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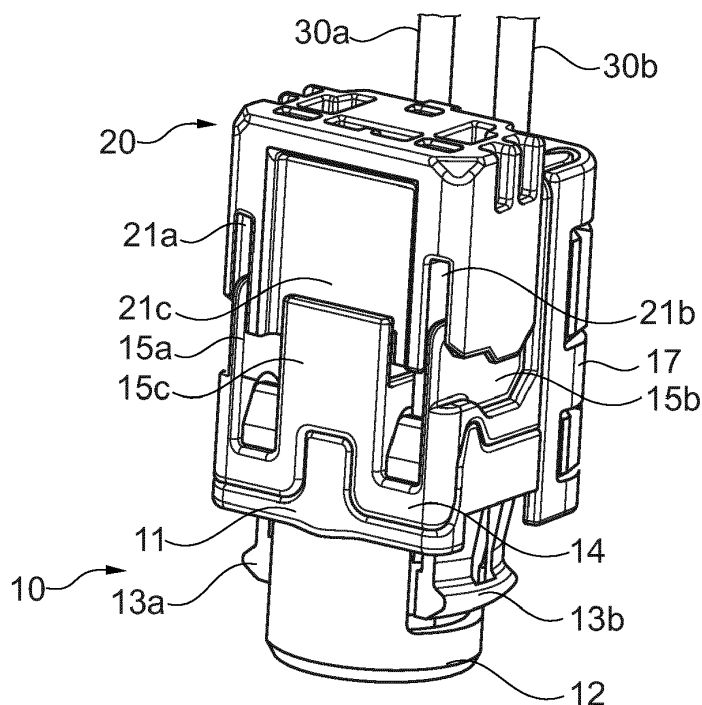
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(54) **Connector assembly with connector position assurance member**

(57) The present invention relates to an electrical connector assembly comprising a plug connector. The plug connector comprises a plug connector housing and a secondary locking device. The secondary locking device is arranged on the outside of the plug connector

housing and is movable between an open and a closed position. A pitch formed between the plug connector housing and the secondary locking device in the open position is covered from at least two opposite sides of the assembly.



Description

FIELD OF THE INVENTION

5 **[0001]** The present invention relates to an electrical connector assembly with a connector position assurance member, and in particular to an electrical connector assembly to be used in an airbag connection system.

TECHNICAL BACKGROUND

10 **[0002]** In many applications, the safe coupling of connectors is of high importance. In particular, in the case of car safety systems such as for example airbag systems in passenger cars, the connectors used for the connection of an airbag to its ignition base have to be provided with reliable safety mechanisms. To ensure that the connectors cannot become loose unintentionally, secondary locking members are known to guarantee a safe mechanical coupling.

15 **[0003]** Fig. 1 shows a typical example of a connector in particular for use in an airbag ignition system, which is provided with a secondary locking member. Such a connector is also known from WO 2007/131535 A1. The connector comprises a plug connector housing 1, which is adapted to be plugged into a corresponding receptacle of an airbag igniter or airbag squib. The connector of Fig. 1 further comprises a secondary locking device 2, which is also often denoted as connector position assurance (CPA) device. This secondary locking device 2 is arranged moveable on the plug connector housing 1 in mating direction of the plug connector between an open and a locked or closed position. In the open position, the secondary locking device projects to some extent from the upper surface of the plug connector and in this open position it is possible to mate the plug connector with a corresponding counter connector. When the plug connector is mated to the corresponding counter connector, the secondary locking device can be moved manually into the locked or closed position. In this locked position the secondary locking device prevents a release movement of the plug connector from the corresponding counter connector.

25 **[0004]** However, as can be seen from Fig. 1, the conventional connector features a wide gap or pitch 3 which is open between the plug connector housing 1 and the secondary locking device 2 in the shown open position of the device 2. During the mating process and subsequent locking process, objects such as for example parts of the gloves of the operator can get caught in the gap or pitch. As a consequence, the movement of the secondary locking device gets blocked such that the connector cannot be fully coupled to the corresponding counter connector. This is a particular a problem in production lines, where operators install and mate the connector to the airbag system.

30 **[0005]** Accordingly, it is an object of the present invention to provide an electrical connector assembly which reduces or minimizes the above described problems and disadvantages. It is in particular an object of the present invention to provide an airbag connector assembly featuring a secondary locking device, where the movement of the secondary locking device is protected from being blocked by objects.

35 **[0006]** These and other objects, which become apparent by reading the following description, are achieved by an electrical connector assembly according to the subject matter of claim 1.

SUMMARY OF THE INVENTION

40 **[0007]** According to the invention, an electrical connector assembly is provided, which comprises a plug connector. The plug connector in turn comprises a plug connector housing and a secondary locking device which is being arranged on the outside of the plug connector housing. In other words, the secondary locking device is not fully provided inside the plug connector housing, but is arranged such that most of the secondary locking device is accessible from the outside. The secondary locking device is thereby arranged such that it is movable between an open and a closed position. The direction of movement is generally preferred the mating direction of the plug connector, i.e. the secondary locking device can be moved back and forth in mating direction. When the secondary locking device is in the open position, a pitch is opened or forms between the plug connector housing and the secondary locking device. According to the invention, this pitch is covered from at least two opposite sides of the assembly by plate members extending from the plug connector housing to the secondary locking device in the open position, i.e. in the open position of the secondary locking device.

45 When the secondary locking device is in the closed position, this pitch is covered by the secondary locking device. In other words, the electrical connector assembly features plate members which cover the pitch when the secondary locking device is in the open position such that no objects can block the movement of the secondary locking device. Thus, preferably, when the electrical connector assembly with the secondary locking device in the open position is being coupled to a corresponding counter connector, objects such as for example parts of the gloves of an operator cannot get caught between the plug connector housing and the secondary locking device, because the pitch formed between the plug connector housing and the secondary locking device in the open position is covered from at least two opposite sides of the assembly by plate members. These plate members thereby extend from the plug connector housing to the secondary locking device in the open position. Hence, when moving the secondary locking device to the closed position,

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the movement cannot be blocked by a foreign object, allowing for an easy, fast and fail-proof mounting and mating of the electrical connector assembly.

[0008] The term "counter connector" used herein denotes to any kind of connector adapted to connect to the plug connector and contact terminal provided therein. The counter connector, the plug connector housing and the secondary locking device are preferably fabricated by injection molding.

[0009] Generally preferred, the plate members overlap at least partially with the plug connector housing or the secondary locking device when the secondary locking device is in the closed position. Preferably, the plate members are adapted such that the extent of overlap increases when the secondary locking device is moved from the open position to the closed position. In other words, when the secondary locking device is in the open position, the plate members extend from the plug connector housing to the secondary locking device. When moving the secondary locking device to the closed position, the plate members cover or mask more and more of the plug connector housing or the secondary locking device. When the secondary locking device is in the closed position, the plate members cover or mask the plug connector housing or the secondary locking device. Hence the plate members protect the movement of the secondary locking device from being blocked and also provide stability of the mounted electrical connector assembly with closed secondary locking device.

[0010] Preferably, each plate member is either an integral part of the plug connector housing, or an integral part of the secondary locking device. Preferably, the secondary locking device and/or the plug connector housing comprises corresponding recess means which are adapted to receive the respective plate members when the secondary locking device is moved from the open position to the closed position. Thus, preferably, a plate member being an integral part of the plug connector housing is received by a corresponding recess means of the secondary locking device, or vice versa. In a particular preferred embodiment, the recess means are adapted to receive the corresponding plate members partially, when the secondary locking device is in the open position. This provides additional protection of the pitch from objects, and increases the stability of the electrical connector assembly when the secondary locking device is in the open or closed position. Preferably the plate members and the recess means form pairs of parallel portions. These parallel portions overlap when the secondary locking device is in the closed position. The extend of overlap thereby increases when the secondary locking device is moved from the open to the closed position.

[0011] In a preferred embodiment, at least one of the plate members extends from a periphery of the plug connector housing to a periphery of the secondary locking device, when the secondary locking device is in the open position. Hence, the pitch is fully covered by the plate members such that no objects can be introduced into the pitch. Preferably, the assembly comprises three plate members adapted to cover the pitch from at least three different sides of the assembly, and even more preferably the assembly comprises at least four plate members adapted to cover the pitch from at least four different sides of the assembly. Thereby, the movement of the secondary locking device is further protected from being blocked by foreign objects.

[0012] In a preferred embodiment, the plug connector housing of the electrical connector assembly comprises retention means adapted to engage the secondary locking device in the open position. In other words, when the secondary locking device is moved from the closed position to the open position, the retention means prevents a complete removal of the secondary locking device from the electrical connector assembly. Further preferred, the secondary locking device in turn comprises protrusion means adapted to interact with the retention means of the plug connector housing. When the secondary locking device is in the open position, the interaction of the protrusion means with the retention means hinders the secondary locking device from an unwanted movement from the open position to the closed position.

[0013] Preferably, the plug connector housing of the electrical connector assembly further comprises blocking means adapted to provide terminal position assurance (TPA) for the contact terminal provided in the plug connector housing. TPA is known in the art to ensure correct positioning of the contact terminal inside the plug connector housing, thereby reducing the need for time-consuming and costly inspection during assembly.

[0014] The electrical connector assembly described herein is particularly useful for airbag connection systems in passenger cars.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0015] In the following the invention is described exemplarily with reference to the enclosed figures:

Fig. 1 is a schematic illustration of a connector according to the prior art.

Fig. 2 shows an electrical connector assembly according to the present invention, with the secondary locking device being in the open position.

Fig. 3 shows the electrical connector assembly of Fig. 2, with the secondary locking device being in the closed position.

Fig. 4 is an exploded view of the electrical connector assembly of Fig. 2.

Figs. 5 and 6 show 3-dimensional cross-sections of the electrical connector assemblies according to Figs. 2 and 3.

Fig. 7 is a schematic view of the plug connector housing of Fig. 2.

Fig. 8 shows a 3-dimensional cross-section of the plug connector housing of Fig. 7.

Fig. 2 shows an electrical connector assembly comprising a plug connector housing 10 and a secondary locking device 20. The plug connector housing of Fig. 2 comprises a main portion 11, a holder part 14 and a cap part 17. The main portion 11 features a plug-in portion 12, which in turn comprises two latching arms 13a and 13b, being arranged on opposite sides of the plug-in portion 12. These latching arms serve for latching with corresponding latching means of a corresponding counter connector (not shown).

[0016] The holder part 14 of the plug connector housing 10 illustrated in Fig. 2 comprises plate members 15a, 15b, 15c, being arranged on different sides of the electrical connector assembly. The secondary locking device 20 of the plug connector comprises recess means 21 a, 21b, 21 c, being arranged on different sides of the secondary locking device 20. The recess means 21a, 21 b, 21c are thereby adapted such that they can receive the plate members 15a, 15b, 15c of the holder part 14 of the plug connector housing 10.

[0017] The secondary locking device 20 of the electrical connector assembly illustrated in Fig. 2 is in the open position. The pitch formed between the main portion 11 of the plug connector housing 10 and the secondary locking device 20 is thereby covered by the plate members 15a, 15b, 15c. These plate members 15a, 15b, 15c prevent the insertion of objects into the pitch. For example, when an operator installs the plug connector, the plate members prevent that parts of the gloves of the operator get snatched between the secondary locking device 20 and the main portion 11 of the plug connector housing 10. The skilled person understands that the plate portions 15a, 15b, 15c also hinder the insertion of other objects, such as e.g. cables or the fingers of the operator into the pitch.

[0018] The expression "pitch" used herein denotes to the gap formed between the secondary locking device 20 and the plug connector housing 10. When the secondary locking device 20 is in the open position this pitch is most pronounced. However, when the secondary locking device 20 is moved to the closed position, this pitch is being increasingly covered by the secondary locking device 20. The provision of the plate members 15a, 15b, 15c thereby cover or shield the pitch to prevent the movement of the secondary locking device 20 from being blocked.

[0019] As the skilled person will recognize from a comparison between Fig. 2 and 3, Fig. 3 illustrates the electrical connector assembly of Fig 2, with the secondary locking device 20 being in the closed position. The recess means 21 a, 21b, 21c of the secondary locking device (best visible in Fig. 2) receive the plate members 15a, 15b, 15c of the plug connector housing 10. This allows for an enhanced stability of the plug connector.

[0020] Preferably, the plate members 15a, 15b, 15c are essential flat-shaped portions. These flat-shaped portions have preferably a thickness in the range of 0.1 mm to 1.5 mm, more preferably in the range of 0.3 mm to 1.0 mm, and most preferred the flat-shaped portions have a thickness of about 0.5 mm. The plate members 15a, 15b, 15c may each have different thicknesses. For example the plate member 15c of the illustrated plug connector housing may be thicker than e.g. plate member 15a.

[0021] As can be seen from Fig. 4 in detail, the secondary locking device 20 further comprises blocking legs 24a, 24b, 24c, 24d adapted to interact with the latching arms 13a, 13b of the main portion 11 of the plug connector housing 10. In closed position the blocking legs 24a, 24b, 24c, 24d are arranged behind the latching arms 13a, 13b, so that the latching arms 13a, 13b cannot be moved inwardly toward the plug-in portion 12 and are thus blocked. When the plug connector is fully coupled to a corresponding counter connector and the secondary locking device 20 is in closed position, the latching arms 13a, 13b latch into for example a corresponding groove of the corresponding counter connector, and since an inward movement of the latching arms 13a, 13b is prevented by the blocking legs 24a, 24b, 24c, 24d it is no longer possible to unmate the plug connector and corresponding counter connector. In other words, the blocking legs 24a, 24b, 24c, 24d block a release movement of the latching arms 13a, 13b.

[0022] The secondary locking device 20 further comprises stopping shoulders 22a, 22b arranged on a spring arm 25a. As the skilled person recognizes, the secondary locking device 20 is symmetrical and does thus comprise two identical stopping shoulders 22a, 22b on spring arm 25b. When the plug connector is not connected to a corresponding counter connector, the stopping shoulders 22a, 22b interact with respective means of the plug connector housing 10 such that the secondary locking device 20 cannot be moved from the open position to the closed position. Accordingly, the shoulders 22a, 22b rest on a corresponding portion of the main part 11 of the plug connector housing 10 when the plug connector is not mated. When the plug connector is mated to a corresponding counter connector the blocking shoulders 22a, 22b are released. To this end, the secondary locking device 20 further comprises actuating projections 23a, 23b provided on the free ends of spring arms 25a, 25b. During mating, the spring arms 25a, 25b are deflected by portions of the counter connector, that come into contact with the actuating projections 23a, 23b. Thereby, the stopping shoulders 22a, 22b are released.

[0023] The main portion 11 of the plug connector housing 10 comprises a cavity for the reception of electrical contact terminals 19. The contact terminals 19 are connected with signal cables 30a, 30b. It will be appreciated that an electro-magnetic shielding can additionally be provided (not shown). As known by the skilled person the terminals 19 may be provided with e.g. electronic interference damping devices in the form of a ferrite block.

[0024] The plug connector housing 10 of Figs. 2 - 4 consists of three different elements, namely a main portion 11, a

holder part 14 and a cap part 17. These portions and parts feature means adapted to mount the portion and parts to each other. As illustrated, the main portion 11, the holder part 14 and the cap part 17 may be provided with protrusions and corresponding locking apertures adapted to fixingly receive the protrusions of the respective counterpart when the plug connector is assembled. It will further be appreciated that the plug connector housing 10 may also be formed of any number of single elements. In particular, all means and features of the preferred embodiments described herein may be integral components of a single element forming the plug connector housing 10.

[0025] As can further be seen from Figs. 5 and 6 in detail, the holder part 14 of the plug connector housing 10 further comprises retention means 16. This retention means 16 is of the form of a hook and is adapted such that it hinders a complete removal of the secondary locking device 20 from the plug connector. Accordingly, the secondary locking device 20 comprises respective means adapted to interact with the retention means 16 of the plug connector housing 10. The secondary locking device 20 further comprises protrusion means 26, which hinder the secondary locking device 20 from falling from the open position to the closed position unwantedly. When an external force is applied to the secondary locking device 20 forcing a movement from the open position to the closed position, the protrusion means 26 push back the retention means 16 of the holder part 14, thereby unlocking the blocking function of the retention means 16.

[0026] Figs. 7 and 8 show another view of the plug connector housing 10 with the secondary locking device 20 removed. The cap part 17 of the plug connector housing 10 features blocking means 18, which is adapted to interact with the electrical contact terminals 19. The blocking means 18 thereby provide terminal position assurance (TPA). Accordingly, mounting the cap part 17 to the main portion 10 and holder part 14 indicates that the pre-inserted electrical contact terminal 19 is in correct position inside the main portion 11 of the plug connector housing 10. This reduces the need for any costly and expensive inspection during assembly.

Reference chart

[0027]

1	Plug connector housing (Prior art)
2	Secondary locking device (Prior art)
3	Pitch (Prior art)
10	Plug connector housing
11	Main portion
12	Plug-in portion
13a, 13b	Latching arm
14	Holder part
15a, 15b, 15c	Plate member
16	Retention means
17	Cap part
18	Blocking means
19	Electrical contact terminal
20	Secondary locking device
21a, 21b, 21c	Recess means
22a, 22b	Stopping shoulder
23a, 23b	Actuating projection
24a, 24b, 24c, 24d	Blocking leg
25a, 25b	Spring arm
26	Protrusion means
30a, 30b	Signal cables

Claims

1. Electrical connector assembly comprising:

a plug connector, comprising:

a plug connector housing (10); and
a secondary locking device (20), being arranged on the outside of the plug connector housing (10), such that it is movable between an open and a closed position;
wherein a pitch is open between the plug connector housing (10) and the secondary locking device (20) in

the open position; and

wherein the pitch is covered by the secondary locking device (20) in the closed position;

characterized in that

the pitch is covered from at least two opposite sides of the assembly by plate members (15a, 15b, 15c) extending from the plug connector housing (10) to the secondary locking device (20) in the open position.

2. The electrical connector assembly of claim 1, wherein each plate member (15a, 15b, 15c) overlaps at least partially with the plug connector housing (10) or the secondary locking device (20), when the secondary locking device (20) is in the closed position.
3. The electrical connector assembly of claim 2, wherein the plate members (15a, 15b, 15c) are adapted such that the extend of overlap increases when the secondary locking device (20) is moved to the closed position.
4. The electrical connector assembly of any one of the preceding claims, wherein each plate member (15a, 15b, 15c) is an integral part of either the plug connector housing (10) or the secondary locking device (20).
5. The electrical connector assembly of any one of the preceding claims, wherein the secondary locking device (20) and/or the plug connector housing (10) comprises corresponding recess means (21 a, 21 b, 21 c) adapted to receive the corresponding plate member (15a, 15b, 15c), when the secondary locking device (20) is in the closed position.
6. The electrical connector assembly of claim 5, wherein the recess means (21a, 21b, 21c) are adapted to receive the corresponding plate member (15a, 15b, 15c) partially, when the secondary locking device (20) is in the open condition.
7. The electrical connector assembly of claims 5 - 6, wherein the recess means (21a, 21b, 21c) and the respective plate members (15a, 15b, 15c) form pairs of parallel portions.
8. The electrical connector assembly of any one of the preceding claims, wherein at least one of the plate members (15a, 15b, 15c) extends from a periphery of the plug connector housing (10) to a periphery of the secondary locking device (20) in open position.
9. The electrical connector assembly of any one of the preceding claims, wherein the assembly comprises at least three plate members (15a, 15b, 15c) adapted to cover the pitch from at least three different sides of the assembly, or wherein the assembly comprises at least four plate members (15a, 15b, 15c) adapted to cover the pitch from at least four different sides of the assembly.
10. The electrical connector assembly of any one of the preceding claims, wherein at least one of the plate members (15a, 15b, 15c) has a thickness in the range of 0.1 - 1.5 mm, preferably in the range of 0.3 - 1.0 mm, and most preferred wherein at least one of the plate members (15a, 15b, 15c) has a thickness of about 0.5 mm.
11. The electrical connector assembly of any one of the preceding claims, wherein the plug connector housing (10) comprises retention means (16) adapted to engage the secondary locking device (20) in the open position, in particular wherein the secondary locking device (20) comprises protrusion means (26) adapted to interact with the retention means (16) of the plug connector housing (10), such that the secondary locking device (20) retains in open position.
12. The electrical connector assembly of any one of the preceding claims, wherein the plug connector housing (10) consists of at least three different parts, each comprising corresponding mounting means.
13. The electrical connector assembly of any one of the preceding claims, wherein the plug connector housing (10) comprises blocking means (18) adapted to provide terminal position assurance, TPA, when the assembly is fully assembled.
14. The electrical connector assembly of any one of the preceding claims, wherein the plug connector housing (10) comprises a plug-in portion (12), comprising at least two latching arms (13a, 13b) for latching with corresponding latching means of a corresponding counter connector, and wherein the secondary locking device (20) comprises blocking legs (24a, 24b, 24c, 24d) adapted to block a release movement of the latching arms (13a, 13b) when the secondary locking device (20) is in the closed position and the plug connector is fully coupled to the corresponding counter connector, and

wherein the secondary locking device (20) can only be moved from the open position to the closed position when the plug connector is fully coupled to the corresponding counter connector.

- 5 **15.** The electrical connector assembly of any one of the preceding claims, wherein the plug connector is a 180° plug connector.

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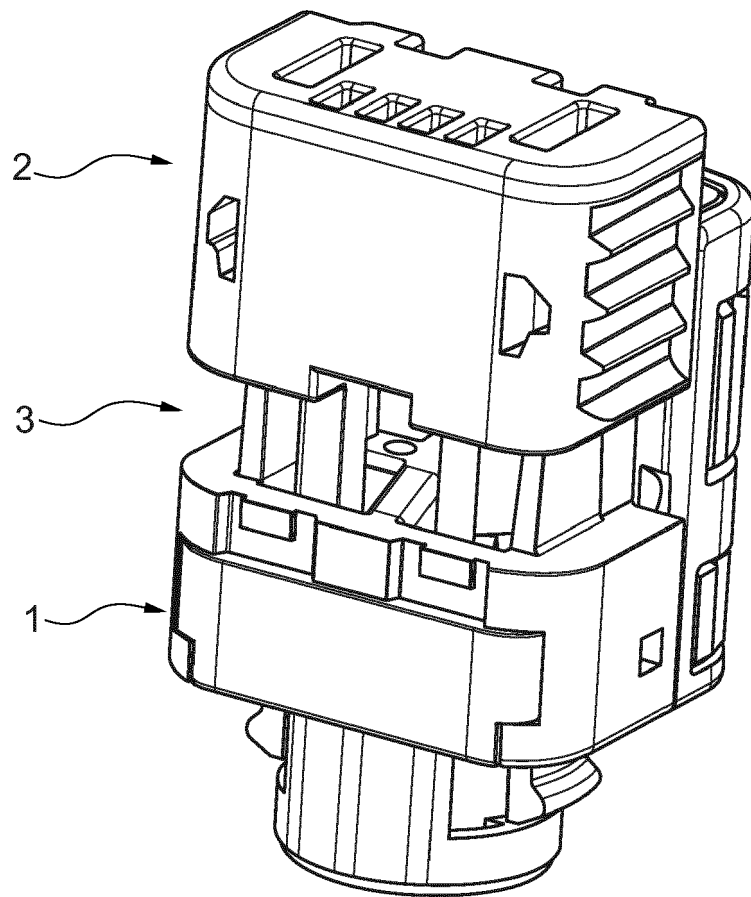


Fig. 1
(prior art)

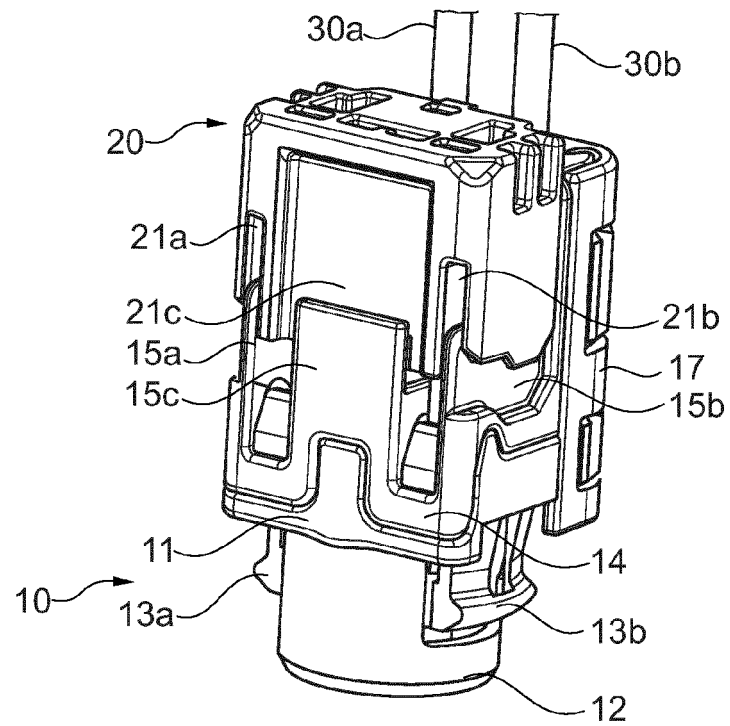


Fig. 2

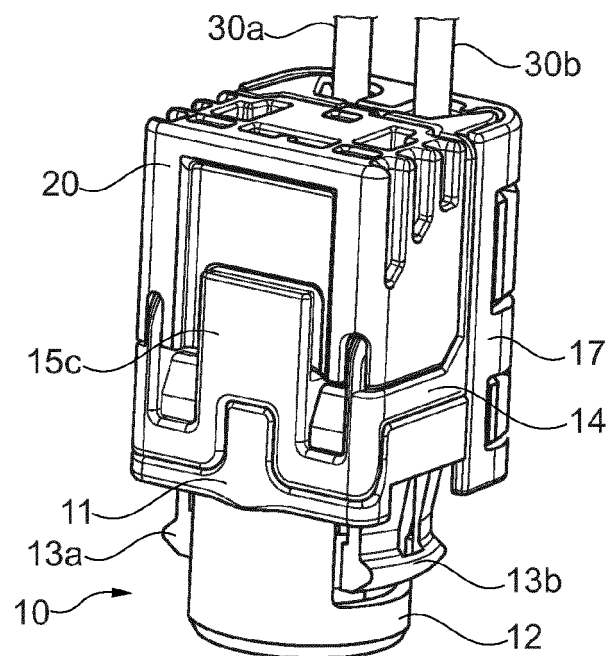


Fig. 3

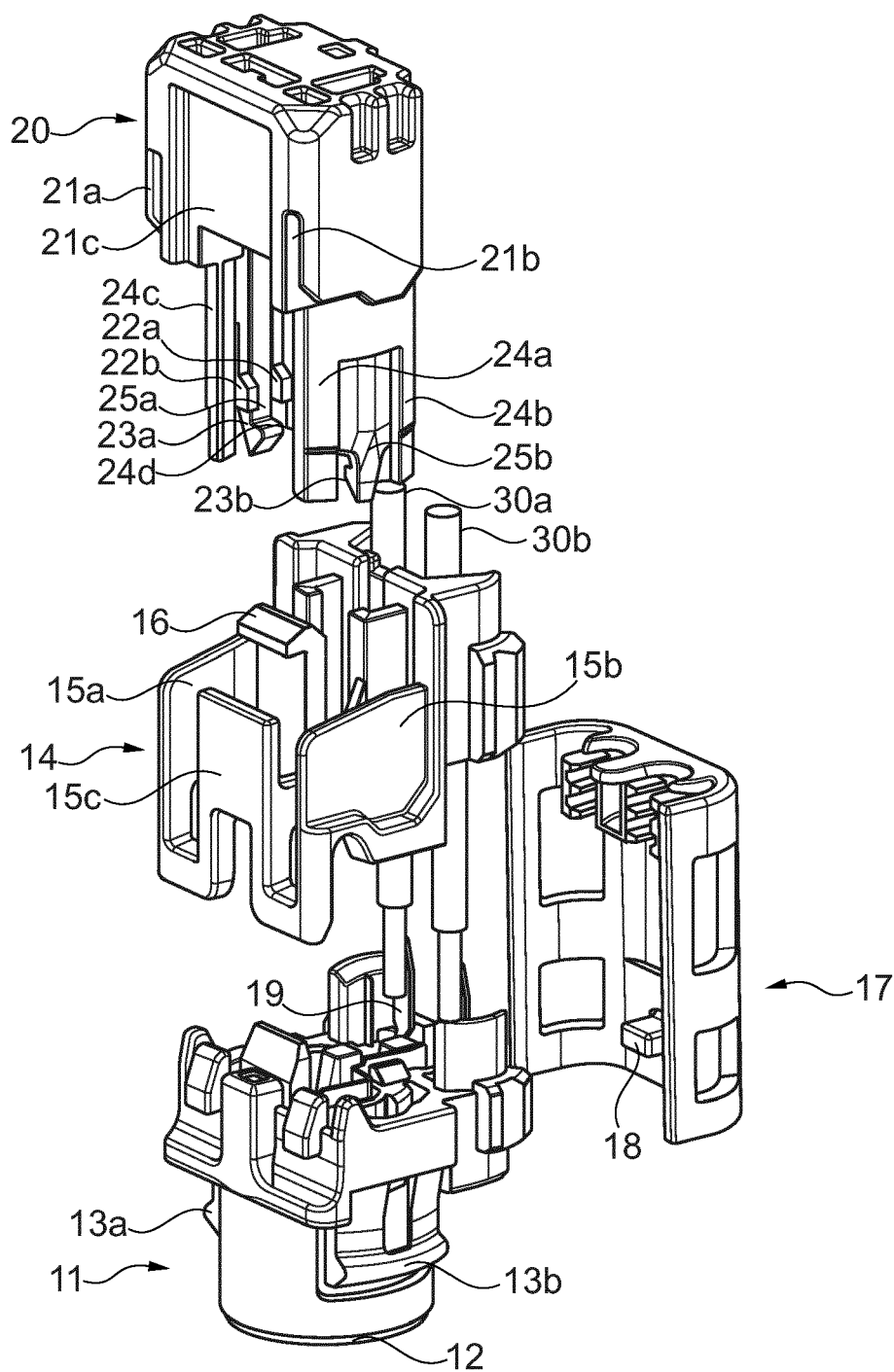


Fig. 4

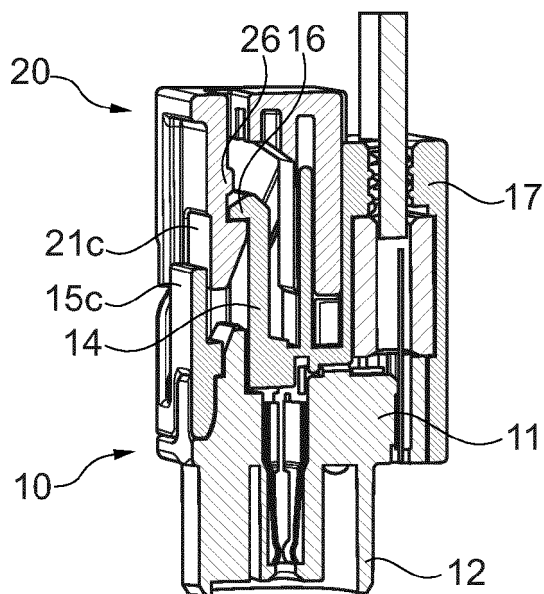


Fig. 5

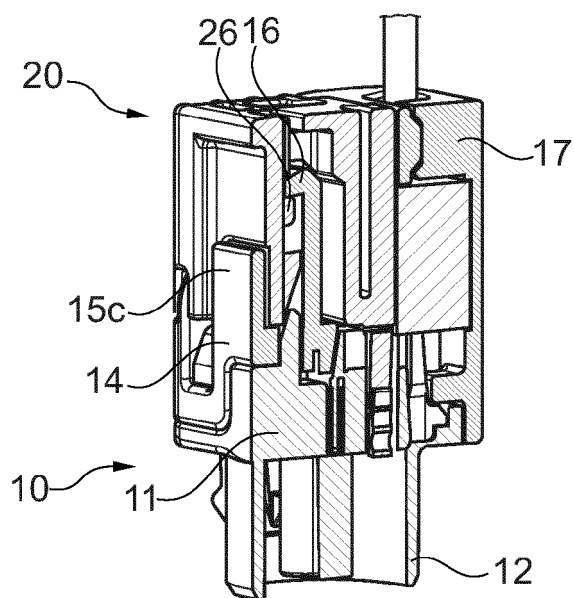


Fig. 6

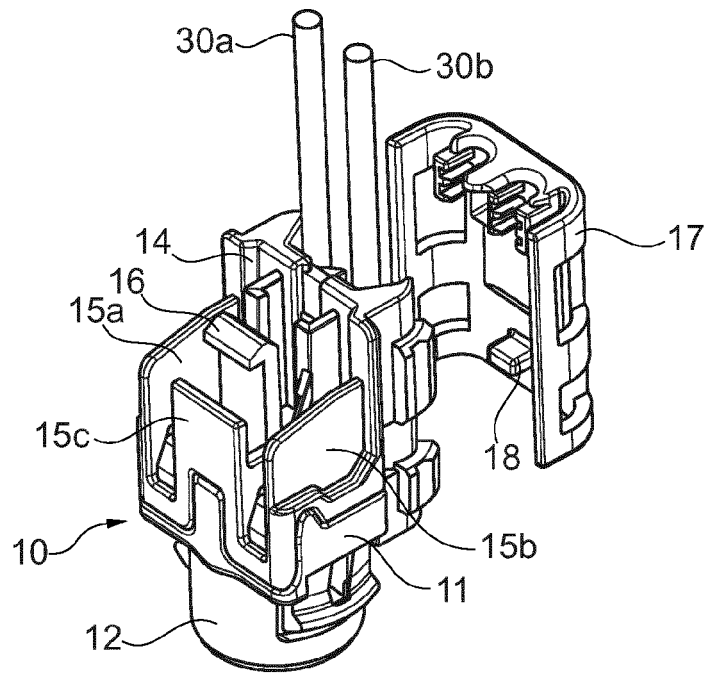


Fig. 7

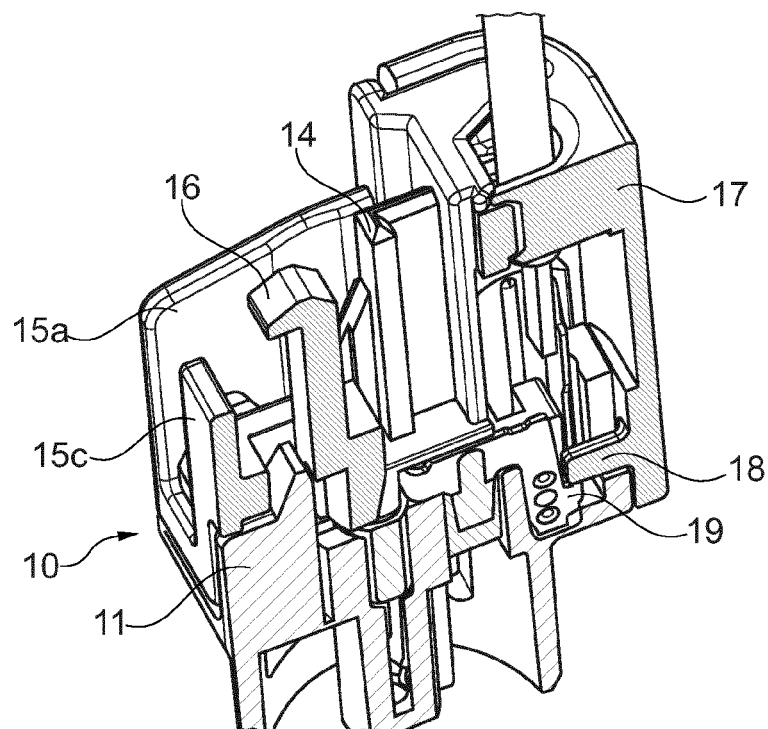


Fig. 8



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Place of search The Hague		Date of completion of the search 5 September 2014	Examiner Corrales, Daniel
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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