

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
6 July 2006 (06.07.2006)

PCT

(10) International Publication Number
WO 2006/069810 A1

(51) International Patent Classification:

G01R 31/04 (2006.01) **H01R 43/20** (2006.01)
H01R 13/641 (2006.01)

(21) International Application Number:

PCT/EP2005/014201

(22) International Filing Date:

30 December 2005 (30.12.2005)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

TO2004A000923

30 December 2004 (30.12.2004) IT

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

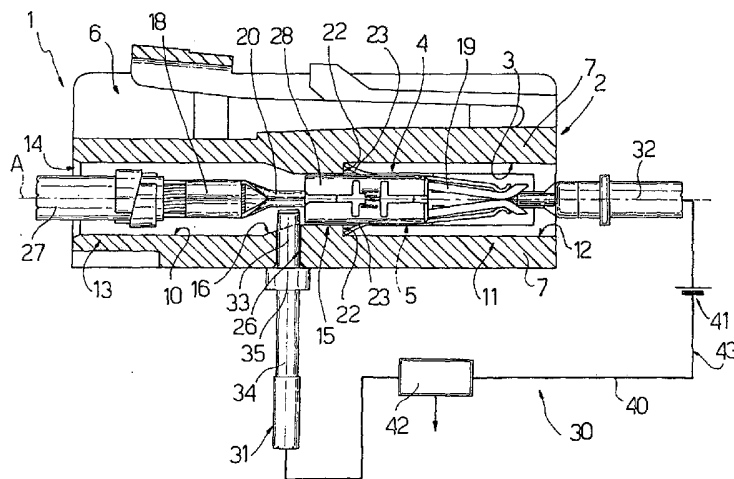
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD OF ASSEMBLING AN ELECTRIC CONNECTOR, ELECTRIC CONNECTOR SO FORMED, AND DEVICE FOR DETERMINING CORRECT ASSEMBLY OF THE CONNECTOR



(57) Abstract: A method of assembling an electric connector (1) connectable to a complementary connecting member along a predetermined axis (A) and having an insulating casing (2) defining at least one axial cavity (3), and at least one electric terminal (4) housed inside the cavity (3); the method includes the steps of inserting the terminal (4) inside the cavity (3) into a predetermined position defining a correct assembly position of the terminal (4) inside the casing (2); and checking the terminal (4) is in the predetermined position using a detecting device (30) separate from the electric connector (1), and which interacts with the terminal (4) through a check opening (26) formed in the casing (2), crosswise to the aforementioned axis (A), and communicating with the cavity (3); the detecting device (30) is deactivated after the checking step and before the electric connector (1) is connected to the complementary connecting member, so that the check opening (26) is left completely clear.

METHOD OF ASSEMBLING AN ELECTRIC CONNECTOR, ELECTRIC
CONNECTOR SO FORMED, AND DEVICE FOR DETERMINING CORRECT
ASSEMBLY OF THE CONNECTOR

5 The present invention relates to a method of
assembling an electric connector, an electric connector
so formed, and a device for determining correct assembly
of the connector.

Electric connectors are known comprising an
10 insulating casing defining a number of through cavities;
and a number of electric terminals housed in respective
cavities and retained inside the cavities by primary
retaining means.

The primary retaining means are normally defined,
15 for each cavity, by one or more flexible tongues forming
part of the electric terminal or casing, and which snap
onto the casing or terminal respectively.

Electric connectors of the above type normally also
comprise a secondary retaining device for determining
20 correct insertion of the terminals inside the respective
cavities, and therefore correct engagement of the
terminals by the primary retaining means, and which
provides for further ensuring retention of the terminals
inside the casing.

25 The secondary retaining device normally comprises a
movable member which snaps onto the casing, and which may
be either hinged to and integral with the casing, or
defined by a separate member. Whichever the case, the
movable member can only snap onto the casing when each
30 terminal is correctly inserted inside the relative cavity

and retained by the primary retaining means. If any one of the terminals is not correctly or fully inserted, the primary retaining means remain flexed, thus preventing assembly of the movable member and so enabling detection
5 of the fault prior to connecting the connector to a complementary connecting member.

In embodiments in which the movable member is hinged to and integral with the casing, constraints must be established to define a preassembly or release position
10 and a fully-assembled or locked position of the movable member, in which the member permits insertion of the terminals inside the respective cavities and retains the terminals inside the cavities respectively.

Similarly, in embodiments in which the movable
15 member is separate from the casing, it normally fits onto the casing in a preassembly position permitting insertion of the electric terminals inside the respective cavities, and from which it is slid in a given direction with respect to the casing into the fully-assembled position.

20 To achieve the above positions and prevent loss of the movable member, respective constraint means, e.g. openings and teeth, must be provided on the movable member and the casing.

In both the above cases, the casing must also be
25 provided with appropriate seats for receiving the movable member in the preassembly and fully-assembled positions.

For both types of secondary retaining device, the connector must therefore be designed to permit not only insertion of the terminals inside the respective
30 cavities, but also interaction of other parts to retain

the terminals in, and determine attainment of, given positions.

As a result, known connectors are extremely complicated to design and produce.

5 It is an object of the present invention to provide a method of assembling an electric connector, designed to eliminate the aforementioned drawbacks.

According to the present invention, there is provided a method of assembling an electric connector, as
10 claimed in Claim 1.

The present invention also relates to an electric connector, as claimed in Claim 5, and to a device for determining correct assembly of an electric connector, as claimed in Claim 16.

15 Two preferred, non-limiting embodiments of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a view in perspective of an electric connector in accordance with the teachings of the present
20 invention;

Figures 2 and 3 show longitudinal sections of the Figure 1 connector in a correct assembly position and, respectively, in an incorrect assembly position interacting with a detecting device also in accordance
25 with the teachings of the present invention;

Figure 4 shows a larger-scale view in perspective of an interacting portion of the Figure 2 and 3 detecting device;

Figure 5 shows a view in perspective of an
30 alternative embodiment of an electric connector in

accordance with the teachings of the present invention.

With reference to Figures 1, 2 and 3, number 1 indicates as a whole an electric connector connectable along an axis A to a known complementary connecting member (not shown), e.g. another electric connector.

It should be pointed out that the terms "front", "rear", "top", "bottom" and similar in the following description are in no way limiting, and are used purely for the sake of clarity with reference to the orientation of connector 1 in Figures 2 and 3.

Connector 1 substantially comprises an insulating casing 2 defining a number of through cavities 3 having respective axes parallel to axis A; and a number of electric terminals 4 housed inside respective cavities 3 and retained inside the cavities by known retaining means 5 described in detail below.

More specifically, casing 2 is defined by a substantially parallelepiped-shaped box body 6 comprising two, respectively top and bottom, walls 7 lying in planes parallel to axis A; and two lateral walls 8 connecting walls 7 and lying in planes parallel to axis A and perpendicular to the planes of walls 7.

Casing 2 also comprises a number of partitions 9 interposed between walls 7 and lying in planes parallel to walls 8 to define cavities 3 together with walls 7.

More specifically, walls 7 are bounded, inwards of each cavity 3, by respective surfaces 10, each of which comprises, axially, a front portion 11 and a rear portion 13 defining a front opening 12 and a rear opening 14 of cavity 3 respectively.

Each surface 10 comprises, axially, an intermediate portion 15 defining a minimum-section portion of relative cavity 3 and joined to rear portion 13 by a sloping connecting portion 16 sloping with respect to axis A, and to front portion 11 by a shoulder 22 facing front opening 12 and perpendicular to axis A.

Each electric terminal 4 substantially comprises a rear connecting portion 18 for connection to a relative electric cable 27 projecting, in use, from casing 2 through relative rear opening 14; a front contact portion 19 - in this case, female - which fits to a corresponding known electric terminal (not shown) of the complementary connecting member; and an intermediate portion 28 supporting retaining means 5.

In the embodiment shown, retaining means 5 of each terminal 4 comprise a number of flexible retaining tongues 23, which snap onto shoulder 22 of relative cavity 3 to define a correct assembly position of terminal 4 inside casing 2.

More specifically, each retaining tongue 23 is normally set in an unflexed configuration, in which it projects, crosswise to axis A, from relative intermediate portion 28, and can be flexed towards intermediate portion 28 into a configuration parallel to axis A.

More specifically, when each terminal 4 is assembled correctly inside respective cavity 3, as shown in Figure 2, retaining tongues 23 are set to the unflexed configuration and cooperate with shoulder 22 to prevent axial withdrawal of terminal 4 through relative rear opening 14, and to permit correct connection of connector

1 to the complementary connecting member.

In the correct assembly position as described above, intermediate portion 28 and front portion 19 of each terminal 4 are housed entirely inside intermediate portions 15 and front portions 11 of surfaces 10 of relative cavity 3.

Conversely, in one possible incorrect assembly position of each electric terminal 4, as shown in Figure 3, retaining tongues 23 are pressed towards relative intermediate portion 28 and positioned parallel to axis A, by interaction with intermediate portions 15 of surfaces 10 of relative cavity 3.

For each cavity 3, connector 1 also comprises a check opening 26, by which to insert an interacting portion 33 of a detecting device 30 for determining correct assembly of each electric terminal 4 inside casing 2, and which is left clear after the check by device 30 and before connecting connector 1 to the complementary connecting member.

Each check opening 26 advantageously connects a respective cavity 3 to the outside of casing 2, and extends crosswise to axis A. In the example shown, each check opening 26 extends radially with respect to the axis of relative cavity 3, and comes out inside cavity 3 at portion 16 of one of surfaces 10 of casing 2.

More specifically, each check opening 26 is smaller parallel to than perpendicularly to axis A, to prevent foreign bodies being inserted accidentally inside respective cavity 3 from outside casing 2.

In a preferred embodiment, rear portion 18 of each

terminal 4 comprises a connecting portion 20 for connection to, and smaller radially than, intermediate portion 28.

In the correct assembly position, connecting portion 20 of each terminal 4 is located at relative matching with check opening 26, as explained in detail below, to permit full insertion of interacting portion 33 of detecting device 30. And conversely, in the incorrect assembly position, intermediate portion 28 of each terminal 4 projects axially inside portions 16 of surfaces 10 of relative cavity 3, and interferes with relative check opening 26 to prevent full insertion of interacting portion 33 of detecting device 30.

As a result, the radial space between terminal 4 and check opening 26 is greater in the correct than in the incorrect assembly position.

With reference to Figures 2 to 4, detecting device 30 is electric, and substantially comprises a first contact member 31 having interacting portion 33 for insertion inside a relative check opening 26; and a second contact member 32 which cooperates with front portion 19 of a relative terminal 4, and is connected electrically to contact member 31 to define an electric circuit 43 which is closed or open, depending on whether or not interacting portion 33 contacts terminal 4.

More specifically, contact member 31 is substantially cylindrical, and defines interacting portion 33 at one axial end, and, at the opposite axial end, a portion 34 for electrical connection to contact member 32.

Contact member 31 also comprises an intermediate enlargement 35 larger in diameter than portions 33 and 34, and which rests against the outer surface of the wall 7 with check openings 26, to define a full-insertion
5 position of portion 33 through one of check openings 26.

More specifically, interacting portion 33 has a lateral surface 39 calibrated in diameter to fit inside one of check openings 26; and an axial end 38 cooperating with relative terminal 4.

10 Portion 33 is of such an axial length as not to contact connecting portion 20 of relative terminal 4 when the terminal is assembled correctly inside relative cavity 3, and enlargement 35 is positioned resting against the outer surface of relative wall 7.

15 More specifically, portion 33 comprises a core 36 of conducting material; and a sheath 37 made of insulating material and defining lateral surface 39.

Contact members 31 and 32 are connected to each other over an electric line 40, which comprises a power
20 battery 41; and an electric current flow display device 42 indicating correct assembly of each terminal 4 inside relative cavity 3.

Assembly of connector 1 comprises a first step of inserting terminals 4 inside respective cavities 3 into a
25 predetermined position defining the correct assembly position of terminals 4 inside casing 2; and a second step of checking each terminal 4 is actually in said predetermined position.

The first step is performed by inserting each
30 electric terminal 4 inside respective cavity 3 through

respective rear opening 14, and sliding each electric terminal 4 axially towards respective front opening 12 until a click is felt corresponding to retaining tongues 23 interacting with respective shoulders 22.

5 Since, downstream from the intersection with relative check opening 26 in the insertion direction of terminals 4 inside casing 2, each cavity 3 is more or less the same radial size as defined by rear portions 13 of surfaces 10, retaining tongues 23 are prevented from
10 snapping accidentally onto check opening 26.

 The check step is performed using detecting device 30, by positioning contact member 32 in contact with a relative terminal 4, and inserting portion 33 of contact member 31 inside relative check opening 26.

15 If each terminal 4 is assembled correctly inside relative cavity 3 (Figure 2), connecting portion 20 of terminal 4 is located at relative check opening 26, and interacting portion 33 of contact member 31 can slide inside check opening 26 so that enlargement 35 rests on
20 the outer surface of relative wall 7 of casing 2.

 Detecting device 30 is so sized that, when enlargement 35 rests against casing 2, axial end 38 of interacting portion 33 is detached from connecting portion 20 of relative terminal 4.

25 Since contact members 32 and 31 are respectively connected to and disconnected from relative terminal 4, electric circuit 43 remains open, and display device 42 supplies a signal indicating no electric current flow.

 Conversely, in the event any one of terminals 4 is
30 assembled incorrectly inside relative cavity 3 (Figure

3), intermediate portion 28 of terminal 4 interferes with relative check opening 26; and insertion of interacting portion 33 of detecting device 30 inside relative check opening 26 is therefore stopped by axial end 38 coming to
5 rest against intermediate portion 28 of the incorrectly assembled terminal 4, so that enlargement 35 remains detached from casing 2.

Since both contact members 31 and 32 are connected to terminal 4, electric circuit 43 is therefore closed,
10 and display device 42 supplies a signal indicating electric current flow.

Once correct assembly of terminals 4 inside relative cavities 3 has been checked, detecting device 30 is disabled by detaching contact members 31 and 32 from
15 check openings 26 and front openings 12 of casing 2 respectively.

Connector 1 can then be connected to the complementary connecting member.

Number 1' in Figure 5 indicates as a whole an
20 alternative embodiment of an electric connector in accordance with the teachings of the present invention. Any parts of connector 1' identical or corresponding with those of connector 1 already described are indicated, where possible, using the same reference numbers.

25 Connector 1' differs from connector 1 by comprising a single check opening 26' communicating with all of cavities 3 and extending crosswise to the cavities and to axis A. More specifically, check opening 26' extends on one side of the respective axes of cavities 3, and has a
30 cross section complementary in shape to that of the

terminals 4 on the side facing the terminals.

Consequently, when terminals 4 are all assembled correctly, no portion of terminals 4 interferes with check opening 26. Conversely, in the event any one of
5 terminals 4 is not assembled correctly, one or more portions of the terminal interfere with check opening 26, thus enabling detection of the fault.

In the embodiment described, a detecting device, indicated schematically by 30', for emitting and
10 receiving radiation 50, e.g. a laser device, is preferably employed.

The radiation 50 emitted by device 30' travels through check opening 26' without interacting with terminals 4, when the terminals are assembled correctly
15 inside relative cavities 3. Conversely, if any one of terminals 4 is not assembled correctly inside relative cavity 3, the radiation 50 emitted by device 30' is reflected by the part of terminal 4 projecting through check opening 26', thus indicating the fault.

20 In a further embodiment, not shown, the detecting device may be mechanical, i.e. employing a single interacting member similar in design to contact member 31 and only insertable fully inside each check opening 26 when the relative terminal 4 is assembled correctly
25 inside casing 2.

In which case, the interacting member may be defined at least by a portion for insertion inside relative check opening 26 and of the same shape as interacting portion 33; and by a stop portion similar to enlargement 35.

30 Correct assembly of each terminal 4 would be

indicated by the stop portion resting against casing 2; and, conversely, incorrect assembly would be indicated by the stop portion remaining detached from casing 2.

The advantages of connector 1 and the assembly method according to the present invention will be clear from the foregoing description.

In particular, connector 1 involves governing no movable parts, and reduces the number of interactions between its various component parts. In other words, using an external detecting device, which is deactivated and detached from casing 2 after checking, provides for greatly simplifying design and manufacture of connector 1.

Moreover, check openings 26 being crosswise to axis A, correct assembly of terminals 4 can be determined without first connecting terminals 4 to the detecting means, thus avoiding stress of front contact portions 19 of terminals 4 prior to connecting connector 1 to the complementary connecting member.

Clearly, changes may be made to connector 1 and the assembly method as described and illustrated herein without, however, departing from the protective scope as defined in the accompanying Claims.

In particular, check openings 26 may be a completely different shape from that shown, and may be formed elsewhere on casing 2, e.g. in the area engaged by retaining tongues 23 of terminals 4, so that detecting device 30 interacts directly with the tongues.

CLAIMS

1) A method of assembling an electric connector (1, 1') connectable to a complementary connecting member along a predetermined axis (A) and comprising an
5 insulating casing (2) defining at least one axial cavity (3), and at least one electric terminal (4) housed inside said cavity (3); said method comprising the steps of:

- inserting said terminal (4) inside said cavity (3)
10 into a predetermined position defining a correct assembly position of the terminal (4) inside said casing (2); and
- checking said terminal (4) is in said predetermined position inside said cavity (3);

characterized in that said checking step is
15 performed using a detecting device (30, 30') separate from said electric connector (1, 1'), and which interacts with said terminal (4) through a check opening (26, 26') formed in said casing (2), crosswise to said axis (A), and communicating with said cavity (3); said detecting
20 device (30, 30') being deactivated after said checking step and before said electric connector (1, 1') is connected to said complementary connecting member, so that said check opening (26, 26') is left completely clear.

25 2) A method as claimed in Claim 1, characterized in that said step of checking the correct assembly position of said terminal (4) inside said casing (2) is based on the insertion depth of said detecting device (30) inside said check opening (26).

30 3) A method as claimed in Claim 1 or 2,

characterized in that said checking step is performed by establishing a first electric contact between said detecting device (30) and said terminal (4), and determining a second electric contact between said
5 detecting device (30) and said terminal (4), through said check opening (26), in only one of said correct assembly position and an incorrect assembly position of said terminal (4) inside said casing (2), so as to form an electric circuit (43) which is open or closed, depending
10 on the assembly position of said terminal (4).

4) A method as claimed in Claim 1, characterized in that said interaction occurs by radiation, which interacts differently with said terminal (4), depending on whether said terminal (4) is assembled correctly or
15 incorrectly inside said cavity (3).

5) An electric connector (1, 1') connectable to a complementary connecting member along a predetermined axis (A) and comprising an insulating casing (2) defining at least one axial cavity (3), and an electric terminal
20 (4) housable inside said cavity (3) in a predetermined position defining a correct assembly position;

characterized by comprising at least one check opening (26, 26') formed in said casing (2), crosswise to said axis (A), and communicating with said cavity (3);
25 said check opening (26, 26') permitting interaction with a detecting device (30, 30') for determining correct assembly of said terminal (4) inside said cavity (3), and being left completely clear after the check made by said detecting device (30, 30') and before said electric
30 connector (1, 1') is connected to said complementary

connecting member.

6) A connector as claimed in Claim 5, characterized in that said terminal (4) comprises at least two portions (28, 19) differing in size crosswise to said axis (A), and in that, in one of said correct assembly position and an incorrect assembly position of said terminal (4) inside said casing (2), a transversely larger first (28) of said portions of the terminal (4) interferes with said check opening (26).

7) A connector as claimed in Claim 6, characterized in that said first portion (28) of said terminal (4) interferes with said check opening (26) in said incorrect assembly position.

8) A connector as claimed in Claim 6 or 7, characterized in that said check opening (26) is of such a given extension that an interacting portion (33) of said detecting device (30) only contacts said terminal (4) in the incorrect assembly position.

9) A connector as claimed in Claims 5 to 8, characterized in that said casing (2) defines, about said check opening (26), a stop surface for said detecting device (30), so that a predetermined amount of said interacting portion (33) is insertable inside the check opening (26).

10) A connector as claimed in any one of Claims 5 to 9, characterized in that said check opening (26) is smaller axially with respect to said axis (A) than radially with respect to said axis (A).

11) A connector as claimed in any one of Claims 5 to 10, characterized by comprising flexible retaining means

(5, 23) carried by said terminal (4) and projecting from the terminal, crosswise to said axis (A), in an unflexed condition to cooperate with said casing (2) and define said correct assembly position of said terminal (4) inside said cavity (3); and in that, downstream from the intersection with said check opening (26), in the insertion direction, parallel to said axis (A), of said terminal (4) inside said casing (2), said cavity (3) is of such a radial size with respect to said axis (A) as to prevent said retaining means (5, 23) from accidentally engaging the check opening (26).

12) A connector as claimed in Claim 11, characterized in that, at the intersection with said check opening (26), said cavity (3) is bounded by a surface (16) sloping with respect to said axis (A).

13) A connector as claimed in any one of Claims 5 to 12, characterized by comprising a number of said cavities (3) for housing respective said terminals (4).

14) A connector as claimed in Claim 13, characterized by comprising a check opening (26) for each said cavity (3).

15) A connector as claimed in Claim 13, characterized by comprising a single check opening (26') communicating with all the cavities (3).

16) A detecting device (30, 30') for determining correct assembly of an electric connector (1) as claimed in any one of Claims 5 to 15, said detecting device (30, 30') being characterized by comprising interacting means (31, 50) engaging said check opening (26, 26') to indicate, on the basis of the type of interaction,

correct or incorrect assembly of said terminal (4) inside said cavity (3).

17) A device as claimed in Claim 16, characterized in that said interacting means (31) comprise a body (33) of given shape insertable through said check opening (26) to indicate correct or incorrect assembly of said terminal (4) inside said cavity (4) on the basis of the insertion depth of the body inside the check opening (26).

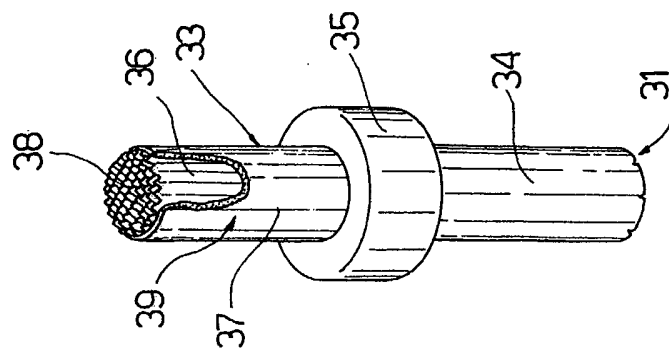
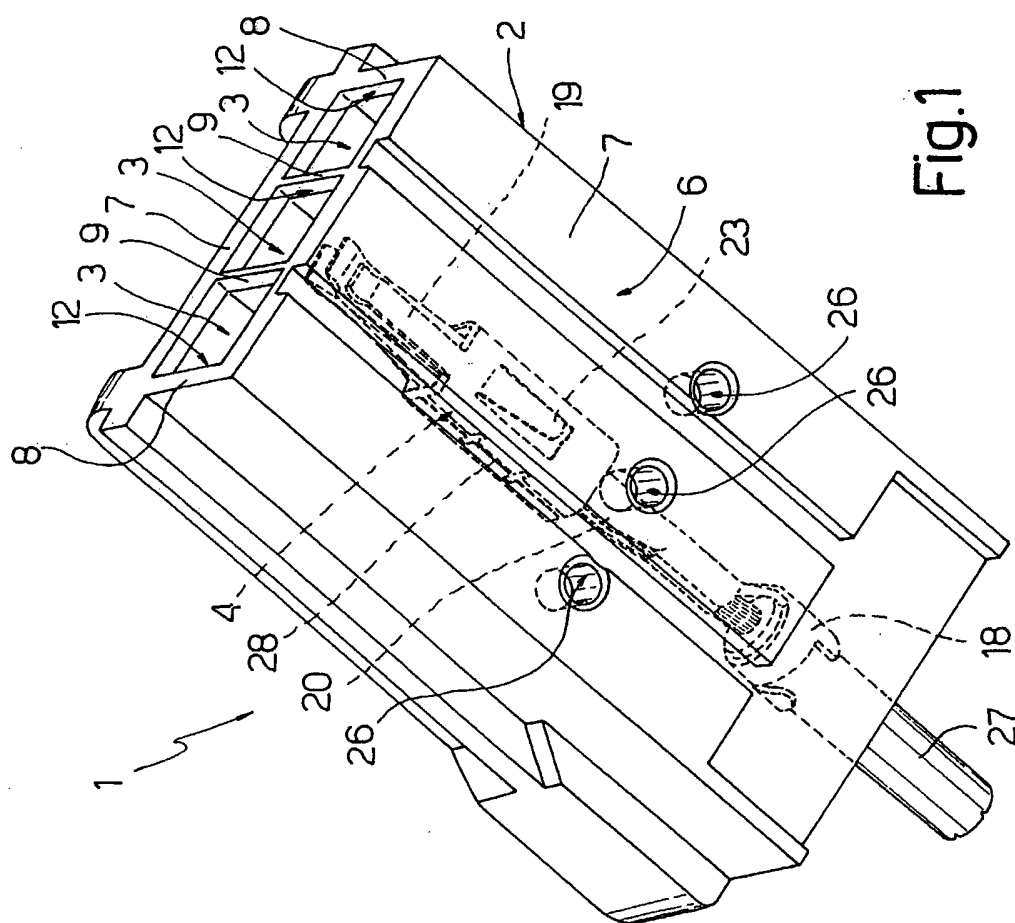
18) A device as claimed in Claim 17, characterized in that said interacting means (31) comprise a stop member (35), which rests on said casing (2) to define a maximum-insertion position of said body (33) inside said check opening (26).

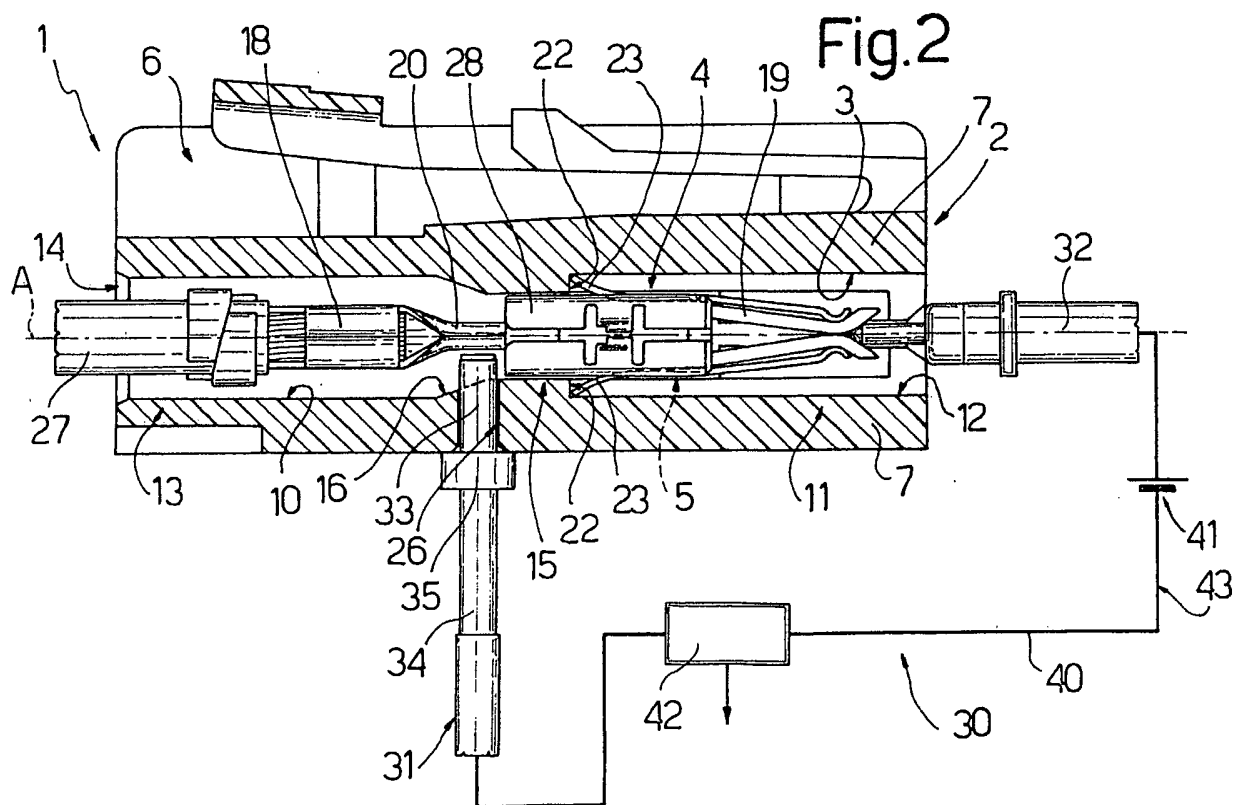
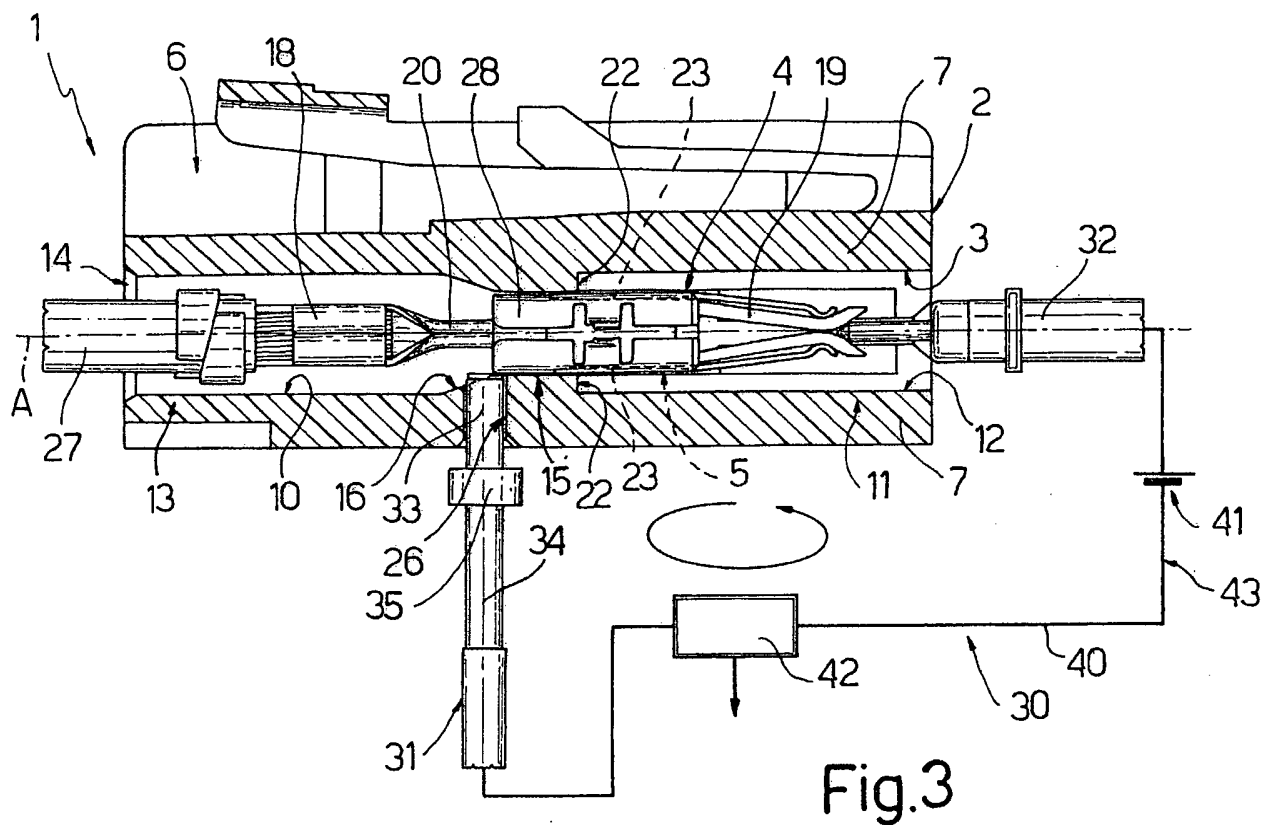
19) A device as claimed in any one of Claims 16 to 18, characterized by comprising electric connecting means (32) for defining a first electric contact with said terminal (4); and in that said interacting means (31) are connected electrically to said electric connecting means (32), and only define a second electric contact with said terminal (4), through said check opening (26), in one of said correct assembly position and said incorrect assembly position of said terminal (4), so as to form an electric circuit (43) which is open or closed, depending on the assembly position of the terminal (4).

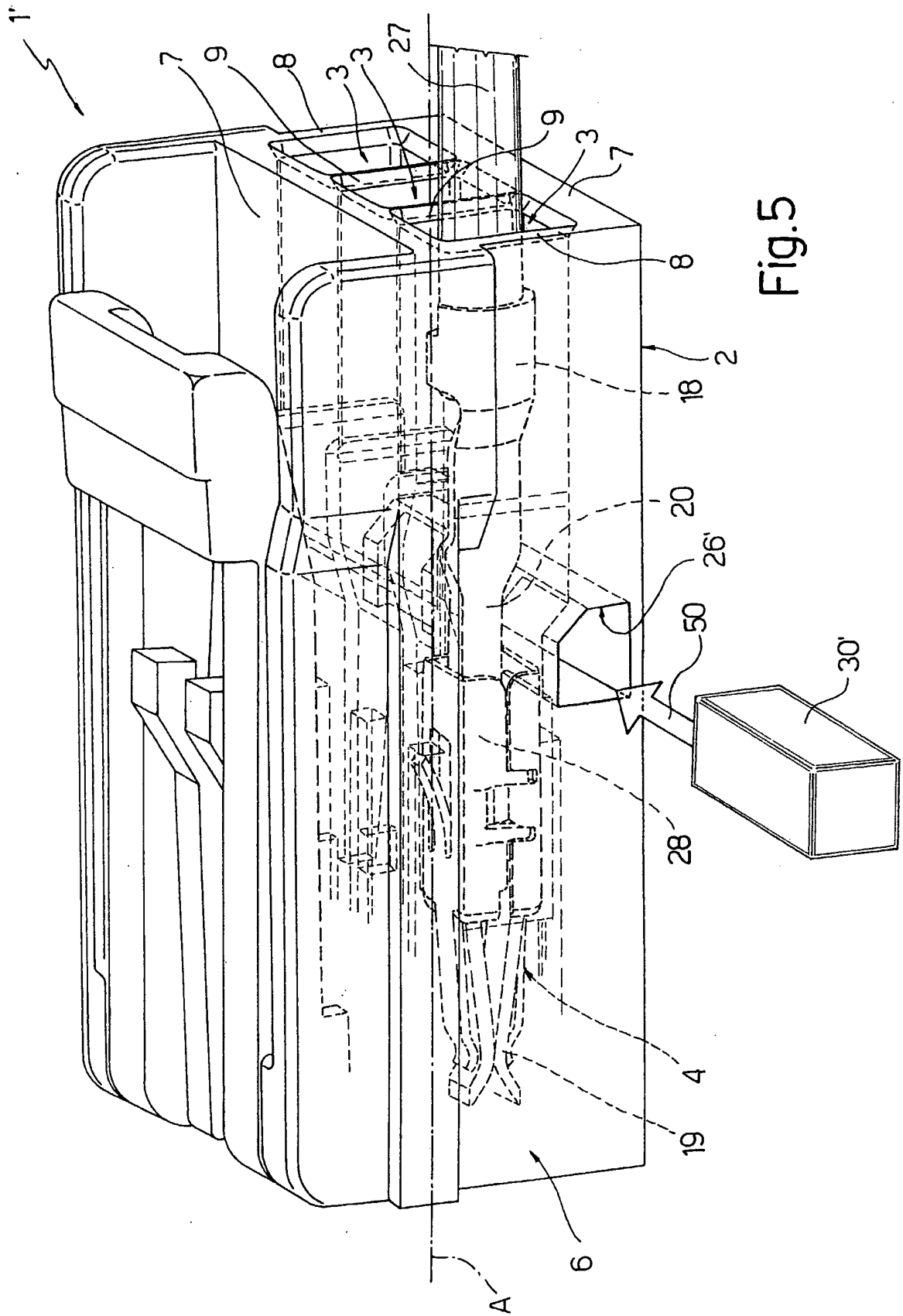
20) A device as claimed in any one of Claims 16 to 19, characterized in that said interacting means (31) comprise a first contact area (38) made of conducting material and cooperating selectively with said terminal (4); and a second area (39) made of insulating material

and cooperating with said check opening (26) in said casing (2).

21) A device as claimed in Claim 16, characterized in that said interacting means are defined by radiation
5 (50) directed through said check opening (26') of said connector (1').







INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2005/014201

A. CLASSIFICATION OF SUBJECT MATTER
G01R31/04 H01R13/641 H01R43/20

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)
G01R 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 practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	the whole document	4, 15, 21
X	US 5 335 413 A (YAMAMOTO ET AL) 9 August 1994 (1994-08-09)	1-3, 5-9, 13, 14, 16-20
X	US 6 173 488 B1 (ENDO TAKAYOSHI ET AL) 16 January 2001 (2001-01-16) column 7, line 15 - line 47 figure 11	1, 5-8, 10, 15-18
Y	US 2002/106917 A1 (KOIDE TAKASHI ET AL) 8 August 2002 (2002-08-08) paragraph [0058]	4, 15, 21
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☒ 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

5 April 2006

Date of mailing of the international search report

13/04/2006

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INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2005/014201

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT

Information on patent family members

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