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(54) Title: ELECTRICAL HIGH POWER CONNECTOR ASSEMBLY

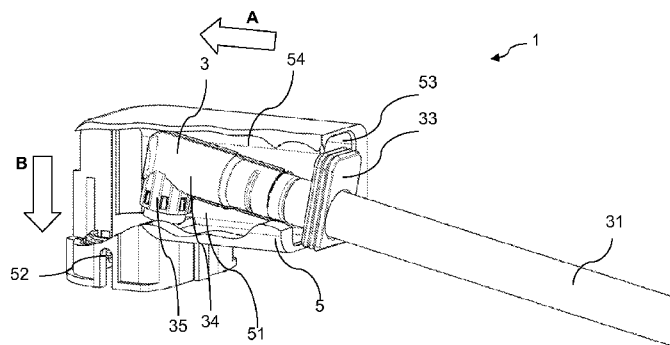


Fig. 4

(57) Abstract: The present invention relates to an electrical high power connector assembly (1) comprising: -a terminal element (3) with a terminal main part (34), -a terminal plug (35) arranged essentially perpendicular to the terminal main part (34) and -a connector or housing (5), the connector housing (5) comprising: -a first reception cavity (51) which extends along a first insertion direction (A), and -a second reception cavity (52) which extends along a second insertion direction (B), essentially perpendicular to the first insertion direction (A), -at least one opening (53) for inserting the terminal element (3) in the first reception cavity (51) in the first insertion direction (A), and -a clearance (54) in the first reception cavity (51) providing space for moving the terminal plug (35) in the second insertion direction (B) until the terminal plug (35) rests at least partially in the second reception cavity (52), wherein the clearance (54) is sufficiently large to allow a rotation or a lateral displacement of the terminal plug (35) from the first reception cavity (51) into the second reception cavity (52).

Electrical high power connector assembly

The present invention relates to an electrical high power connector assembly, in particular for the connection of high power electrical cables in the automotive field. The present invention further relates to an electrical high power connector system comprising the high power connector assembly and a corresponding counter connector.

The growing field of electrical and hybrid vehicles demand for new solutions for the required mechanical and electrical components. In particular, new high power connector assemblies are needed since the high electrical powers which, for example, are needed for running an electrical engine work with currents in the range of hundreds of amperes. Such currents can only be transmitted using relatively big electrical cables with inner conductor diameters in the order of several millimeters. A difficulty which arises, for example, upon assembling corresponding wire harnesses is that bending of such cables is relatively difficult. Thus, to facilitate the installation of such high power electrical cables, specialized 90° connectors are needed, also denoted as right-angled terminals.

An example of an electrical high power connector assembly is described in WO 2011/039099 A1. Therein, a two part high-voltage plug-and-socket connector is described, by means of which an electrical conductor can be connected to a mating contact element of a mating plug element. The connector assembly comprises a housing body with a casing element and a closure piece.

It is an object of the present invention to provide an electrical high power connector assembly which is more stable than a two or more part housing according to the prior art. It is a further object of the present invention to provide an electrical high power connector assembly which can be more easily assembled and which is less susceptible to incorrect assembly. It is a further object of the present invention to provide an electrical high power connector assembly which has better sealing properties against environmental influences and copes better with vibrations and allows broader manufacture tolerances.

Further, it is an object of the present invention to achieve all the above advantages with an inexpensive product.

5 These and other objects, which become apparent upon the description, are solved by electrical high power connector assemblies according to claim 1 and an electrical high power connector system comprising the high power connector assembly and a corresponding counter connector according to claim 16.

10 According to the present invention, an electrical high power connector assembly is provided which comprises at least one terminal element with a terminal main part and a terminal plug arranged essentially perpendicular to the terminal main part. In other words, the present invention is directed to a connector assembly for right-angled terminal elements. The expression terminal main part is to be understood in its broadest sense and is used herein to differentiate between the
15 terminal plug and the part where the cable is attached to the terminal. Preferably, the terminal element is preassembled with a cable, and more preferably even preassembled with a shielding.

20 The electrical high power connector assembly further comprises a connector housing with a first reception cavity which extends along a first insertion direction and a second reception cavity which extends along a second insertion direction whereby the first insertion direction and the second insertion direction are essentially perpendicular to each other. Particularly, the second reception cavity serves for the reception of the contact terminal(s).

25

As it will be clear to the person skilled in the art, in the context of the present invention, the term essentially indicates that expressions such as perpendicular or 90° are not to be understood in a strict mathematical sense but within the typical production tolerances. In other words essentially perpendicular as well
30 as essentially 90° both indicate an angle of 90° +/- 20°, preferably +/- 10°, even more preferably +/- 7.5° and most preferably +/- 5°.

The connector housing further comprises at least one opening for inserting the terminal element in the first reception cavity in the first insertion direction and a clearance in the first reception cavity providing space for moving the terminal plug into the second insertion direction until the terminal plug rests at least partially in the second reception cavity.

The clearance enables a rotation or a lateral displacement of the terminal plug from the first reception cavity into the second reception cavity.

Thereby, a connector housing can be provided which is more stable than a connector housing which are assembled from two or more components as it is often the case in the prior art.

In a preferred embodiment, the electrical high power connector assembly further comprises a cover attachable to the connector housing. The cover is preferably shaped such that it fills the clearance, when the terminal plug of the terminal element rests at least partially in the second reception cavity, such that its return into the first reception cavity is prevented. In other words, the cover does not necessarily completely fill the remaining free space in the clearing but only fills the clearing in sufficient extend to hold the terminal in its position inside of the connector housing.

Preferably, the cover and the connector housing are connectable by snap tabs, screws or the like. Further preferably, the electrical high power connector assembly comprises a sealing element arranged between the cover and the connector housing to improve the sealing properties against environmental influences, vibrations, broader manufacture tolerances and so on.

In another preferred embodiment, the electrical high power connector assembly further comprises a spacer insertable into the connector housing in the first insertion direction to displace the terminal plug from the first reception cavity into the second reception cavity and to prevent its return into the first reception cavity. Preferably, the spacer is connectable to the connector housing and/or

the terminal element by snap tabs, screws or the like and further preferably the spacer can be pushed into the opening of the connector housing.

5 Preferably, the spacer is arranged around the terminal element, further preferably, the spacer has a U-shaped cross section to be plugged on the terminal element.. The sealing properties can be further improved by the provision of a sealing element arranged between the spacer and the connector housing.

10 The sealing properties can be even more improved by the provision of a spreader and/or filling material arranged between the terminal element and the cover and/or the connector housing. Another measure for improving the sealing properties can be the provision of a sealing element arranged between the connector housing and the cable of the terminal element.

15 In a preferred embodiment, the terminal element is mounted to a cable and preferably provided with a shielding. The shielding may comprise a shield contact ring, a shield base sample, an insulation housing, an insulation cover, a shield cover, a SWS, and/or a seal holder etc..

20 The electrical high power connector assembly can be further provided with at least two terminal elements which are interlocked/shortened by fixed contact bridge.

25 In a preferred embodiment, a CPA and/or TPA function and/or a mate assist system is provided which assures that the terminal element and/or the connector housing are correctly assembled.

30 Generally, the assembly comprises one, two or three terminals as this is the most common requirement for high power applications.

In the following, the invention is described exemplarily with reference to the enclosed Figures of which

- Fig. 1 shows a three dimensional view of one embodiment of an electrical high power connector assembly,
- Fig. 2 shows another three dimensional view of the electrical high power connector assembly of Fig. 1,
- 5 – Fig. 3 shows another three dimensional view of the electrical high power connector assembly of Figs. 1 and 2,
- Fig. 4 shows a three dimensional view of another embodiment of an electrical high power connector assembly,
- Fig. 5 shows another three dimensional view of the electrical high power connector assembly of Fig. 4,
- 10 – Fig. 6 shows another three dimensional view of the electrical high power connector assembly of Figs. 4 and 5,
- Fig. 7 shows another three dimensional view of the electrical high power connector assembly of Figs. 4 to 6, and
- 15 – Fig. 8 shows another three dimensional view of the electrical high power connector assembly of Figs. 4 to 7.

Fig. 1 illustrate an electrical high power connector assembly 1 comprising a right-angled terminal element 3 with a terminal main part 34 and a terminal plug 35 arranged essentially perpendicular to the terminal main part 34, and a single part connector housing 5. The terminal element 3 is mounted to a cable 31 and provided with a shielding, which is not currently shown.

20

As shown in Figs. 1 and 2, the connector housing 5 is made from a single injection molded part and comprises a first reception cavity 51, as shown on Fig. 2, which extends along a first insertion direction A, and a second reception cavity 52 which extends along a second insertion direction B, essentially perpendicular to the first insertion direction A.

25

The single part connector housing 5 further comprises openings 53 for inserting the terminal element 3 in the first insertion direction A in the first reception cavity 51, and a clearance 54 providing space to allow moving the terminal plug 35, in particular in the first reception cavity 51, into the second insertion direction B

30

until the terminal plug 35 rests at least partially in the second reception cavity 52.

5 The clearance 54 is dimensioned and shaped such that it allows a rotation of the terminal plug 35 from the first reception cavity 51 into the second reception cavity 52.

In the shown embodiment, the clearance 54 is particularly large, due to the open configuration of the connector housing 5.

10

Figs. 1 to 3 illustrate the process of angled inserting of the terminal element 3 into the single part connector housing 5.

15 In Fig. 1, the terminal element 3 approaches the single part connector housing 5. In Fig. 2, the terminal element 3 has entered the single part connector housing 5 through the opening 53. The terminal element 3 is in the first reception cavity 51. The terminal element 3 can now be rotated until the terminal plug 35 rests at least partially in the second reception cavity 52. This can be effected by manually rotating the terminal element 3 or by pushing the
20 terminal main part 34 in the second insertion direction B by means of a cover 55, a tool or the like. In Fig. 3, the approach of the cover 55 in the direction of the housing 55 is shown, as will be described in detail below.

25 As illustrated in Fig. 3, in the shown embodiment, the electrical high power connector assembly 1 further comprises the cover 55 attachable to the connector housing 5. The cover 55 comprises a base having spacer means 55' that fills the clearance 54 when the terminal plug 35 of the terminal element 3 rests at least partially in the second reception cavity 52, such that its return into the first reception cavity 51 is prevented.

30

Preferably, the cover 55 can be used to push the terminal main part 34 in a second insertion direction B, so that the terminal plug 35 is at least partially inserted into the second reception cavity 52.

As further illustrated in Fig. 3, the cover 55 and the connector housing 5 are connectable by snap tabs 56.

5 The electrical high power connector assembly 1 further comprises a sealing element 57 arranged between the cover 55 and the connector housing 5 to improve the sealing properties of the electrical high power connector assembly 1.

10 Another measure for improving the sealing properties is shown in the alternative embodiment of Fig. 4, namely the provision of a sealing element 33 arranged between the connector housing 5 and the cable 31 of the terminal element 3.

15 Such a sealing element 33 can also be provided with the embodiment of Figs. 1 to 3 comprising the cover 55.

The sealing properties can be further improved by the provision of a spreader and/or filling material (not shown) arranged between the terminal element 3 and the cover 55 and/or the connector housing 5.

20 The electrical high power connector assembly 1, preferably, further comprises a mate assist system 60, only shown in Figs. 1 and 3 for clarification purposes, which assures that the terminal element 3 and/or the connector housing 5 are correctly assembled. The mate assist systems 60 may comprise a lever 61
25 which rotates around a rotation axis arranged on the connector housing 5. Such mate assist systems 60 are, in general, known to the skilled person, so that it is refrained from a detailed description thereof.

30 As a result, the electrical high power connector assembly 1 according to the present invention is more robust than prior art housings which are assembled from several parts in order to allow for the mounting of the right-angled terminal elements. Due to the particular design of the inventive connector housing 5, a secure mounting of right-angled terminal elements is possible and the electrical

high power connector assembly 1 is cheaper and has better sealing properties against environmental influences and copes better with vibrations and broader manufacture tolerances.

5 Figs. 4 to 8 illustrate another embodiment of the electrical high power connector assembly 1 according to the invention.

10 This second embodiment does not comprise a cover but is apart from that similar to the first embodiment of Figs. 1 to 3. It should be noted that in the figures like parts are designed with the same reference numbers.

15 Similar to the first embodiment, the second embodiment according to Figs. 4 to 8 comprises a terminal element 3 with a terminal main part 34, a terminal plug 35 arranged essentially perpendicular to the terminal main part 34 and a single part connector housing 5. The terminal element 3 is mounted to a cable 31.

20 In particular referring to Fig. 5, as with the first embodiment, the single part connector housing 5 comprises a first reception cavity 51 which extends along a first insertion direction A and a second reception cavity 52 which extends along a second insertion direction B essentially perpendicular to the first insertion direction A.

25 The single part connector housing 5 further comprises an opening 53 for inserting the terminal element 3 in the first insertion direction A in the first reception cavity 51. A clearance 54 is provided into the single part connector housing 5, offering sufficient space for moving the terminal plug 35 into the second insertion direction B until the terminal plug 35 rests at least partially in the second reception cavity 52.

30 The clearance 54 enables a lateral displacement of the terminal plug 35 from the first reception cavity 51 into the second reception cavity 52, i.e. it is possible to dispose the terminal plug 35 into the second cavity 52 without the necessity

for angular movement, although such an angular movement is possible. This facilitates automation of the assembly process.

5 Figs. 4 to 8 illustrate the process of inserting the terminal element 3 into the single part connector housing 5 according to the second embodiment.

10 In Fig. 4, the terminal element 3 has entered the single part connector housing 5 through the opening 53. The terminal element 3 is in the first reception cavity 51. The first reception cavity 51 is adapted to provide enough space to insert the terminal element 3 in a linear movement, but also in an angled manner.

As shown in Figs. 5 and 6, a spacer 58 is set onto the cable 31.

15 As shown in Fig. 7, the spacer 58 can be pushed into the connector housing 5 through the opening 53. Thereby, the spacer 58 pushes the terminal main part 34 in the second insertion direction B, so that the terminal plug 35 is at least partially inserted into the second reception cavity 52.

20 Preferably, its return into the first reception cavity 51 is prevented by the spacer 58.

25 As shown in Fig. 8, the spacer 58 has completely entered into the connector housing 5 and the sealing 33 is inserted in contact with the connector housing 5.

As one can see from Figs. 5 to 8, the spacer 58 is shaped to fill the clearance 54, such that the return of the terminal plug 35 into the first reception cavity is prevented.

30 In other words, the electrical high power connector assembly 1 further comprises the spacer 58 insertable into the connector housing 5 in the first insertion direction A to push the terminal plug 35 from the first reception cavity

51 into the second reception cavity 52 and to prevent its return into the first reception cavity 51.

5 The spacer 58 may be arranged around the terminal element 3 and may have a U-shaped cross section to be plugged on the terminal element 3. The spacer 58 may be connectable to the connector housing 5 and/or the terminal element 3 by snap tabs.

10 To improve the sealing properties, a sealing element 33 is provided to seal off the opening 53 of the connector housing 5.

15 The sealing properties can be further improved by the provision of a spreader and/or filling material (not shown) arranged between the terminal element 3 and the connector housing 5.

20 In a preferred embodiment, the electrical high power connector assembly 1 is adapted for 50 A to 500 A, more preferably 100 A to 250 A and 100 V to 400 V, even more preferably 150 A to 200 A and for 50 V to 800 V, more preferably 100 V to 400 V, even more preferably 200 V to 300 V.

In a preferred embodiment, the electrical high power connector assembly 1 is adapted for at least 10 kW, more preferably for at least 50 kW, even more preferably for at least 100 kW, and most preferably for at least 150 kW.

Claims

1. Electrical high power connector assembly (1) comprising:
- 5 – a terminal element (3) with a terminal main part (34),
- a terminal plug (35) arranged essentially perpendicular to the terminal main part (34) and
- a connector housing (5),
- the connector housing (5) comprising:
- 10 – a first reception cavity (51) which extends along a first insertion direction (A), and
- a second reception cavity (52) which extends along a second insertion direction (B), essentially perpendicular to the first insertion direction (A),
- 15 – at least one opening (53) for inserting the terminal element (3) in the first reception cavity (51) in the first insertion direction (A), and
- a clearance (54) in the first reception cavity (51) providing space for moving the terminal plug (35) in the second insertion direction (B) until the terminal plug (35) rests at least partially in the second
- 20 reception cavity (52),
- wherein the clearance (54) is sufficiently large to allow a rotation or a lateral displacement of the terminal plug (35) from the first reception cavity (51) into the second reception cavity (52).
- 25 2. Electrical high power connector assembly (1) according to claim 1, further comprising a cover (55) attachable to the connector housing (5) and shaped to fill the clearance (54) when the terminal plug (35) of the terminal element (3) rests at least partially in the second reception cavity (52), such that its return into the first reception cavity (51) is prevented.
- 30 3. Electrical high power connector assembly (1) according to one of the preceding claims, wherein the cover (55) and the connector housing (5) are connectable by snap tabs (56), screws or the like.

4. Electrical high power connector assembly (1) according to one of the preceding claims, further comprising a sealing element (57) arranged between the cover (55) and the connector housing (5).
- 5 5. Electrical high power connector assembly (1) according to one of the preceding claims, further comprising a spacer (58) insertable into the connector housing (5) in the first reception cavity (51) in the first insertion direction (A) to displace the terminal plug (35) from the first reception cavity (51) into the second reception cavity (52) and to prevent its return
10 into the first reception cavity (51).
6. Electrical high power connector assembly (1) according to claim 5, wherein the spacer (58) is shaped to fill the clearance (54), such that the return of the terminal plug (35) into the first reception cavity (51) is
15 prevented.
7. Electrical high power connector assembly (1) according to claim 5 or 6, wherein the spacer (58) has a U-shaped cross section to be arranged on the terminal element (3).
20
8. Electrical high power connector assembly (1) according to one of the claims 5 to 7, wherein the spacer (58) is connectable to the connector housing (5) and/or the terminal element (3) by snap tabs, screws or the like.
25
9. Electrical high power connector assembly (1) according to one of the claims 5 to 8, wherein a sealing element is provided to seal off the opening (53).
- 30 10. Electrical high power connector assembly (1) according to one of the preceding claims, wherein the terminal element (3) and the connector housing (5) are connectable by snap tabs (56), screws or the like.

11. Electrical high power connector assembly (1) according to one of the preceding claims, wherein the terminal element (3) is mounted to a cable (31).
- 5 12. Electrical high power connector assembly (1) according to one of the preceding claims, wherein the terminal element (3) comprises a shielding.
- 10 13. Electrical high power connector assembly (1) according to one of the preceding claims, wherein a spreader and/or filling material is arranged between the terminal element (3) and the cover (55) and/or the connector housing (5).
- 15 14. Electrical high power connector assembly (1) according to one of the preceding claims, wherein a sealing element (33) is arranged between the connector housing (5) and the cable (31) of the terminal element (3).
- 20 15. Electrical high power connector assembly (1) according to one of the preceding claims, further comprising a mate assist system (60).
16. Electrical high power connector system comprising an electrical high power connector assembly (1) according to one of the preceding claims and a corresponding counter connector.

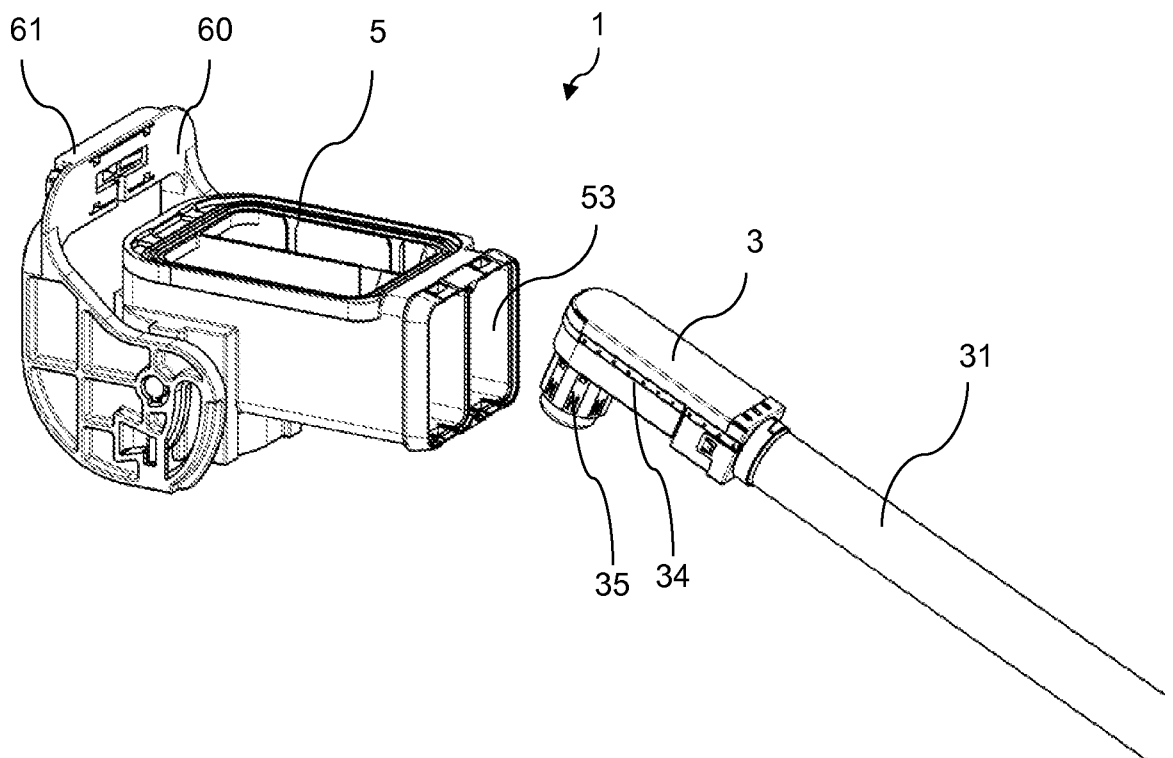


Fig. 1

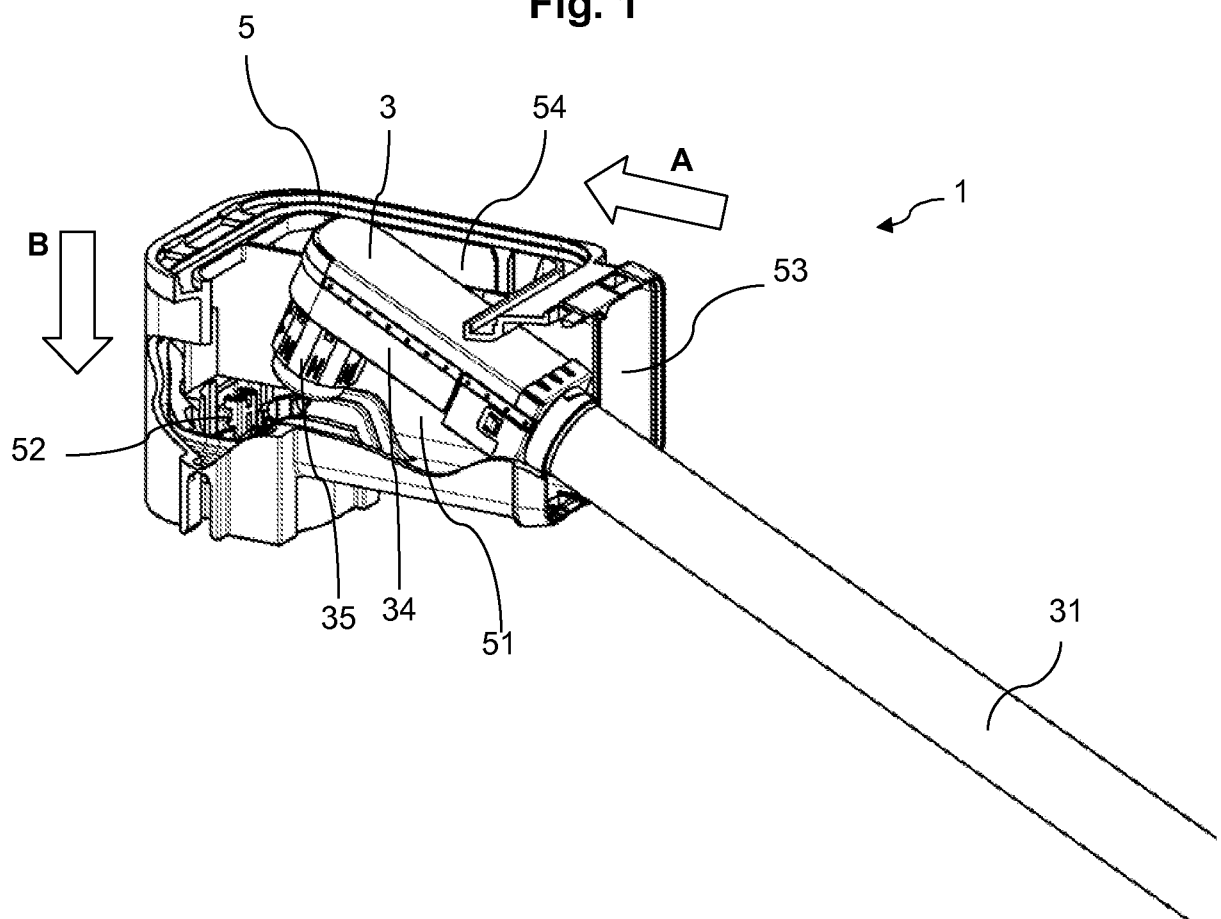


Fig. 2

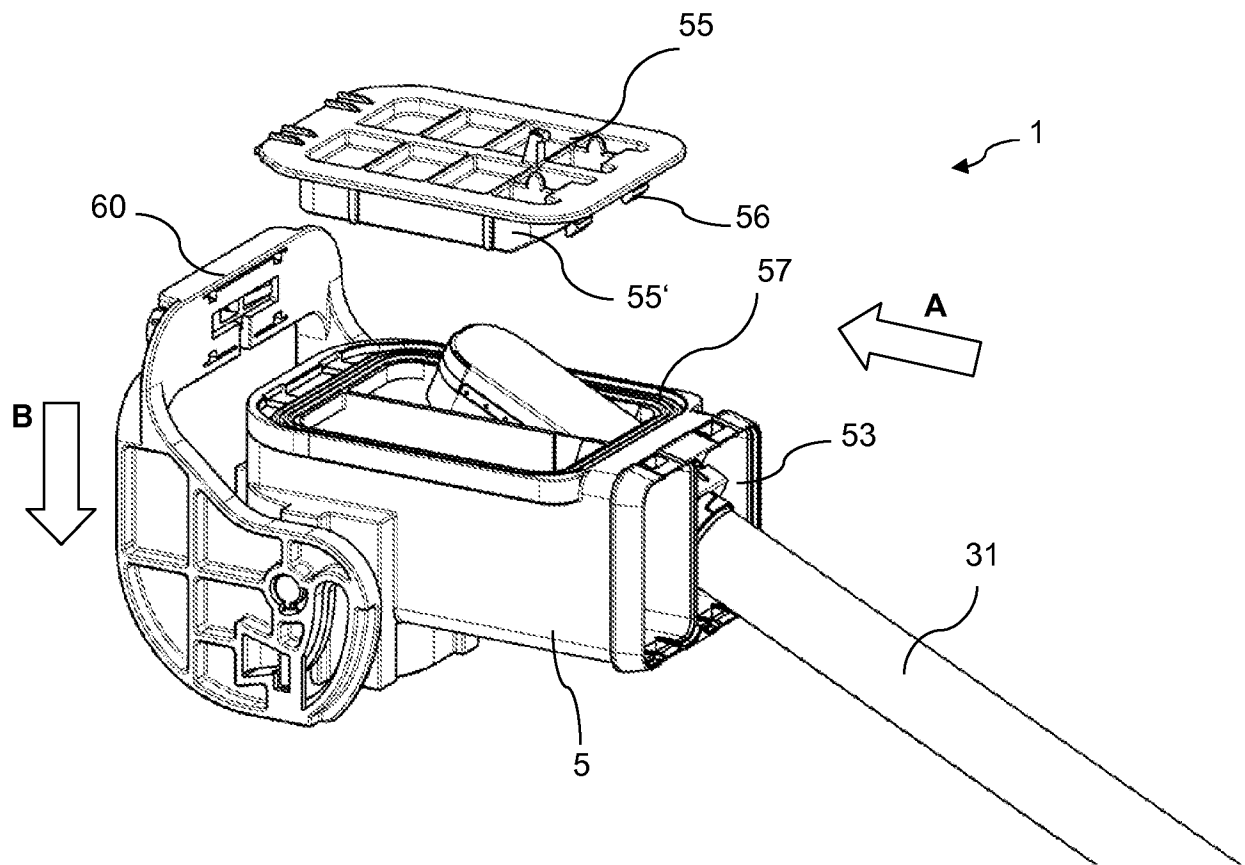


Fig. 3

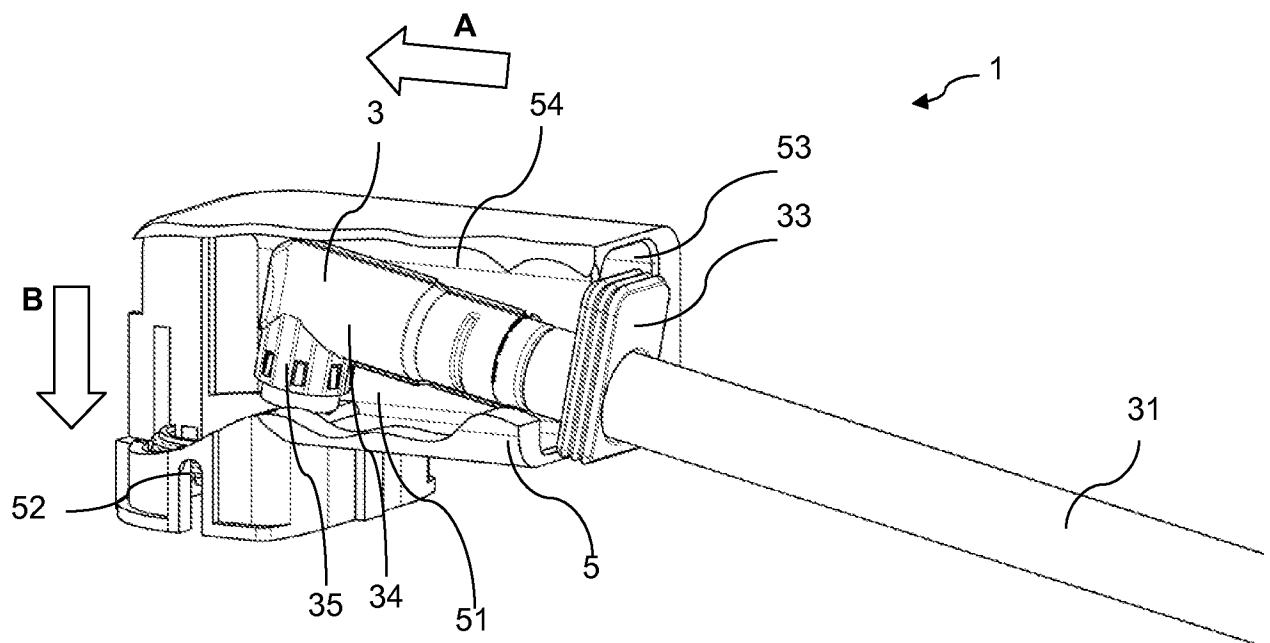


Fig. 4

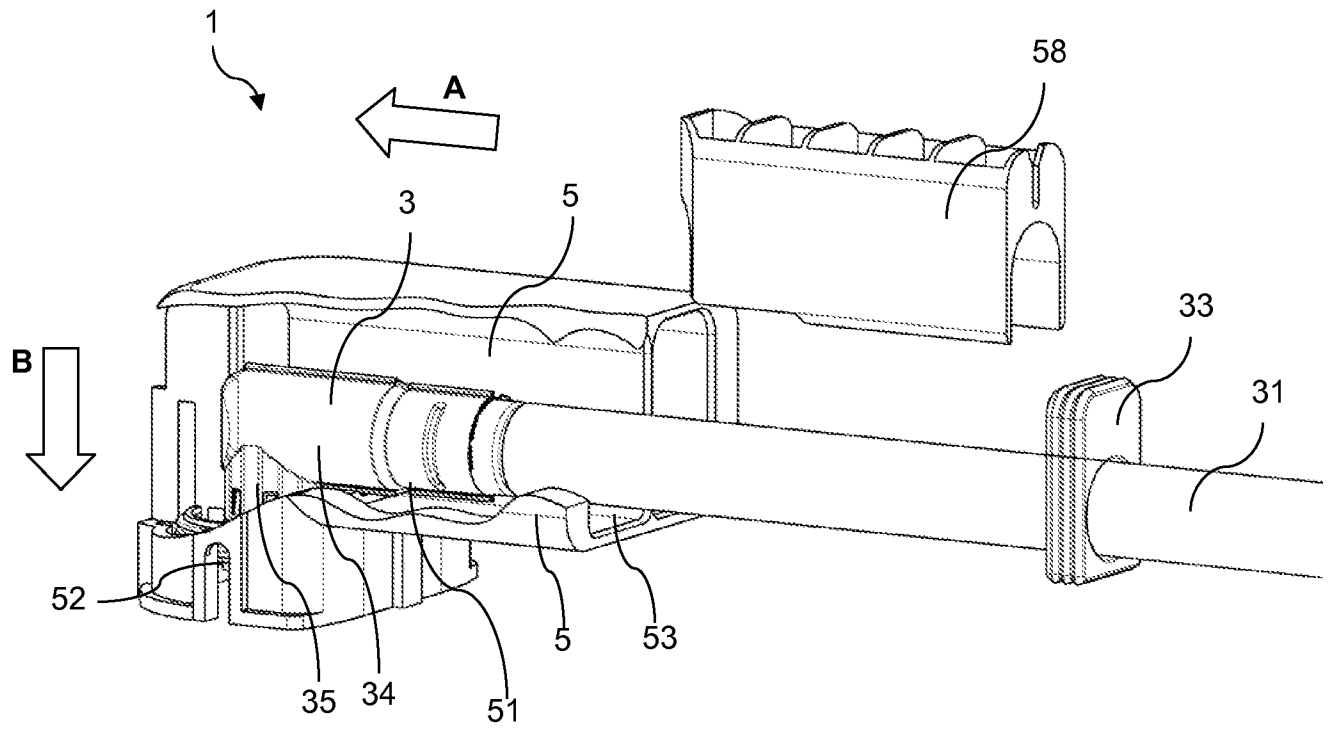


Fig. 5

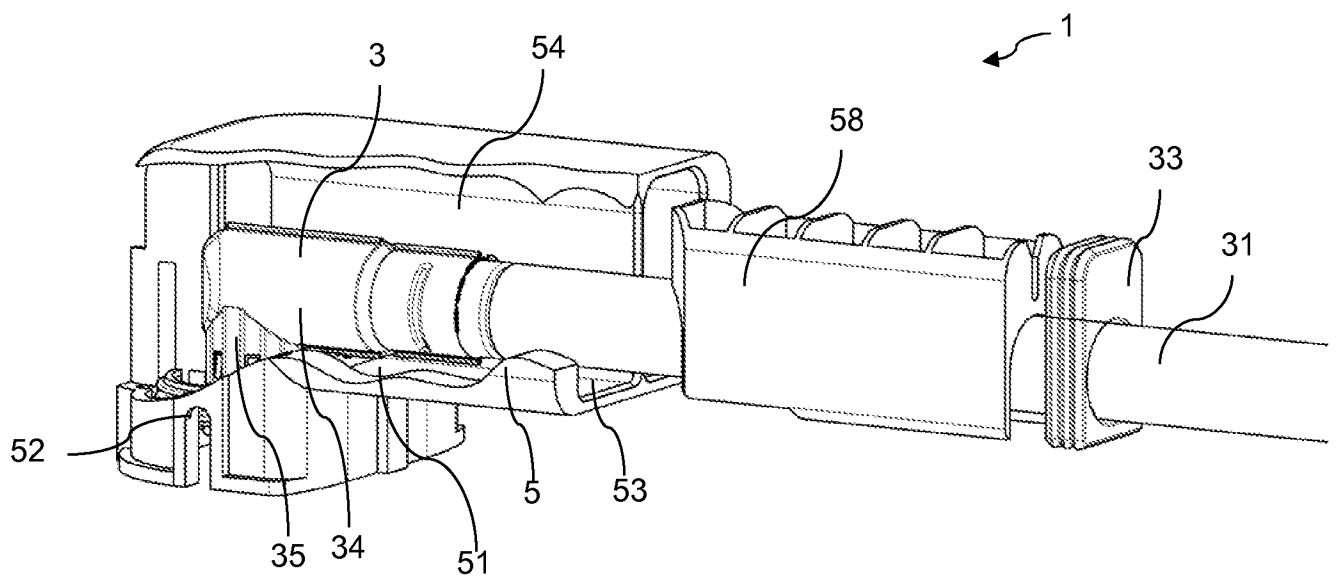


Fig. 6

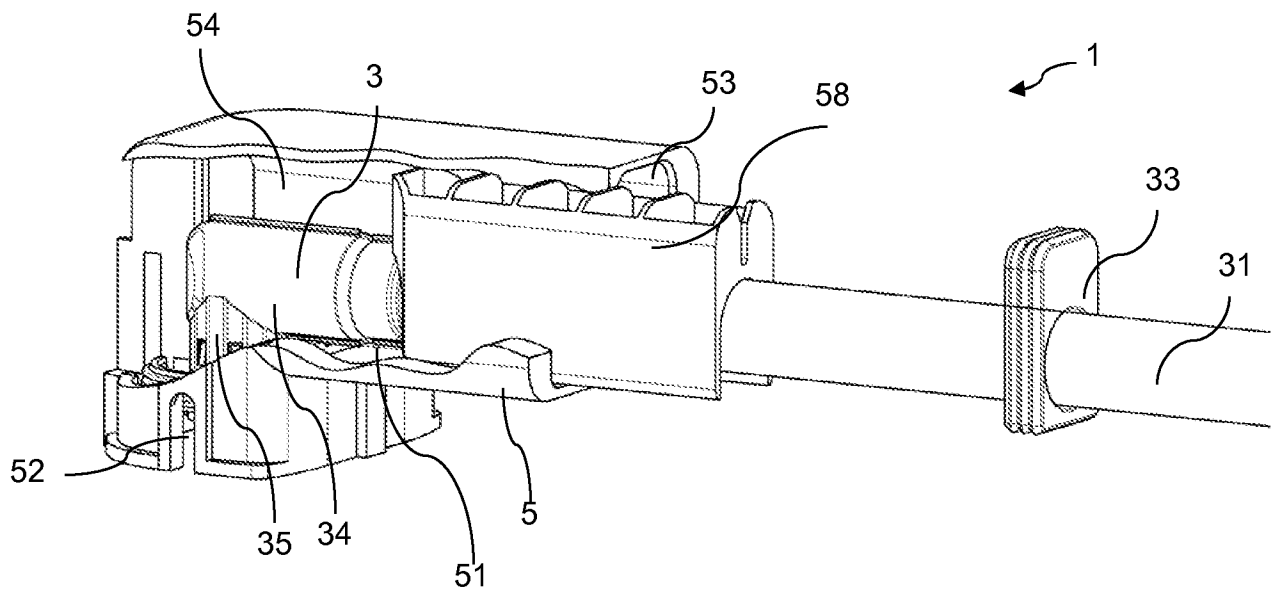


Fig. 7

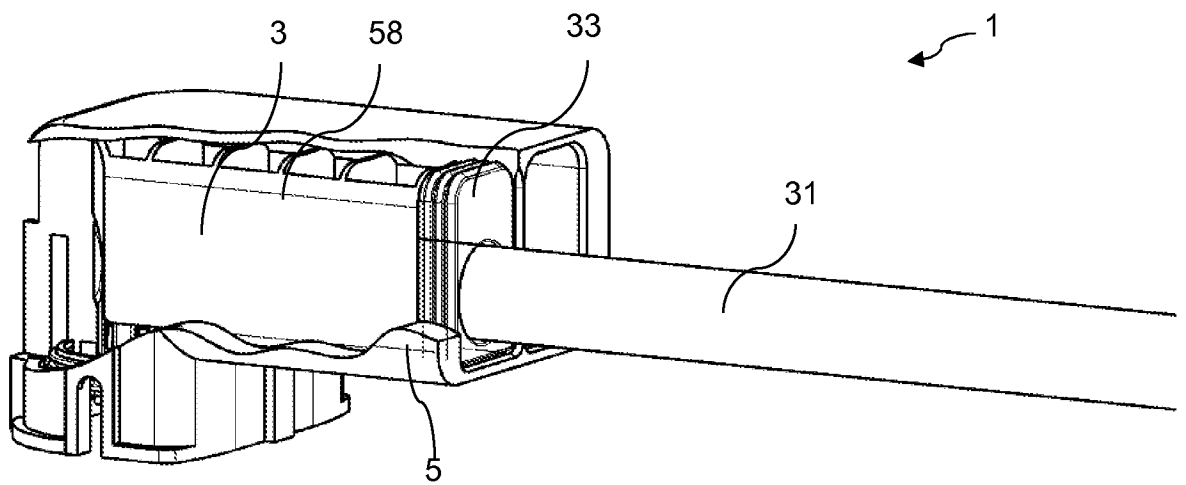


Fig. 8

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2012/002835

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01R13/506
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)

EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 8 057 261 B1 (DESIO JOSEPH P [US] ET AL) 15 November 2011 (2011-11-15) column 2, line 28 - line 65; figures 2-4 -----	1-16
X	US 2003/228782 A1 (NISHIDA ATSUSHI [JP] ET AL) 11 December 2003 (2003-12-11) paragraph [0073] - paragraph [0080]; figures 3,5 -----	1
X	EP 1 097 491 A1 (THOMAS & BETTS INT [US]) 9 May 2001 (2001-05-09) paragraph [0012] - paragraph [0014]; figure 1 -----	1
A	EP 1 732 175 A2 (LAPP ENGINEERING & CO [CH]) 13 December 2006 (2006-12-13) paragraph [0041]; figure 1 ----- -/--	1

☒ 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

13 August 2013

Date of mailing of the international search report

21/08/2013

Name and mailing address of the ISA/

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Knack, Steffen

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2012/002835

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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A	WO 2011/039099 A1 (TYCO ELECTRONICS AMP GMBH [DE]; STOKOWSKI ALEXANDER [DE]; KOSMALSKI CH) 7 April 2011 (2011-04-07) cited in the application page 9, line 6 - page 10, line 18; figure 1 -----	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2012/002835

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