(19) Europäisches Patentamt
European Patent Office
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(11) **EP 2 712 029 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
26.03.2014 Bulletin 2014/13

(51) Int Cl.:
H01R 4/24 *(2006.01)*

(21) Application number: **13184873.1**

(22) Date of filing: **18.09.2013**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **21.09.2012 IT TO20120820**

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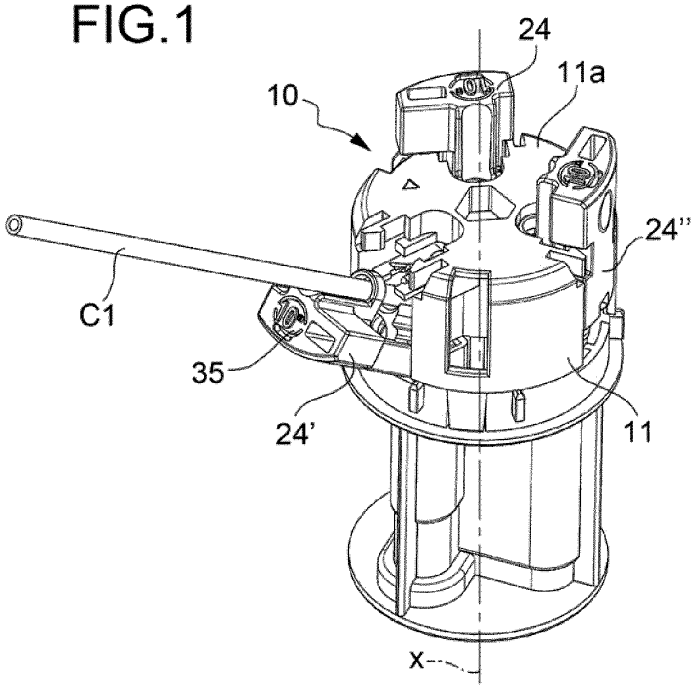
(54) A contact carrier unit for an electrical connection socket or plug

(57) A contact carrier unit for an electrical connection socket or plug includes corresponding levers (24) for guiding and locking respective conductors. The levers are pivoted in axial planes so as to carry a respective conductor between a pair of contact blades (15, 16) whose facing edges (18, 19) extend in radial directions. Along the edges of the facing blades there are formed two electrical connection seats (20, 21), of which one seat is wider to receive a thicker conductor and the other seat is narrower to receive a thinner conductor. Each lever (24) has two retaining elements (25, 26) for selectively retaining a conductor (C1 or C2) to be electrically connected to a pair of blades. The retaining elements of each lever are located in positions at different radial distances from the axis (x) such that they can be aligned with the two electrical connection seats of a pair of blades in the vicinity of the lever.

FIG.1



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Description

[0001] The present invention relates to a contact carrier unit for an electrical connection socket or plug having the features defined in the preamble of Claim 1. The invention is applicable both to electrical connection sockets or plugs of the fixed type and to sockets or plugs of the movable or "in-line" type normally used in industry. A socket or plug of the aforesaid type is known from patent publication WO 2004/105186 A1.

[0002] Sockets or plugs are connected to the ends of an electrical cable and they generally each comprise a containment casing forming within itself a generally cylindrical housing seat for a contact carrier unit (also called the "body") which carries a plurality of electrical contacts formed by pairs of blades lying in a plane perpendicular to the direction x along which the socket or plug is coupled to a matching plug or socket. Each pair of blades can receive one of the conductors of an electrical cable which is to be connected electrically to the unit. A lever for guiding and locking a conductor of the cable is mounted on the body of the contact carrier, near each pair of blades. Each lever generally has an engagement means (such as an annular formation) to assist in the correct positioning of the conductor, and is hinged to the body of the contact carrier about an axis of rotation perpendicular to the direction of coupling. The lever can be rotated in an axial plane parallel to the direction of coupling so as to reach an open or unlocked position, for example during an operation of connection/disconnection or replacement of the conductors, in which the conductor retained by the lever is removed and is disengaged from the pair of blades. To make an electrical contact between the conductor and the pair of blades, the lever is rotated into a closed position, thus forcing the conductor retained by the lever to slide between the pair of blades and to remain locked in a position of insertion between the blades. In the closed position, part of the lever projects beyond the body, enabling the lever to be unlocked conveniently by a manual operation.

[0003] The object of the present invention is to provide a contact carrier unit which enables conductors of different thicknesses to be connected effectively. In particular, it is desirable to provide an assured electrical connection for conductors having cross sections in the range from 2.5 mm^2 to 10 mm^2.

[0004] These and other objects and advantages, which will be made clearer below, are achieved according to the invention with a contact carrier unit having the features stated in the attached claims.

[0005] Briefly, each lever can retain, in at least two distinct positions, conductors of different thicknesses which can be positioned selectively in one of two different retention holes formed in the lever in positions aligned in the same axial plane parallel to the direction of coupling and uncoupling of the socket or plug. For each lever, a blade-like electrical contact is provided, having a slit orientated in the axial plane in which the two retention holes of the lever lie. Along the slit there are formed two widenings, one wider and one narrower, located in positions at different distances from the central axis of the unit. The two widenings form electrical connection seats for respective conductors. If a conductor having a thickness or cross section not exceeding a certain value is to be connected, the conductor is inserted into the hole in the lever which is axially aligned with the narrower of the widenings or electrical connection seats when the lever is rotated to an axially orientated closed position in which it forces the conductor to be inserted into the slit. On the other hand, if a thicker conductor is to be connected, it is inserted into the retaining hole which will be axially aligned, when the lever is in the closed position, with the wider electrical connection seat.

[0006] The structural and functional features of some preferred, but not limiting, embodiments of a contact carrier unit according to the invention will now be described, with reference to the attached drawings, in which:

Figures 1 and 2 are perspective views of a contact carrier unit in two different positions for connecting a thin conductor;
Figure 3 is an axial section through the unit of Figure 2;
Figure 4 is a partial sectional view taken along the line IV-IV of Figure 3;
Figure 5 is a perspective view of an electrical contact of the unit of Figure 1;
Figures 6 and 7 are a sectional view and a top view of a lever forming part of the unit of Figure 1;
Figures 8, 10 and 11 are perspective views of the contact carrier unit in two different positions for connecting a thicker conductor;
Figure 9 shows a detail of Figure 10;
Figure 12 is a partial view in axial section of the unit of Figure 11; and
Figure 13 is a partial sectional view taken along the line XIII-XIII in Figure 12.

[0007] With reference to the drawings, the number 10 indicates the whole of a contact carrier unit for an electrical connection socket or plug that can be coupled to a corresponding plug or socket in a given direction of coupling, parallel to or coinciding with an axis indicated by x. In the present example, the unit 10 is designed to be incorporated into a sleeve-like housing (not shown) of an electrical socket or plug of the movable or "in-line" type. The reference to this possible field of application is not to be interpreted as in any way limiting the scope of the patent, which is also applicable to sockets or plugs of the fixed type.

[0008] The contact carrier unit comprises a body 11 having an overall cylindrical shape which has a plurality of peripheral recesses 13, there being three of these recesses in the present example. Throughout the present description and the following claims, any terms and expressions indicating positions and orientations such as

"axial", "longitudinal", "transverse" and "radial" are to be interpreted as relating to the central geometrical axis x of the unit.

[0009] In each recess there is mounted a respective electrical contact 14 (illustrated separately) having a pair of facing blades 15, 16. Each pair of blades has a radially extending slit 17, is open at a radially outer end 22, and is delimited by two facing contact edges 18, 19. The contact edges are suitably shaped to form two electrical connection seats 20, 21, located in two respective radially distinct positions, which can selectively retain an electrical conductor C1 or C2 of an electrical cable which is to be connected electrically to the socket or plug.

[0010] The first electrical connection seat 20, which is the radially inner seat or the seat closer to the central axis x of the unit, is formed by a widening which is preferably located at the radially inner end of the slit 17, and serves to retain an electrical conductor C1 having a given maximum cross section, for example a maximum cross section of 6 mm^2.

[0011] The second electrical connection seat 21, which is the radially outer seat or the seat farther from the axis x, is formed by a widening located in an intermediate position between the first seat 20 and the radially outer opening or end 22 of the slit 17. The second seat 21 is wider than the first seat 20, and is conveniently designed to retain an electrical conductor C2 (Figures 10 - 13) having a cross section greater than the maximum cross section of the conductor that can be received in the first seat 20. For example, the second seat 21 is designed to receive a conductor with a cross section of 10 mm^2.

[0012] In the illustrated embodiment, the contact edges 18, 19 have cutting portions 23 adapted to cut the sheath of the conductor.

[0013] In each recess 13 there is mounted a respective lever 24 for guiding and locking a respective conductor C1 or C2. Each lever 24 has two retaining elements, namely a first and a second retaining element 25, 26, located in positions at different radial distances from the central axis x, for selectively retaining the conductor (C1 or C2) to be electrically connected to a pair of blades.

[0014] In one embodiment, the first retaining element 25 comprises an annular formation forming a first through hole 25a through which the end part of a relatively thin conductor C1 can be passed so as to be placed in the first, narrower, electrical connection seat 20 of the slit 17. The annular formation projects from a face 24a of the lever facing the central axis x. The second retaining element 26 is preferably formed by a second through hole 26a made through the body of the lever. This second hole or passage 26a has a cross section greater than the transverse dimension of the first hole 25a, in order to retain a thicker conductor C2, which is to be placed in the wider second electrical connection seat 21 of the slit 17.

[0015] Each lever 24 is hinged on the body 11 of the contact so as to be rotatable in a plane defined herein as the "axial" plane, between a disengaged position (indicated by 24', as shown by the levers located on the left-hand side of Figures 1, 8 and 10) and a closed position of the electrical contact in which the lever occupies the respective recess 13 and is orientated in a substantially axial direction. In the closed position of the electrical contact, indicated by 24" in Figure 8, the levers are included within the circular profile of the contact carrier unit, which can thus be inserted into the outer containment casing or sleeve (not shown).

[0016] The two retaining means 25, 26 formed by each lever 24 are aligned in the same axial plane as the slit 17 formed by the contact 14 which is housed in the recess 13 where the lever is mounted.

[0017] Each lever may be hinged to the body 11 by methods which may, for example, be similar or identical to that illustrated in WO 2004/105186 A1, which is incorporated herein by reference. More specifically, each of the levers may have, for example, a pair of opposed pins 28 (Figure 6), orientated in a tangential direction, which engage in corresponding hinge seats (not shown) formed in the body 11 of the contact carrier.

[0018] In order to connect a conductor C1 or C2 electrically to the socket or plug, a lever 24 must first be placed in the open, or outwardly inclined, position.

[0019] Depending on whether the conductor is relatively thin or relatively thick, it is threaded either into the first hole 25a or into the second hole 26a of a lever, in order to connect it electrically to the first 20 or the second 21 seat of the slit 17 respectively. In the present example, if the conductor has a cross section of not more than 6 mm^2, it is threaded into the first hole 25a (Figure 1); otherwise, it is threaded into the second hole 26a (Figure 10). In the lever 24 there are conveniently formed two stop surfaces 29, 30, against which the end of the conductor comes to bear when it is fully inserted through the first hole 25a or the second hole 26a respectively.

[0020] Both the first and the second hole 25a, 26a are spaced apart from the base of the lever where the pins 28 are formed, so as to leave an exposed portion C1a, C2a of the cable facing the contact 14.

[0021] A conductor is then threaded into the first hole 25a or into the second hole 26a of the lever, the cable being pushed until it meets the respective stop surface 29 or 30. The lever 24 is pushed manually from the open, or outwardly rotated, position 24', causing it to rotate in an axial plane so as to penetrate into the recess 13. This forces the conductor C1 or C2 retained in the hole 25a or 26a to be inserted between the edges 18, 19 of the blades 15, 16, which cut the insulating sheath of the conductor and thus make the electrical contact. In this way the lever 24 reaches a closed or locked position, in which it is orientated axially. It should be noted that, in this closed position of the electrical contacts, the first hole 25a of each lever is axially aligned with the first seat 20, and the second hole 26a is axially aligned with the second seat 21. Therefore, a relatively thinner conductor C1, if inserted into the first hole 25a, is mechanically retained and electrically connected in the first seat 20 (Figures 3

and 4); alternatively, if a relatively thicker conductor C2 is inserted into the second hole 26a, it is mechanically retained and electrically connected in the second seat 21 (Figures 12 and 13). As can be appreciated, the contact carrier unit enables the operator to have an assured electrical connection of conductors of different thicknesses.

[0022] Resilient locking catches 31 (Figure 8) are provided, in pairs in this example, in each recess 13 of the body 11 of the contact carrier, to lock the lever 24 in the closed position by a snap-fitting action. The locking catches 31 engage with corresponding recesses or attachment formations 32 formed on the lever 24 (Figure 9).

[0023] In the illustrated embodiment, in the closed position of the contacts, that is to say when the lever 24 is locked parallel to the axis x of the socket or plug, an appreciable portion of the lever 24 (as shown in Figures 2 and 11) projects axially beyond the transverse wall 11a of the body 11. This configuration, which is optional, enables an operator to unlock each lever easily by pressing with his fingers on the part of the lever that projects axially beyond the body of the unit.

[0024] In order to reduce the manual effort required from the operator, an engagement means for a tool, such as a recess 33 for the tip of a screwdriver, can be provided for unlocking the lever from the closed contact position. Preferably, the recess or other engagement means for a tool is formed in the lever in a position such that it does not cause any increase in the thickness or overall radial dimension of the lever. In use, the levers are all orientated parallel to the longitudinal axis of the socket or plug so that the contact carrier unit can be inserted into a housing sleeve (not shown) and locked therein. In the illustrated embodiment, the recess 33 is formed adjacent to the second hole 26a, in an end portion 34 of the lever projecting in a substantially tangential direction. This enables the radial dimensions of the lever to be kept within a limited circular profile defined by the housing sleeve.

[0025] In one embodiment, the second, wider hole 26a can be provisionally blocked by a removable closure element 35, such as a small plate formed in one piece with the lever 24. The closure element 35, which can be removed, with a screwdriver 36 for example, in order to free the hole 26a, serves to prevent the erroneous insertion of a small-sized conductor into the hole 26a, since the electrical connection of a thin conductor in the wider seat 21 would not be secure.

[0026] Finally, with reference to Figure 5, in one embodiment the electrical contact 14 which includes the slit 17 is substantially S-shaped, and has:

- a rectilinear free end portion 14a, extending in a radial direction, which is bifurcated and includes the blades 15, 16 and the slit 17;
- a base portion 14b, which has two parallel plate-like formations to be welded to a pin (if the unit is to be used in a plug) or to a bushing (if the unit is to be used in a socket);
- a radial intermediate portion 14c, having two opposite bent ends, of which a first end 14d, located in use in a position radially farther in or closer to the central axis of the unit, is bent in an axial direction (upwards in Figure 5) and is joined to an axially extending intermediate portion 14e, while a second end 14f, located in a position radially farther out or farther from the central axis x of the unit, is bent in an axial direction (downwards in Figure 5) opposite to the direction in which the first end 14d is bent, and is joined to the base portion 14b; and
- the axial intermediate portion 14e, which is joined by means of two bends 14g and 14d to the radial intermediate portion 14c and the free end portion 14a respectively.

[0027] The electrical contact is made in a single piece from copper sheet which is cut and bent in various ways to form the aforesaid shape. Because of its S-shaped configuration as described, the electrical contact has at least three distinct bending points which allow the contact to be resiliently deflected at a plurality of points when the conductors are forcibly inserted into the slit during the connection operations. The distribution of the deflection over a plurality of points prevents the concentration of forces, and therefore the contact is not subject to significant permanent plastic deformation and is less inclined to break or become detached after repeated connection operations. As can be appreciated, the S-shape of the electrical contact can also be used with conventional contact blades, which have a slit with only one seat for housing an electrical conductor.

[0028] It is to be understood that the invention is not limited to the embodiments described and illustrated herein, which are to be considered as examples of embodiment of the unit; in fact, the invention can be modified in respect of the forms and arrangements of parts and constructional details, and in respect of its operation. For example, the conductor retaining means could be formed by holes or housings having shapes and/or dimensions other than those illustrated herein. As a further example, the retaining seat of the contact which serves to retain thicker conductors could be formed towards the base of the slit 17, while the seat intended to house thinner conductors could be placed in an intermediate position between the base of the slit and its opening.

Claims

1. A contact carrier unit for an electrical connection socket or plug, including:

   - a body (11) forming a plurality of peripheral recesses (13) angularly spaced around an axis (x);
   - a corresponding plurality of electrical contacts (14), each mounted in a respective recess (13),

wherein each contact comprises a pair of blades (15, 16) with facing edges (18, 19) that define a slit (17) orientated in a radial direction for accommodating an electrical conductor of a cable to be electrically connected to the unit;
- a corresponding plurality of levers (24) for guiding and locking respective conductors, each lever having at least one retaining element for retaining a respective conductor, wherein each lever is pivotally mounted on the body (11) to rotate in a respective axial plane;
characterized in that
each lever (24) has a first and a second retaining element (25, 26) for selectively retaining a conductor (C1 or C2) to be electrically connected to a pair of blades, wherein the retaining elements belonging to each lever are located in positions at different radial distances from the axis (x) and lie in the same axial plane passing through a respective slit (17), and **in that**
along the slit there are formed, at radially separate positions, first (20) and second (21) electrical connection seats of which one seat is wider to receive a thicker conductor and the other seat is narrower to receive a thinner conductor,
wherein the lever can reach a closed contact position, in which the lever is received in a respective recess (13), and wherein, in this closed contact position, the first retaining element (25) is axially aligned with the first electrical connection seat (20), and the second retaining member (26a) is axially aligned with the second electrical connection seat (21).

2. A unit according to Claim 1, **characterized in that** the first and the second retaining elements (25, 26) have a respective first and second through hole (25a, 26a), wherein the first through hole (25a) is narrower than the second through hole (26a).

3. A unit according to Claim 1 or 2, **characterized in that** the first electrical connection seat (20) is located in a position radially closer to the central axis (x) of the assembly and **in that** the second electrical connection seat (21) is located in a position radially farther from the axis (x).

4. A unit according to Claim 3, **characterized in that** the first electrical connection seat (20) is located at a radially inner end of the slit (17).

5. A unit according to Claim 3 or 4, **characterized in that** the second electrical connection seat (21) is located in an intermediate position between the first electrical connection seat (20) and a radially outer opening or end (22) of the slit (17).

6. A unit according to any one of the preceding claims, **characterized in that** the second retaining element (26) has a through hole (26a) made through the body of the lever (24).

7. A unit according to any one of the preceding claims, **characterized in that** the first retaining element (25) has a through hole (25a) made through an annular formation projecting from a face (24a) of the lever (24) facing the central axis (x).

8. A unit according to any one of the preceding claims, **characterized in that** each lever (24) forms a portion (34) projecting in a direction substantially tangential or perpendicular to the central axis (x), and **in that** the projecting portion (34) has a seat or an engagement means (33) for a tool.

9. A unit according to Claim 6, **characterized in that** the second hole (26a) is blocked by a removable closure element (35).

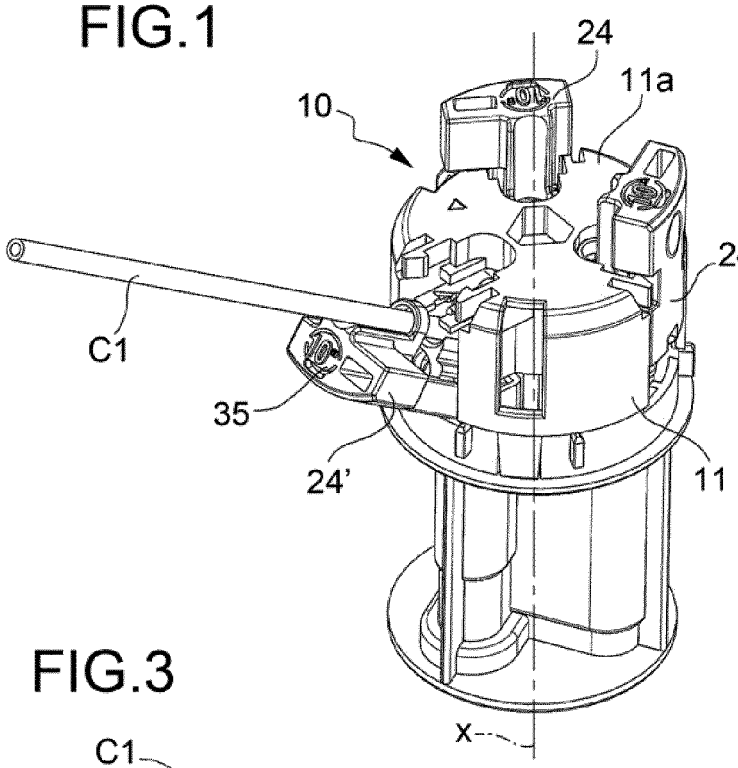
10. An electrical contact (14) for a unit according to any one of the preceding claims, **characterized in that** the electrical contact (14) is substantially S-shaped, and has:

- a rectilinear free end portion (14a), extending in a radial direction, which is bifurcated and includes the two blades (15, 16) and the slit (17);
- a base portion (14b) that can be fixed to the unit, joined to the free end portion by connecting portions which include at least three bent portions (14g, 14d, 14f).

11. An electrical contact according to Claim 10, **characterized in that** the connecting portions include:

- a radial intermediate portion (14c), having two opposite bent ends, of which a first end (14d), located in use in a position radially farther in or closer to the central axis (x), is bent in an axial direction and is joined to an axially extending intermediate portion (14e), and a second end (14f), located in use in a position radially farther out or farther from the central axis (x), is bent in an axial direction opposite to the direction in which the first end (14d) is bent, and is joined to the base portion (14b); and
- the axial intermediate portion (14e), which is joined by means of two bends (14g, 14d) to the radial intermediate portion (14c) and the free end portion (14a) respectively.

FIG.1



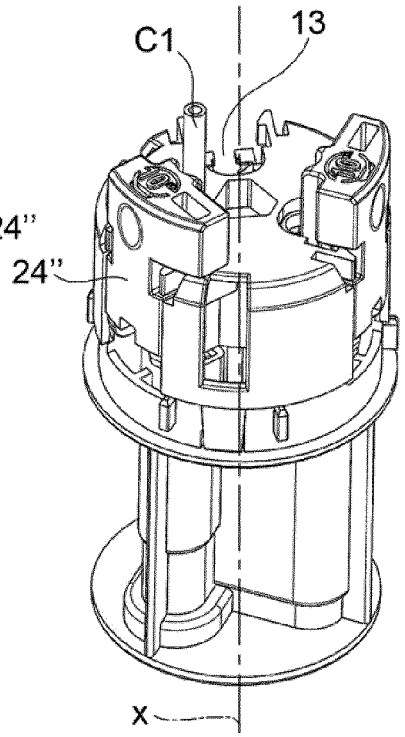
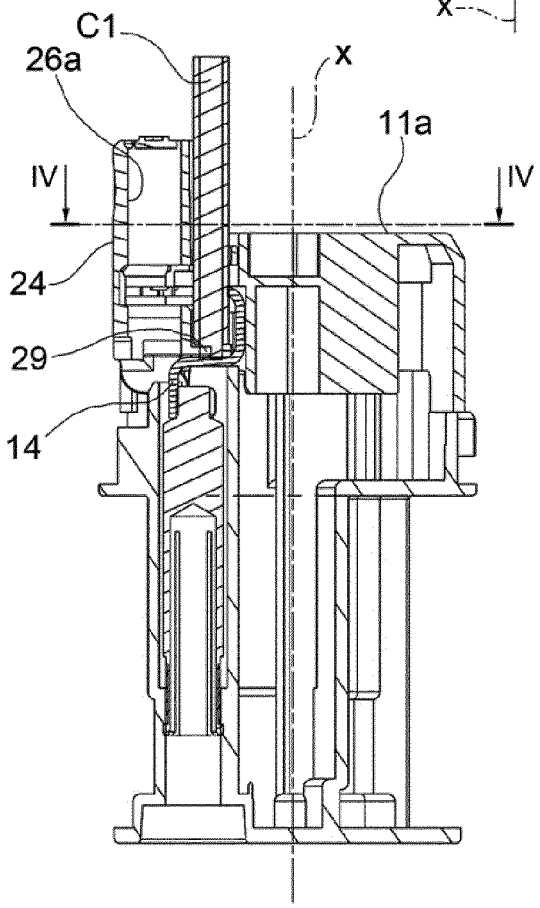


FIG.2

FIG.3



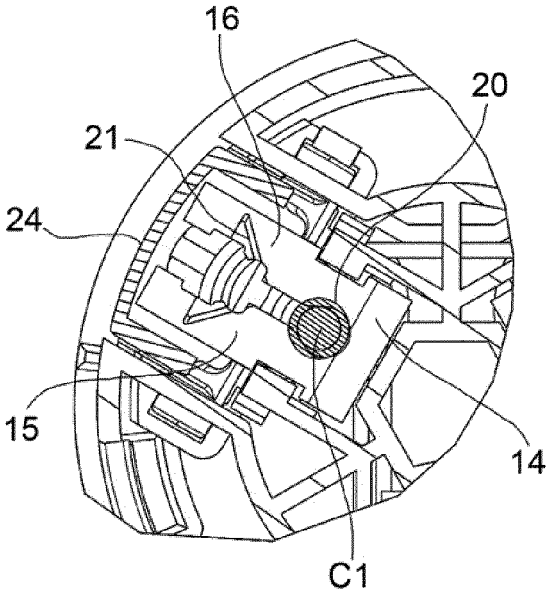


FIG.4

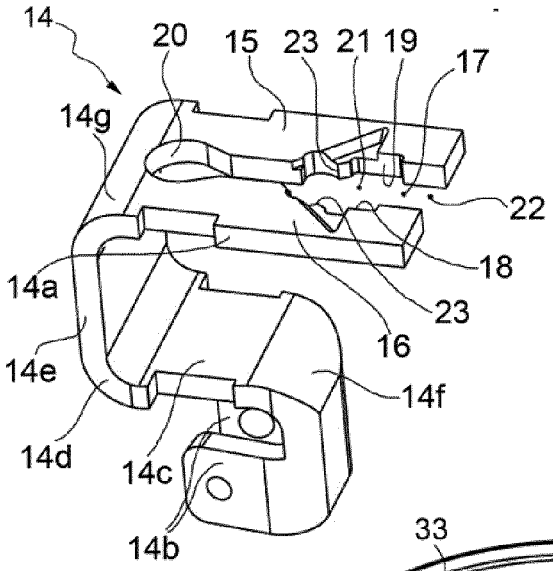


FIG.5

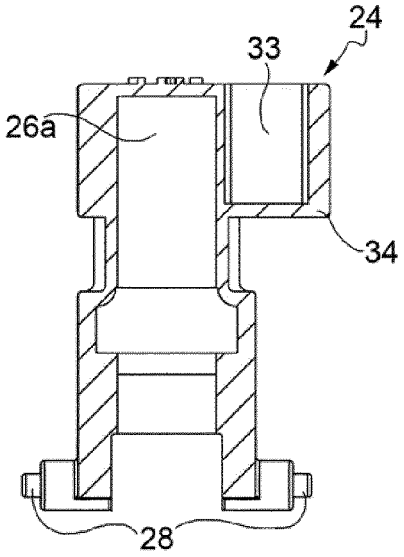


FIG.6

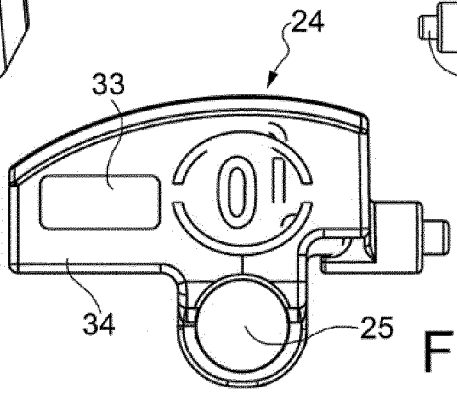


FIG.7

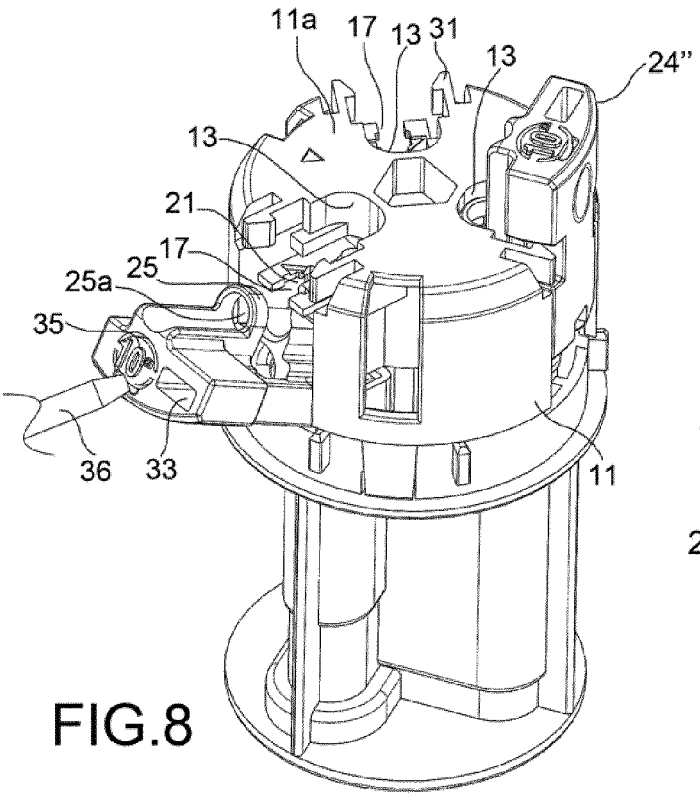


FIG.8

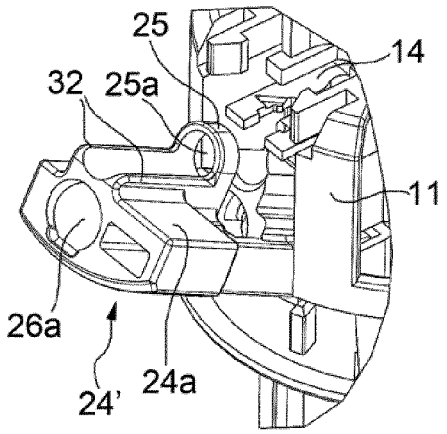
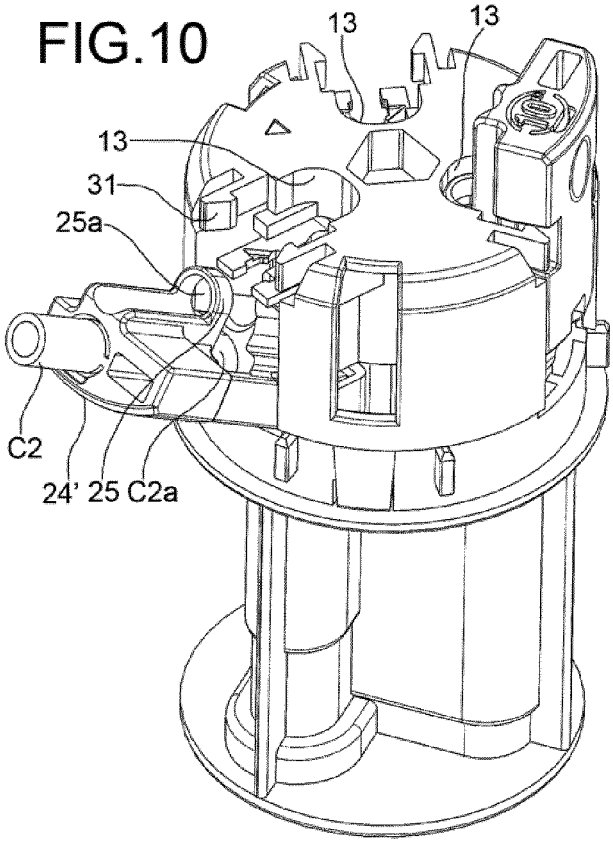


FIG.9

FIG.10



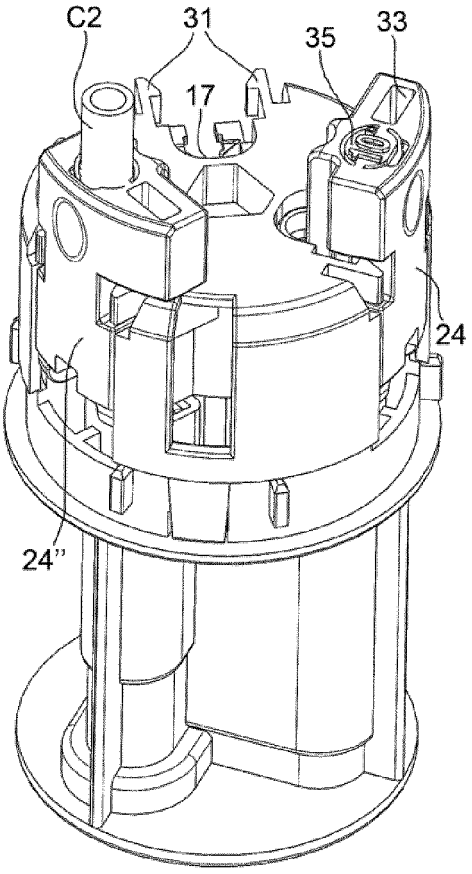


FIG.11

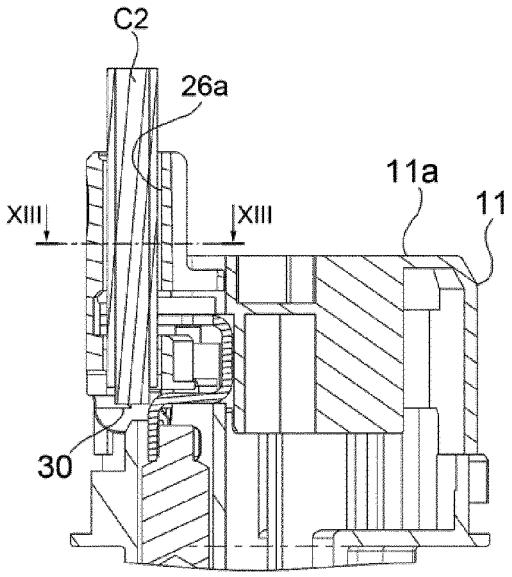


FIG.12

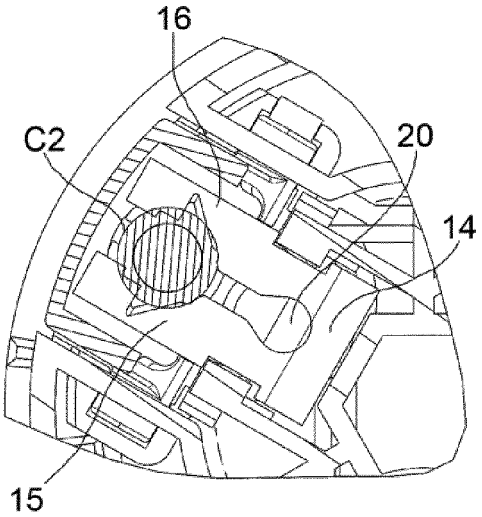


FIG.13

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European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 13 18 4873

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	WO 2004/105186 A1 (SAIP & SCHYLLER S R L [IT]; COLOMBI ALDO [IT]) 2 December 2004 (2004-12-02) * page 3, line 15 - page 6, line 6; figures 2-6 *	1-9	INV. H01R4/24
A	WO 2007/125463 A1 (PHILIPS INTELLECTUAL PROPERTY [DE]; KONINKL PHILIPS ELECTRONICS NV [NL) 8 November 2007 (2007-11-08) * page 6, line 14 - line 27; figure 1 *	1-9	
A	US 6 196 861 B1 (SALIGNY YVES [FR]) 6 March 2001 (2001-03-06) * column 3, line 42 - column 5, line 16; figures 9,12,1,6 * * column 5, line 60 - column 6, line 23 *	1-9	
X	FR 2 694 141 A1 (CIT ALCATEL [FR]) 28 January 1994 (1994-01-28) * page 2, line 19 - page 3, line 26; figures 1,2,3,4 *	10,11	

TECHNICAL FIELDS SEARCHED (IPC)
H01R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	21 January 2014	Bouhana, Emmanuel

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

3

EPO FORM 1503 03.82 (P04C01)

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Application Number
EP 13 18 4873

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

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LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 13 18 4873

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-9

   A contact holder for an electrical connection plug/socket

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2. claims: 10, 11

   An electrical contact

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 13 18 4873

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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21-01-2014

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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