall surrounding the reception zone (20) of
30 the flange (11) and wherein a forward extremity (13) of said wall (12) provides for the individual rearward axial stop.

- 12 -

9. Plug according to claim 8, wherein at least one of said wall (12) is press-fitted into the connector body (1).

5

10. Plug according to claims 9 or 10, wherein at least one of said wall (12) extends on an angular sector about an axis (5) of the corresponding electrical contact (4) which is greater than 180° .

10

11. Plug according to any one of claims 1 to 10, wherein the back shell (2) comprises two half shells (2a, 2b) attached to each other following an attachment direction which is transverse with respect to the mating axis (3).

15

12. Plug according to claim 11, wherein each of the half shells (2a, 2b) comprises a rib (16), both ribs being aligned to each other.

20

13. Plug according to any one of claims 1 to 12, wherein the back shell comprises a first stop (15) inserted in a corresponding groove (18) of the connector body (1).

25

14. Plug according to any one of claims 1 to 13, wherein the back shell has hand gripping recesses on its external face.

30

15. Electrical power charging system for vehicle, comprising:

- an electrical power station provided with an

- 13 -

electrical power socket,

- an electrical power inlet adapted to be attached to the vehicle, and

- an electrical power link, having a first
5 extremity adapted to mate with the electrical power socket and a second extremity adapted to mate with the electrical power inlet,

wherein at least one of the power link extremities comprises a plug according to any one of claims 1 to 14.

10

16. Assembly method for assembling an electrical multicontact plug comprising the steps of:

- assembling a sub-assembly (25) including a multiwire electrical cable (24), a plurality of
15 electrical contacts connected to wire extremities and a rear body (10) provided with individual rearward axial stops (13) for each electrical contact (4),

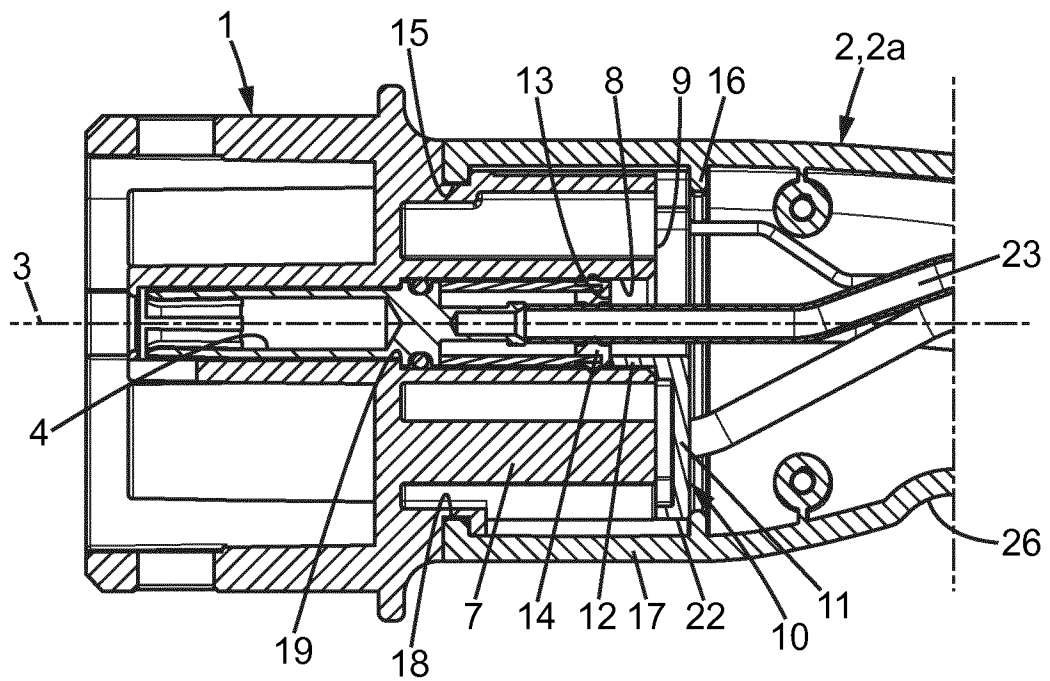
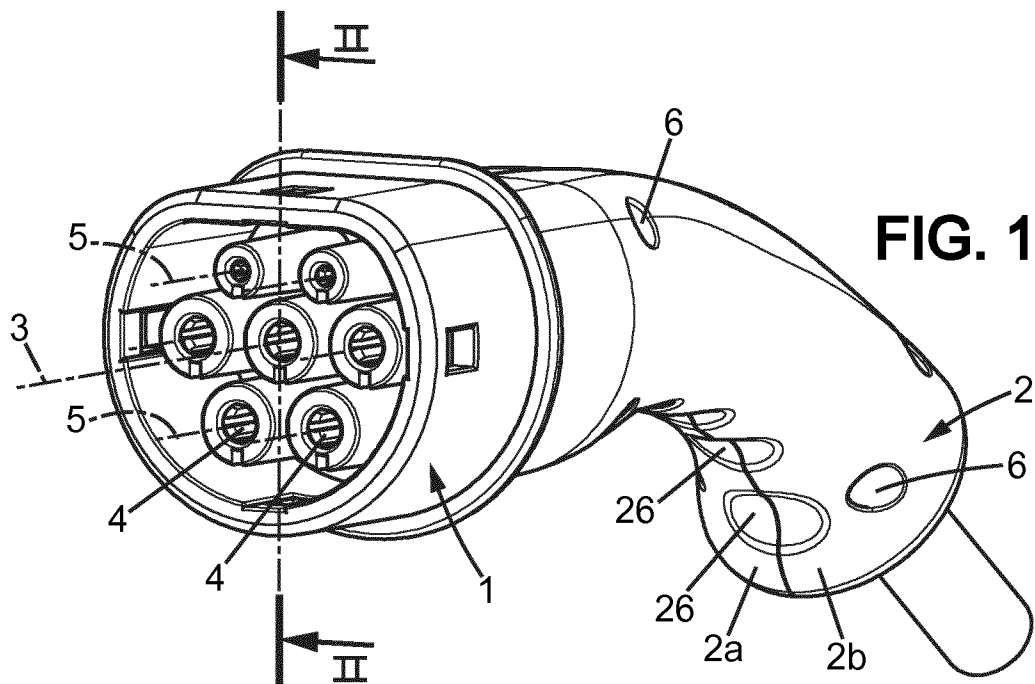
- introducing the electrical contacts (4) into a connector body (1), and

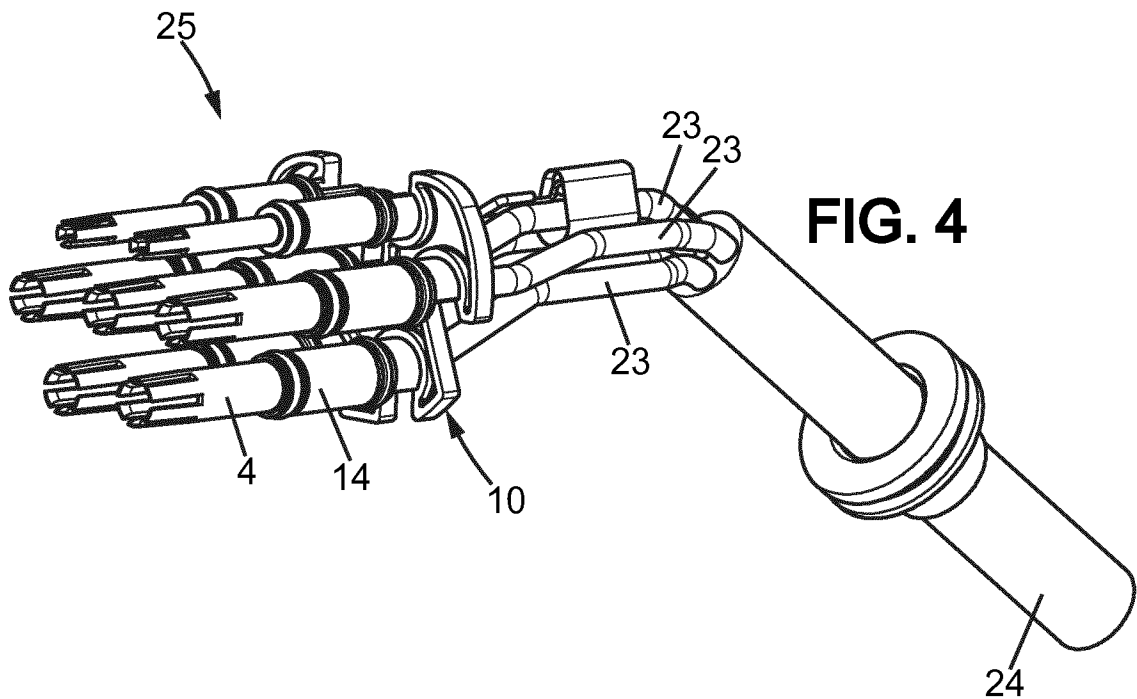
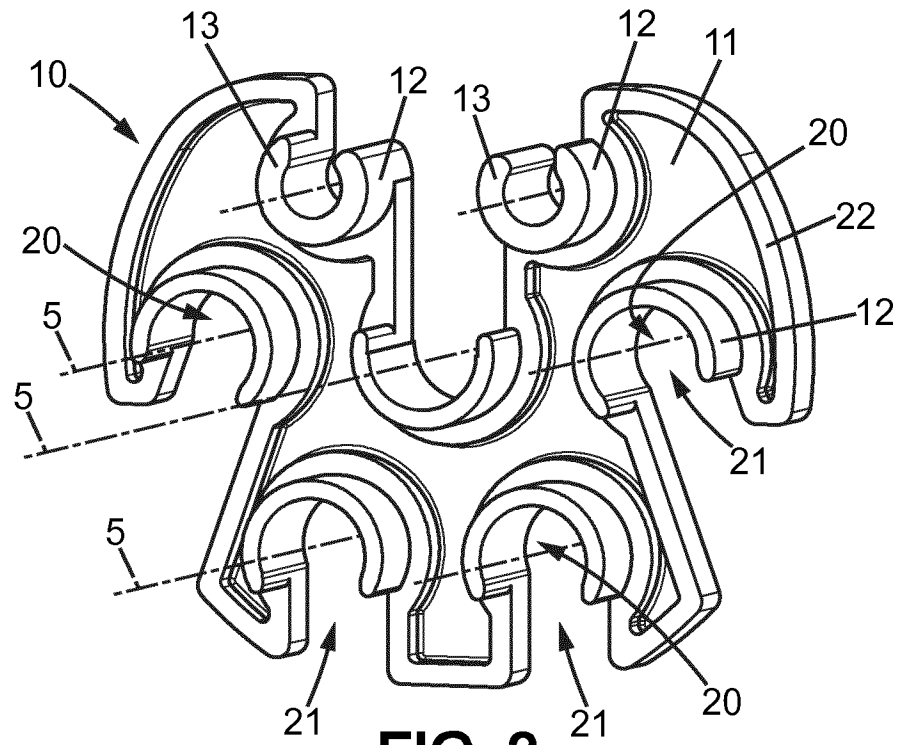
- 20 - stopping rearwardly and collectively all the electrical contacts (4),

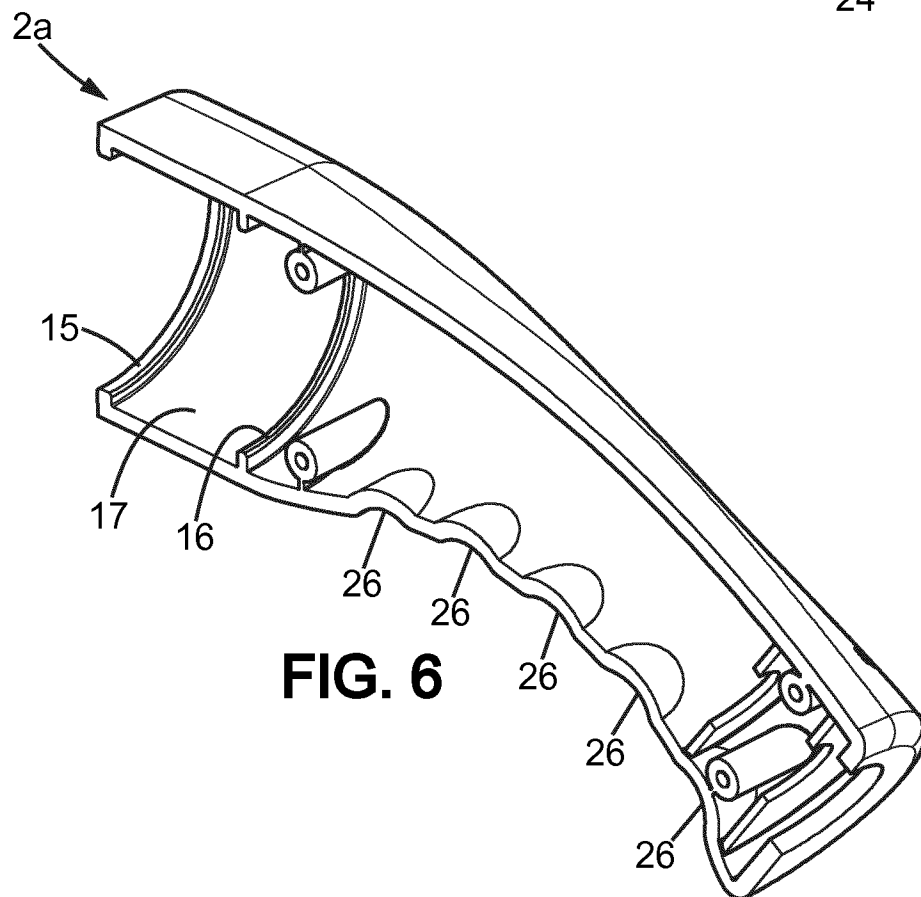
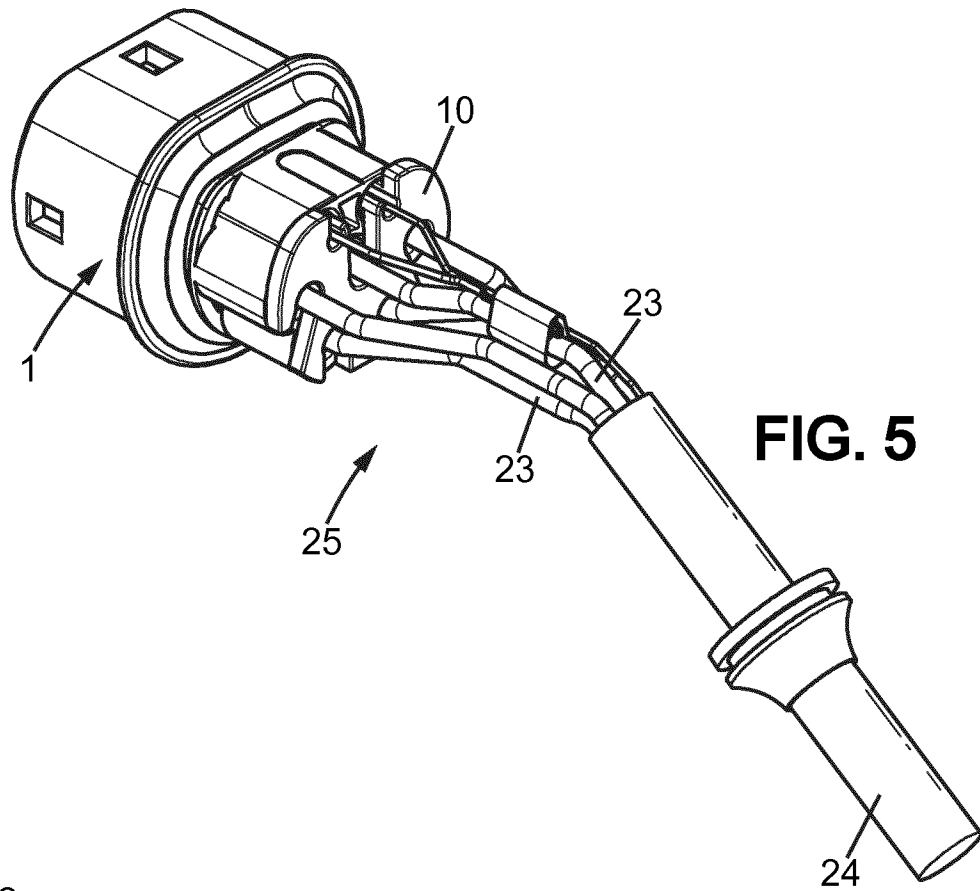
characterized in that the stopping of all the electrical contacts includes:

- stopping rearwardly the rear body (10) with
25 respect to a back shell (2), and

- attaching the back shell (2) to the connector body (1).







INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2012/061885

A. CLASSIFICATION OF SUBJECT MATTER

INV. H01R13/436 H01R13/512
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)

H01R

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 5 346 406 A (HOFFMAN ERNEST G [US] ET AL) 13 September 1994 (1994-09-13)	1,2, 5-10, 14-16
Y	figures 1,4,5,6,10,13,16,18-22 column 4, lines 25-48 column 6, lines 24-46 column 7, lines 42-53 column 8, lines 6-61 column 9, lines 14-40	3,4,11, 12
X	----- WO 95/06970 A1 (HUBBELL INC [US]) 9 March 1995 (1995-03-09) figures 7-13 pages 15-18	1,16
X	----- US 2011/059642 A1 (SLIPPY GORDON [US] ET AL) 10 March 2011 (2011-03-10) figure 5 ----- -/-	1,2,5, 13,16



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

10 September 2012

Date of mailing of the international search report

17/09/2012

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

Hugueny, Bertrand

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2012/061885

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 7 878 866 B1 (KWASNY KEITH [US] ET AL) 1 February 2011 (2011-02-01)	1,2,5,16
Y	figure 5 -----	11,12
X	WO 2010/024362 A1 (YAZAKI CORP [JP]; TOYOTA MOTOR CO LTD [JP]; MATSUMOTO MITSUHIRO; KATO) 4 March 2010 (2010-03-04)	1,2,16
Y	figures 1,3 -----	3
Y	DE 43 43 210 A1 (YAZAKI CORP [JP]) 7 July 1994 (1994-07-07) figure 11 -----	4
X	JP 61 091885 A (NICHIDEN SHOKO CO LTD; NIPPON GIA KOGYO KK) 9 May 1986 (1986-05-09) figure 1 -----	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2012/061885

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5346406	A	13-09-1994	CA 2158151 A1 10-11-1994 US 5346406 A 13-09-1994 WO 9426002 A1 10-11-1994
WO 9506970	A1	09-03-1995	US 5413493 A 09-05-1995 US 5478250 A 26-12-1995 WO 9506970 A1 09-03-1995
US 2011059642	A1	10-03-2011	AU 2010292357 A1 05-04-2012 CN 102598428 A 18-07-2012 EP 2476167 A2 18-07-2012 US 2011059642 A1 10-03-2011 WO 2011031710 A2 17-03-2011
US 7878866	B1	01-02-2011	CN 102394427 A 28-03-2012 DE 102011078348 A1 05-01-2012 US 7878866 B1 01-02-2011 US 2012003861 A1 05-01-2012
WO 2010024362	A1	04-03-2010	CN 102106044 A 22-06-2011 EP 2319131 A1 11-05-2011 JP 2010055809 A 11-03-2010 US 2011059659 A1 10-03-2011 WO 2010024362 A1 04-03-2010
DE 4343210	A1	07-07-1994	CA 2111810 A1 19-06-1994 DE 4343210 A1 07-07-1994 GB 2274556 A 27-07-1994 JP 3042816 B2 22-05-2000 JP 6236780 A 23-08-1994 US 5558533 A 24-09-1996 US 5573417 A 12-11-1996 US 5674086 A 07-10-1997
JP 61091885	A	09-05-1986	NONE