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(54)

CONNECTOR POSITION ASSURANCE DEVICE

- (57)

The disclosure relates to an electrical connector system. The system comprises a connector housing and a connector position assurance, CPA, device adapted to be movable along the connector housing between a closed position and an open position. The CPA device has two locking arms being configured to be deflectable
- from a rest position to a deflected position. The disclosure further relates to a connector housing having a deflectable cover portion covering a locking zone of the connector housing, which is adapted for locking the connector housing to a corresponding counter connector.

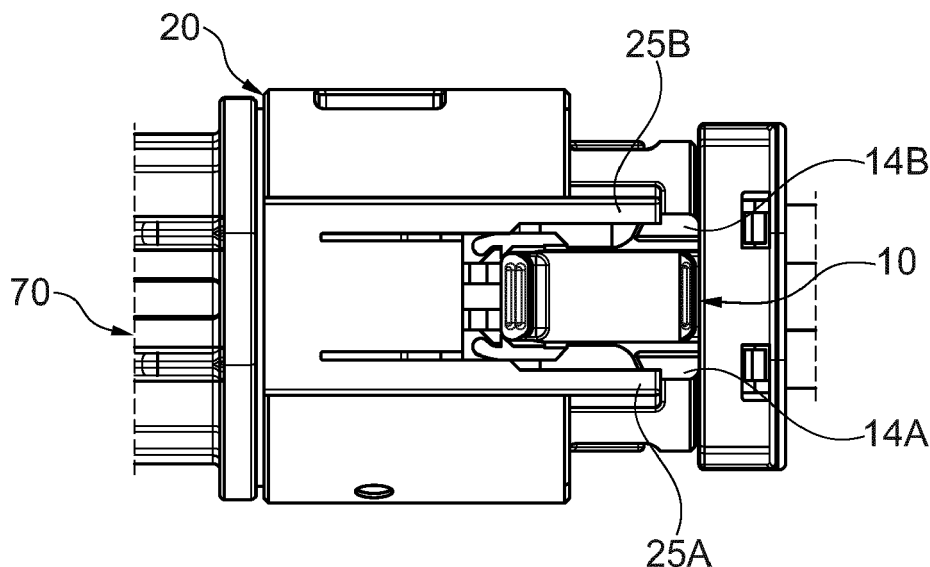


Fig. 11

Description

1. Field of the invention

[0001] The present disclosure relates to an electrical connector system comprising a connector housing and a connector position assurance (CPA) device adapted to be movable along the connector housing between a closed position and an open position.

2. Technical background

[0002] Electrical connector systems are well known in the art. A connector is typically connected with a corresponding counter connector in order to establish an electrical connection between both components.

[0003] Connector position assurance (CPA) devices are often used to ensure that electrical connectors are securely and correctly mated. They are typically used in applications where connector disengagement or incomplete mating could have serious consequences, such as in aerospace or automotive industries. CPA devices may be mated with the connector after the connector is coupled to the corresponding counter connector. Such a CPA device is designed such that a mating to the connector is only possible if the connector is correctly coupled to the corresponding counter connector, i.e. the CPA device cannot be moved from an open position to a closed position if the connector is in an uncoupled or incorrectly coupled condition.

[0004] Fig. 1 illustrates a CPA device 1 according to the prior art. It comprises a longitudinal locking arm 2 with a locking element 3 at its free end. Fig. 2 illustrates the CPA device 1 of Fig. 1 arranged on a connector housing 4. Generally, the CPA device 1 is configured to be moved on the connector housing 4, as is indicated with the arrow in Fig. 2. Movement of the CPA device 1 from the open position illustrated in Fig. 2 to the closed position is blocked, since the locking element 3 of the CPA device 1 is in blocking contact with a blocking nose 5 of the connector housing 4. Only after proper mating with the corresponding counter connector, the locking arm 2 is deflected and the blocking contact between the locking element 3 of the CPA device 1 and the blocking nose 5 of the connector housing 4 is released such that the CPA device 1 can be moved to the closed position in which the locking element 3 of the CPA device 1 is moved past the blocking nose 5 of the connector housing 4.

[0005] The movement of the CPA device 1 from the open position to the closed position requires certain operating space. The connector housing 4 must provide for sufficient large free space along its height allowing for the deflection of the locking arm 2. In a typical prior art system, the clearance allowing for the deflection of the locking arm 2 has a height of more than 2 mm. It is, however, desired to reduce the overall dimensions of electrical connector systems.

[0006] There is thus a need for an improved electrical

connector system which preferably has reduced size and can be easily assembled.

[0007] This and other problems, which may become apparent to the skilled person in view of the present disclosure, are solved by an electrical connector system of claim 1.

3. Summary of the invention

[0008] One aspect of the disclosure relates to an electrical connector system. The electrical connector system comprises a connector and preferably also a corresponding counter connector for establishing an electrical connection between both components, as will be appreciated by the person skilled in the art. The connector may be a H-MTD ("HighSpeed Modular Twisted-Pair Data") connector, for example a female H-MTD connector. H-MTD transmission typically requires very tight tolerances, usually tighter than the ones required for the transmission of standard signals.

[0009] The connector comprises a connector housing and a connector position assurance (CPA) device adapted to be movable along the connector housing between a closed position and an open position. The connector housing may encompass a terminal carrier and/or the electrical terminal(s). The connector housing may have an elongated form with a longitudinal direction along which it may receive one or more straight electrical terminals.

[0010] The CPA device may be arranged at least partially on the outer surface of the connector housing, such that it is accessible from the outside. The CPA device may have one or more grip surfaces, which may allow for an operator to move the CPA device between the open and closed positions. For moving the CPA device between the open and closed positions, the CPA device may be moved along the mating direction of the connector. The mating direction of the connector may correspond to the elongated dimension of the connector housing. The mating direction of the connector may correspond to the longitudinal direction along which the connector housing is adapted to receive one or more straight electrical terminals. Thus, in the closed position, the CPA device may be located closer to the mating opening of the connector housing, compared to the open position.

[0011] The electrical connector system may be configured such that, when the connector is not correctly coupled to the corresponding counter connector, movement of the CPA device from the open position to the closed position is blocked. On the other hand, the electrical connector system may be configured such that, when the connector is correctly coupled to the corresponding counter connector, movement of the CPA device from the open position to the closed position is enabled. In the closed position, the CPA device may lock the connector to the corresponding counter connector, blocking unmating of the connector with the corresponding counter connector. In the open position, the CPA device may not lock

mating or unmating of the connector with the corresponding counter connector.

[0012] The CPA device has two locking arms extending along a mating direction of the connector housing and configured to be deflectable away from each other from a rest position to a deflected position. The locking arms may have an elongated form which may extend along the mating direction of the connector. Each of the two locking arms is configured such that it can be deflected in a direction away from the other locking arm. If not deflected, the locking arms are in the rest position.

[0013] When the locking arms are in the rest position, a blocking abutment of the locking arms with the connector housing prevents movement of the CPA device from the open position to the closed position. Thus, in this configuration, the locking arms may be in contact with the connector housing such that the CPA device cannot be moved from the open position to the closed position. For example, a blocking means of the locking arms may engage a corresponding blocking means of the connector housing when trying to move the CPA device from the open position to the closed position.

[0014] When the locking arms are deflected to the deflected position, the blocking abutment of the locking arms with the connector housing is released allowing a movement of the CPA device from the open position to the closed position. Thus, in this configuration, movement of the CPA device from the open position to the closed position is preferably not blocked by any interplay between the CPA device and the connector housing, and the CPA device may be freely moved from the open position to the closed position. For example, by deflecting the locking arms to the deflected position, the blocking means of the locking arms are not engaging the corresponding blocking means of the connector housing when moving the CPA device from the open position to the closed position.

[0015] The inventors have found that by configuring the locking arms such that they are deflectable away from each other, i.e. by providing locking arms deflecting side-wards, a planar CPA can be provided for which requires less operating space. Particularly, the height of the connector can be reduced, thereby reducing the overall dimensions of the electrical connector system.

[0016] Preferably, the connector system is a linear system in which the mating direction of the connector housing, the movement direction of the CPA device between the open and closed positions, and the insertion direction of a terminal and/or electrical terminal to the connector housing are parallel to each other.

[0017] Preferably, the lateral deflection of each arm between the rest position and the deflected position is in the range of 0.4-1.4 mm, further preferred in the range of 0.6-1.2 mm, further preferred in the range of 0.8-1.0 mm.

[0018] Preferably, each locking arm of the CPA device comprises a rounded bead at the end of the arm, and a blocking wedge on the inner side of the locking arm facing

towards the other locking arm. Preferably, the blocking wedge has a blocking face facing the mating direction. The rounded beads may interact with corresponding means provided on the counter connector such that, when the counter connector is mated with the connector, the locking arms are being deflected. The rounded beads may thus be configured such that they may be engaged to deflect the locking arms. The blocking wedge may be configured such that it provides for the blocking abutment with the connector housing when the locking arms are in the rest position and the CPA device is moved from the open position towards the closed position. The blocking abutment, however, hinders the CPA device from reaching the closed position. In this context, the blocking face of the blocking wedge may engage a corresponding blocking surface of the counter connector housing.

[0019] Preferably, the system further comprises a counter connector housing, e.g. of the corresponding counter connector. The counter connector housing preferably comprises deflection guide means configured to urge a movement of the locking arms of the CPA device from the rest position to the deflected position upon mating the connector housing with the counter connector housing. For example, when the CPA device is in the rest position and the counter connector housing is being mated with the connector housing, the deflection guide means may come into contact with the locking arms of the CPA device, preferably with the rounded beads at the end of the arms, and urge the locking arms to deflect away from each other. In this manner, the blocking abutment of the locking arms with the connector housing is preferably released. Accordingly, when the locking arms are deflected to the deflected position and the blocking abutment is released, the CPA device can be moved from the open position to the closed position, in which it locks the connector housing to the counter connector housing.

[0020] Preferably, the CPA device comprises a retaining element, wherein the retaining element of the CPA device is in blocking abutment with a stopping face of the connector housing when the CPA device is in the open position preventing removal of the CPA device from the connector housing along a longitudinal direction of the connector housing. The longitudinal direction of the connector housing may be parallel to the (un)mating direction of the system. Preferably, the CPA device is in the open position when the retaining element of the CPA device is in blocking abutment with the stopping face of the connector housing. Thus, when moving the CPA device from the closed position to the open position, the blocking abutment limits further longitudinal movement of the CPA device, and prevents an unwanted removal of the CPA device from the connector housing.

[0021] In a preferred embodiment, the connector housing comprises a longitudinally extending guide portion at least partially supporting the CPA device. The CPA device may at least partially be provided on the guide portion in a movable manner. The guide portion may be adapted to allow for the movement of the CPA device from the

open position to the closed position. The guide portion may be adapted to guide the movement of the CPA device between the open position and the closed position. The guide portion may have an elongated form extending along the main movement direction of the CPA device. The provision of the longitudinally extending guide portion may facilitate handling of the electrical connector system, particularly the operation of the CPA device.

[0022] Preferably, the guide portion comprises two counter blocking wedges protruding outwardly away from each other. Preferably, each counter blocking wedge has a blocking face facing opposite to the mating direction. The counter blocking wedges may interact with the blocking wedges of the CPA device to block movement of the CPA device from the open position to the closed position. For example, when the locking arms are in the rest position, the counter blocking wedges of the guide portion, preferably the blocking faces of the counter blocking wedges, may come into blocking abutment with the locking arms (preferably with the blocking faces of the blocking wedges of the locking arms) to prevent movement of the CPA device from the open position to the closed position. When the locking arms are in the deflected position, the blocking faces of the counter blocking wedges may be released from the locking arms, allowing for movement of the CPA device from the open position to the closed position. This allows for a secure CPA functionality of the CPA device.

[0023] Preferably, the CPA device comprises a main body accessible from outside and two side bodies extending from the main body, wherein the main body and the side bodies encompass the geode portion of the connector housing at least partially, and wherein the locking arms are arranged separately on the side bodies. The side bodies of the CPA device may extend away from the main body such that the CPA device has a U-shaped cross section. This U-shaped cross section may be dimensioned such that it receives the guide portion of the connector housing at least partially. In this manner, a secure alignment of the CPA device to the guide portion can be provided for.

[0024] Preferably, the side bodies of the CPA device comprise two opposite snap protrusions configured to prevent removal of the CPA device from the counter housing along a vertical direction of the connector housing. When trying to remove the CPA device along the vertical direction, i.e. lifting the CPA device away from the connector housing, the snap protrusions of the CPA device may engage respective portions of the connector housing to block the removal of the CPA device. This provides for a secure fixation of the CPA device to the connector housing.

[0025] Preferably, the side bodies are pivotable connected to the main body such that upon assembly of the CPA device to the connector housing, the side bodies pivot around a longitudinal axis of the connector housing and allowing for the snap protrusions to move past the guide portion of the connector housing. When attaching

the CPA device to the connector housing, the side bodies may come into contact with the connector housing. Preferably, the snap protrusions of the side bodies may engage the connector housing such that the side bodies are urged away from each other so that the snap protrusions can move past the guide portion of the connector housing. Once having moved past the guide portion, the side bodies may snap back, and the snap protrusions may reach being the guide portion of the connector housing preventing removal of the CPA device from the connector housing along the vertical direction. In this manner, a snap lock mechanism may be provided for. This may facilitate assembly of the connector system.

[0026] Preferably, the guide portion is arranged deflectable around a lateral axis of the connector housing between an idle position and a twisted position. The lateral axis may be perpendicular to the mating direction. In the idle position, the guide portion (and preferably the main movement direction of the CPA device supported by the guide portion) may be aligned parallel to the mating direction. In the twisted position, however, the alignment may not be parallel any longer. Preferably, when the guide portion is in the idle position, a first free end of the guide portion facing the mating opening of the connector housing is adapted to come into blocking contact with a counter connector housing mated with the connector housing. This blocking contact may prevent unmating of the counter connector housing. Preferably, when the guide portion is in the twisted position, the blocking contact of the first free end of the guide portion with the counter connector housing is released. Thus, the guide portion of the connector housing provide for a locking function to the counter connector housing. In order to unmate the connector system, the guide portion is to be deflected to the twisted position in which the locking function is released. Preferably, in order to deflect the guide portion, an operator may press on the CPA device being in the open position causing the guide portion supporting the CPA device to deflect to the twisted position. In this manner, a secure handling of the connector system is provided for.

[0027] Preferably, the guide portion has a second free end opposite of the first free end, wherein the guide portion is supported by a twistable bridge portion at a position between the two free ends. Thus, deflection of the guide portion causes a rocking movement of the guide portion: Urging the second free end downwards will cause the first end to move upwards. Preferably, the second free end of the guide portion is covered by the CPA device in the open position. Thus, in order to move the second end, the operator will have to act on the CPA device. Preferably, vertically pressing onto the CPA device in the open position urges the guide portion to deflect. Vertically pressing onto the CPA device in the open position may cause a pivotal movement of the CPA device and of the guide portion: The second end of the guide portion is urged downwards along the vertical direction, i.e. towards the center of the connector housing, such that the

first end of the guide portion moves upward along the vertical direction, i.e. away from the center of the connector housing. This facilitates easy handling of the connector system.

[0028] Preferably, when the guide portion is deflected from the idle position to the twisted position, the first free end of the guide portion is deflected by 0.7-1.2 mm, further preferred by 0.8-1.1 mm, further preferred by 0.9-1.0 mm. This movement may be such that a locking function of the connector housing (e.g. of the guide portion) to the counter connector housing is released.

[0029] Preferably, the connector housing further comprises a deflectable cover portion covering the first free end of the guide portion in the idle position. The cover portion may cover and protect the lock of the connector housing (e.g. the guide portion) to the counter connector housing. Preferably, the cover portion has a deflectable end pointing away from the mating opening of the connector housing. For example, the cover portion may be essentially rectangular with only one side thereof linked to the remainder of the connector housing, this side being opposite to the deflectable end of the cover portion. Preferably, when the guide portion is deflected from the idle position to the twisted position, the deflectable cover is contacted by the guide portion and urged to deflect allowing for the guide portion to reach the twisted position. Thus, when deflecting the guide portion, the cover is being deflected as well. The deflection of the cover may provide room for the full deflection of the guide portion from the idle position to the twisted position to release the counter connector housing. By providing for the deflectable cover, the overall size of the connector system can be reduced.

[0030] Preferably, the cover portion comprises a laterally extending hook adapted to come into blocking contact with a blocking protrusion of the connector housing limiting deflection of the cover such that the deflectable end of the cover is preferably adapted to deflect by at most 0.5-1.0 mm, further preferred by at most 0.6-0.9 mm, further preferred by at most 0.7-0.8 mm. Thus, the connector system is arranged such that the cover can only be deflected by a defined amount, enabling release of the lock of the guide portion to the counter connector housing while reducing the risk of damaging the cover during operation.

[0031] Preferably, the CPA device comprises tabs separate from the locking arms. These tabs may extend laterally from the CPA device, i.e. in a direction perpendicular to the movement direction of the CPA device between the open and closed positions. Preferably, when the CPA device is in the closed position, the tabs are in blocking abutment with the connector housing preventing a pivotal movement of the CPA device relative to the connector housing. For example, the tabs may be at least partially covered by the connector housing such that the CPA device cannot be pivoted, such that unlocking of the guide portion from the counter connector housing as described above is preferably prevented. Preferably,

when the CPA device is in the open position, the blocking abutment of the tabs with the connector housing is released. With this arrangement, unlocking of the guide portion from the counter connector housing as described above is only enabled with the CPA device in the open position. This improves security of the connector system.

[0032] The person skilled in the art understands that the size reduction of the electrical connector system may particularly be achieved by providing the CPA device with locking arms deflectable sideways, and/or by providing the deflectable cover.

[0033] Accordingly, a further aspect of the present disclosure relates to a connector housing having a deflectable cover portion covering a locking zone of the connector housing, which is adapted for locking the connector housing to a corresponding counter connector. The cover portion may preferably be configured as described above. The cover portion may cover and protect the lock of the connector housing to the counter connector housing, preferably as described above. Preferably, the cover portion has a deflectable end pointing away from the mating opening of the connector housing. For example, the cover portion may be essentially rectangular with only one side thereof linked to the remainder of the connector housing, this side being opposite to the deflectable end of the cover portion. In a preferred embodiment, the connector housing may interact with a CPA device as described above.

[0034] Preferably, the connector housing comprises a (preferably longitudinally extending) guide portion which may further preferred be configured for supporting a CPA device at least partially. The guide portion and/or the CPA device may preferably be configured as described above. The CPA device may at least partially be provided on the guide portion in a movable manner, and the guide portion may be adapted to allow for the movement of the CPA device from the open position to the closed position. Preferably, the guide portion is arranged deflectable around a lateral axis of the connector housing between an idle position and a twisted position. When the guide portion is deflected from the idle position to the twisted position, the deflectable cover is contacted by the guide portion and urged to deflect allowing for the guide portion to reach the twisted position. The deflection of the cover may provide room for the full deflection of the guide portion from the idle position to the twisted position to release the counter connector housing, preferably as described above.

[0035] A further aspect of the present disclosure relates to the use of an electrical connector system as described above. As will be appreciated by the person skilled in the art, a method of using such electrical connector system may comprise providing the connector housing with the CPA device in the open position, coupling the connector housing to a counter connector housing, and moving the CPA device to the closed position. The method may alternatively or further comprise moving the CPA device to the open position, pushing on the CPA

device to cause a pivotal movement of the guide portion to release the lock of the guide portion with the counter connector housing, and uncoupling the counter connector housing from the connector housing.

4. Description of preferred embodiments

[0036] In the following the present invention is described with reference to the accompanying figures. In the figures, similar elements are provided with the same reference signs.

Fig. 1 illustrates a CPA device according to the prior art;

Fig. 2 illustrates a cross section of the CPA device of Fig. 1 arranged on a connector housing according to the prior art;

Fig. 3 illustrates individual components of an electrical connector system according to an embodiment of the invention;

Fig. 4 illustrates a CPA device according to an embodiment of the invention;

Fig. 5 illustrates a connector housing according to an embodiment of the invention;

Fig. 6 illustrates four different configurations of an electrical connector system according to an embodiment of the invention;

Fig. 7 illustrates an electrical connector system according to an embodiment of the invention;

Fig. 8 illustrates a counter connector housing according to an embodiment of the invention;

Fig. 9 illustrates the interplay of various components of an electrical connector system according to an embodiment of the invention;

Fig. 10 illustrates the interplay of various components of the electrical connector of Fig. 9 in a different configuration;

Fig. 11 illustrates the electrical connector system of Fig. 7 in a different configuration;

Fig. 12 illustrates the interplay of various components of the electrical connector system of Fig. 9 in a different configuration;

Fig. 13 illustrates a section of a connector housing according to an embodiment of the invention;

Fig. 14 illustrates a cross section of an electrical connector system according to an embodiment of the invention;

Fig. 15 illustrates a cross section of the electrical connector system of Fig. 14 in a different configuration.

[0037] Fig. 3 illustrates an electrical connector system in a pre-assembled configuration. The system comprises a CPA device 10, a connector housing 20, a sealing element 30, a terminal carrier 40, electrical terminals 50 (e.g. H-MTD terminals), and a terminal position assurance (TPA) device 60. Preferably, the insertion direction of the electrical terminals 50 into the terminal carrier 40

is parallel to the insertion direction of the terminal carrier 40 into the connector housing 20, which is preferably parallel to the principal movement direction of the CPA device 10 between the open and closed positions when mounted to the connector housing 20, which is preferably parallel to the mating direction of the connector housing 20 to a corresponding counter connector housing.

[0038] Fig. 4 illustrates a CPA device 10 according to an embodiment of the invention, corresponding to that illustrated in Fig. 3. The CPA device 10 has an elongated form, and is mirror-symmetric about its longitudinal axis. The CPA device 10 comprises two locking arms 11A, 11B extending along the longitudinal axis of the CPA device 10. The locking arms 11A, 11B can be deflected away from each other from a rest position (shown in Fig. 4) to a deflected position. Each locking arm 11A, 11B comprises a rounded bead 13A, 13B at its end, and a blocking wedge 12A, 12B on the inner side of each locking arm 11A, 11B facing towards the other locking arm 11A, 11B. Further, the CPA device 10 comprises two tabs 14A, 14B, which are laterally extending from the CPA device 10.

[0039] Fig. 5 illustrates the electrical connector system of Fig. 3 in a semi-assembled configuration, in which the CPA device 10 has not been assembled to the connector housing 20. The connector housing 20 comprises a longitudinally extending guide portion 21. The guide portion 21 is in the idle position and thus oriented parallel to the mating direction of the connector housing 20. The guide portion 21 comprises two counter blocking wedges 24A, 24B protruding outwardly away from each other. Further, the connector housing 20 comprises a deflectable cover portion 22 comprising two laterally extending hooks (only one such hook 23 is visible in Fig. 5). The cover portion 22 has a free end 26 point away from the mating opening of the connector housing 20, i.e. the free end 26 is pointing towards the rear end of the connector housing 20.

[0040] Fig. 6 illustrates a cross-section of four different configurations of the electrical connector system of Fig. 3 during assembly of the CPA device 10 to the connector housing 20. The CPA device 10 comprises a main body 15 and two side bodies 16A, 16B extending from the main body 15 such that the CPA device 10 has a generally U-shaped cross-section. Each one of the side bodies 16A, 16B comprises one of the two locking arms 11A, 11B. Further, each one of the side bodies 16A, 16B comprises a snap protrusion 17A, 17B. The snap protrusions 17A, 17B are provided on the inner side of the CPA device 10 such that they face each other. The CPA device 10 further comprises a retaining element 19 on the main body 15 which, when the CPA device is fully coupled to the connector housing 20, prevents removal of the CPA device 10 from the connector housing 20 along the longitudinal direction of the connector housing 20.

[0041] In a first step (a), the CPA device 10 is arranged on top of the connector housing 20. The snap protrusions 17A, 17B are contacting the guide portion 21 of the connector housing 20.

[0042] In a second step (b), the CPA device 10 is being pushed downwards, i.e. onto the connector housing 20. The interplay of the snap protrusions 17A, 17B with the guide portion 21 causes the side bodies 16A, 16B to pivot around the longitudinal axis of the CPA device 10.

[0043] In a third step (c), the CPA device 10 is further pushed on the connector housing 20. The snap protrusions 17A, 17B of the pivoted side bodies 16A, 16B slide downwards along the guide portion 21.

[0044] In a fourth step (d), the snap protrusions 17A, 17B have moved past the guide portion 21 such that the side bodies 16A, 16B snap back to their original configuration. The snap protrusions 17A, 17B are reaching at least partially around the guide portion 21 preventing an upward removal of the CPA device 10, i.e. a removal along the vertical direction of the connector housing 20. Further, a removal along the longitudinal direction of the connector housing 20 is prevented by a blocking abutment of the retaining element 19 with a stopping face of the guide portion 21 of the connector housing 20.

[0045] Fig. 7 illustrates the electrical connector system of Fig. 3 in the assembled configuration. The CPA device 10 is attached to the connector housing 20, in the manner as described above with reference to Fig. 6. The CPA device 10 can principally be moved along the longitudinal direction or overall mating direction of the connector housing 20, as is indicated with the arrow in Fig. 7. In the configuration illustrated in Fig. 7, the CPA device 10 is in the open position. In this configuration, the blocking wedges 12A, 12B of the CPA device 10 are in blocking abutment with counter blocking wedges 24A, 24B of the connector housing. Movement of the CPA device 10 from the open position to the closed position, i.e. moving the CPA device 10 towards the mating opening of the connector housing 20 (i.e. to the left in Fig. 7), is prevented due to the blocking abutment. Moving the CPA device 10 to the closed position is only possible after proper mating of the connector housing 20 with a corresponding counter connector housing.

[0046] Fig. 8 illustrates a counter connector housing 70 which is adapted for mating with the connector housing 20 of Fig. 7. In Fig. 8, the mating opening of the counter connector housing 70 is on the right side, which is adapted for insertion into the mating opening of the connector housing 20. On the outer circumference of the counter connector housing 70, there are provided deflection guide means in the form of two protrusions 71A, 71B. The protrusions 71A, 71B are configured to urge a movement of the locking arms 11A, 11B of the CPA device 10 from the rest position to the deflection position upon mating the connector housing 20 with the counter connector housing 70, as will be described with reference to Fig. 9. The protrusions 71A, 71B are provided such that upon insertion of the counter connector housing 70 into the connector housing 20, each protrusion 71A, 71B comes into contact with a rounded bead 13A, 13B of the CPA device 10. The protrusions 71B, 71B have a form of a parallelogram, with two sides being parallel to the mating

direction and two sides being parallel to the wedged surfaces of the blocking wedge 12B and of the counter blocking wedge 24B.

[0047] Fig. 9 illustrates the interplay of one protrusion 71B of the counter connector housing 70 with one locking arm 11B of the CPA device 10, when mating the counter connector housing 70 with the connector housing 20. As will be appreciated by the skilled person, the following description similarly applies to the interplay of the other protrusion 71A with the other locking arm 11A.

[0048] Upon mating of the counter connector housing 70 with the connector housing 20, i.e. when inserting the counter connector housing 70 into the connector housing 20, the protrusion 71B comes into contact with the rounded bead 13B of the locking arm 11B. Upon further insertion of the counter connector housing 70 into the connector housing 20, the protrusion 71B pushes the rounded bead 13B outwardly, causing the locking arm 11B to deflect outwardly. This deflection is illustrated by means of a dashed line in Fig. 9. When the locking arm 11B has been sufficiently deflected allowing for the protrusion 71B to move past the rounded bead 13B and allowing for the blocking wedge 12B of the locking arm 11B to move past the counter blocking wedge 24B of the connector housing 20, the locking arm 11B is in the deflected position. The counter connector housing 70 can be fully inserted into the connector housing 20 to reach the fully mated position, in which the protrusion 71B of the counter connector housing 70 abuts the wedged surface of the blocking wedge 24B of the connector housing 20.

[0049] In the deflected position of the locking arm 11B, the blocking abutment of the blocking wedge 12B of the CPA device 10 with the counter blocking wedge 24B of the connector housing is released. Accordingly, the CPA device 10 can now be moved to the closed position.

[0050] Fig. 10 illustrates the system of Fig. 9 in a different configuration, in which the CPA device 10 is in the locked position. After proper mating of the counter connector housing 70 with the connector housing 20, causing deflection of the locking arm 11B to reach the deflected position (cf. Fig. 9), the CPA device 10 is moved to the closed position in which the blocking wedge 12B is moved past the counter blocking wedge 24B of the connector housing 20 and past the protrusion 71B of the counter connector housing 70 such that the locking arm 11B deflects back to the rest position. Further movement of the CPA device 10 is blocked by abutment of the counter blocking wedge 24B with a stop face 18B of the CPA device 10.

[0051] Fig. 11 illustrates the electrical connector system of Fig. 7 in which the connector housing 20 is fully mated with the counter connector housing 70 and in which the CPA device 10 is in the closed position. As can be seen from Fig. 11, in the closed position, the tabs 14A, 14B of the CPA device 10 are at least partially covered by projections 25A, 25B of the connector housing 20. This prevents a pivotal movement of the CPA device 10 as will be described further below.

[0052] Fig. 12 illustrates the interplay of the protrusion 71B of the counter connector housing 70 with the locking arm 11B of the CPA device 10 when moving the CPA device 10 from the closed position to the open position to allow for unmating the counter connector housing 70 from the connector housing 20. When moving the CPA device 10 to the open position, the wedged surface of the blocking wedge 12B of the locking arm 11B slips along the protrusion 71B of the counter connector housing 70 causing the locking arm 11B to deflect outwardly. When the locking arm 11B has been sufficiently deflected outwardly, allowing for the blocking wedge 12B to move past the protrusion 71B and the counter blocking wedge 24B, the CPA device 10 can be retracted to the open position.

[0053] Fig. 13 illustrates a section of the connector housing 20 of Fig. 5, with a focus on the laterally extending hook 23 of the deflectable cover 22. Deflection of the cover 22 outwardly, i.e. upwards in Fig. 13, is limited by interplay of the hook 23 with a blocking protrusion 27 of the connector housing 20. The clearance between the hook 23 and the blocking protrusion 27 is 0.72 mm, such that the free end 26 of the cover 22 can be deflected by 0.72 mm.

[0054] Fig. 14 illustrates a cross section of the electrical connector system of Fig. 11, with the CPA device 10 being in the open position. The counter connector housing 70 is fully mated to the connector housing 20. In this configuration, a first free end 211 of the guide portion 21 facing the mating opening of the connector housing 20 is in blocking contact with a locking wedge 72 of the counter connector housing 70. In this manner, the counter connector housing 70 is locked to the connector housing 20.

[0055] Opposite to the first free end 211, the guide portion 21 has a second free end 212 which is covered by the CPA device 10 being in the open position. The guide portion 21 is supported by a twistable bridge portion 28 allowing for deflecting the guide portion 21 around a lateral axis of the connector housing 20. In the configuration illustrated in Fig. 14, the guide portion is not deflected and thus in the idle position. The space between the first free end 211 of the guide portion 21 and the cover 22 is in the range of 0.8 mm, and thus less than the space required with typical prior art systems (e.g. of more than 2.0 mm).

[0056] Fig. 15 illustrates the system of Fig. 14 during release of the lock between the connector housing 20 and the counter connector housing 70. In order to release this lock, an operator may press onto the rear end of the CPA device 10 causing the guide portion 21 to perform a pivotal movement such that the second free end 212 moves downwards or towards the center of the connector housing 20 and the first free end 211 moves upwards or outwardly. In the twisted position of the guide portion 21, the first free end 211 is released from the locking wedge 72 of the counter connector housing 70, as illustrated by the dashed lines in Fig. 15. When the guide portion 21

is deflected from the idle position to the twisted position, the deflectable cover 22 is contacted by the first free end 211 of the guide portion 21 and urged to deflect, allowing for the guide portion 21 to reach the twisted position in which the lock between the connector housing 20 and the counter connector housing 70 is released. After the counter connector housing 70 has been removed from the connector housing 20, the operator can release the CPA device 10 such that the guide portion 21 can return to the idle position, also causing the cover 22 to return to its undeflected state.

Claims

1. An electrical connector system, comprising:

a connector housing (20);
a connector position assurance, CPA, device (10) adapted to be movable along the connector housing (20) between a closed position and an open position;
the CPA device (10) having two locking arms (11A, 11B) extending along a mating direction of the connector housing (20) and being configured to be deflectable away from each other from a rest position to a deflected position;
wherein, when the locking arms (11A, 11B) are in the rest position, a blocking abutment of the locking arms (11A, 11B) with the connector housing (20) prevents movement of the CPA device (10) from the open position to the closed position;
wherein, when the locking arms (11A, 11B) are deflected to the deflected position, the blocking abutment of the locking arms (11A, 11B) with the connector housing (20) is released allowing a movement of the CPA device (10) from the open position to the closed position.

2. The system of claim 1, wherein each locking arm (11A, 11B) of the CPA device (10) comprises:

a rounded bead (13A, 13B) at the end of the arm (11A, 11B);
a blocking wedge (12A, 12B) on the inner side of the locking arm (11A, 11B) facing towards the other locking arm (11A, 11B);
wherein the blocking wedge (12A, 12B) has a blocking face facing the mating direction.

3. The system of claim 1 or 2, further comprising a counter connector housing (70), the counter connector housing (70) comprising:

deflection guide means (71A, 71B) configured to urge a movement of the locking arms (11A, 11B) of the CPA device (10) from the rest position to the deflected position upon mating the connector hous-

ing (20) with the counter connector housing (70).

4. The system of any preceding claim, wherein the CPA device (10) comprises a retaining element (19), wherein the retaining element (19) of the CPA device (10) is in blocking abutment with a stopping face of the connector housing (20) when the CPA device (10) is in the open position preventing removal of the CPA device (10) from the connector housing (20) along a longitudinal direction of the connector housing (20). 5
5. The system of any preceding claim, wherein the connector housing (20) comprises a longitudinally extending guide portion (21) at least partially supporting the CPA device (10). 10
6. The system of claim 5, wherein the guide portion (21) comprises two counter blocking wedges (24A, 24B) protruding outwardly away from each other, wherein each counter blocking wedge (24A, 24B) has a blocking face facing opposite to the mating direction. 15
7. The system of claim 5 or 6, wherein the CPA device (10) comprises a main body (15) accessible from outside and two side bodies (16A, 16B) extending from the main body (15), wherein the main body (15) and the side bodies (16A, 16B) encompass the guide portion (21) of the connector housing (20) at least partially, and wherein the locking arms (11A, 11B) are arranged separately on the side bodies (16A, 16B). 20
8. The system of claim 7, wherein the side bodies (16A, 16B) comprise two opposite snap protrusions (17A, 17B) configured to prevent removal of the CPA device (10) from the connector housing (20) along a vertical direction of the connector housing (20). 25
9. The system of claim 8, wherein the side bodies (16A, 16B) are pivotable connected to the main body such that upon assembly of the CPA device (10) to the connector housing (20), the side bodies (16A, 16B) pivot around a longitudinal axis of the connector housing (20) and allowing for the snap protrusions (17A, 17B) to move past the guide portion (21) of the connector housing (20). 30
10. The system of any one of claims 5-9, wherein the guide portion (21) is arranged deflectable around a lateral axis of the connector housing (20) between an idle position and a twisted position, 35

wherein, when the guide portion (21) is in the idle position, a first free end (211) of the guide portion (21) facing the mating opening of the connector housing (20) is adapted to come into 40

blocking contact with a counter connector housing (70) mated with the connector housing (20), wherein, when the guide portion (21) is in the twisted position, the blocking contact of the first free end (211) of the guide portion (21) with the counter connector housing (70) is released. 45

11. The system of claim 10, wherein the guide portion (21) has a second free end (212) opposite of the first free end (211), wherein the guide portion (21) is supported by a twistable bridge portion (28) at a position between the two free ends, wherein the second free end (212) of the guide portion (21) is covered by the CPA device (10) in the open position, and wherein vertically pressing onto the CPA device (10) in the open position urges the guide portion (21) to deflect. 50
12. The system of claim 10 or 11, wherein, when the guide portion (21) is deflected from the idle position to the twisted position, the first free end (211) of the guide portion (21) is deflected by 0.7-1.2 mm, preferably by 0.8-1.1 mm, further preferred by 0.9-1.0 mm. 55
13. The system of any one of claims 10-12, wherein the connector housing (20) further comprises a deflectable cover portion (22) covering the first free end (211) of the guide portion (21) in the idle position, wherein the cover portion (22) has a deflectable end (26) pointing away from the mating opening of the connector housing (20), wherein, when the guide portion (21) is deflected from the idle position to the twisted position, the deflectable cover (22) is contacted by the guide portion (21) and urged to deflect allowing for the guide portion (21) to reach the twisted position. 60
14. The system of claim 13, wherein the cover portion (22) comprises a laterally extending hook (23) adapted to come into blocking contact with a blocking protrusion (27) of the connector housing (20) limiting deflection of the cover (22) such that the deflectable end (26) of the cover (22) is preferably adapted to deflect by at most 0.5-1.0 mm, further preferred by at most 0.6-0.9 mm, further preferred by at most 0.7-0.8 mm. 65
15. The system of any one of the preceding claims, wherein the CPA device (10) comprises tabs (14A, 14B) separate from the locking arms (11A, 11B), wherein, when the CPA device (10) is in the closed position, the tabs (14A, 14B) are in blocking abutment with the connector housing (20) preventing a pivotal movement of the CPA device (10) relative to the connector housing (20) and wherein, when the CPA device (10) is in the open position, the blocking abutment of the tabs (14A, 14B) with the connector housing (20) is released. 70

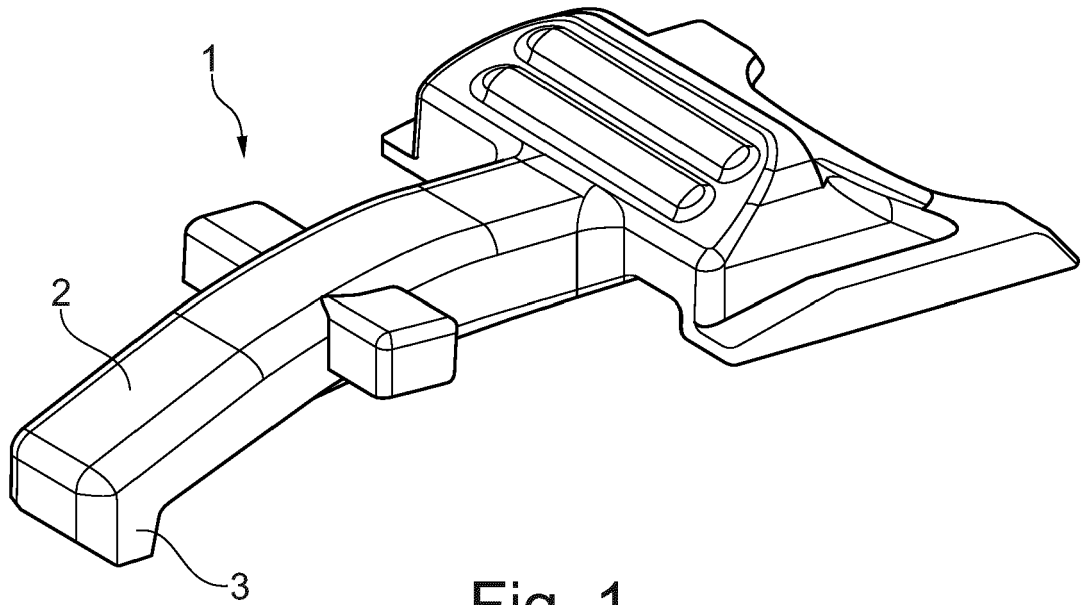


Fig. 1
(prior art)

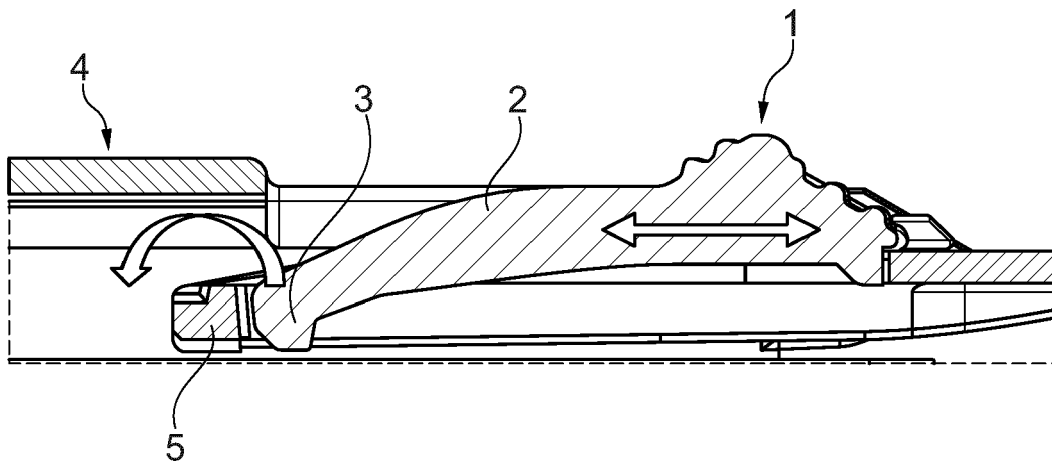


Fig. 2
(prior art)

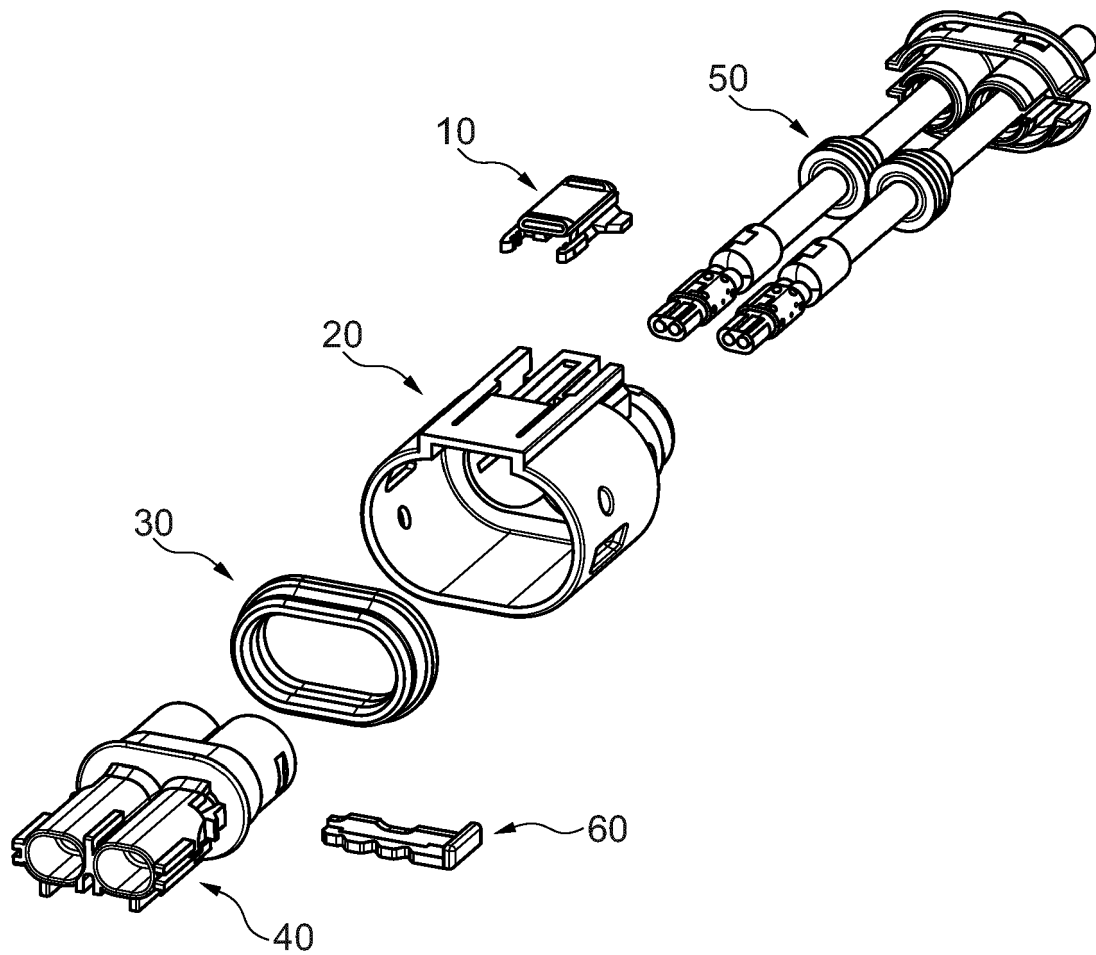


Fig. 3

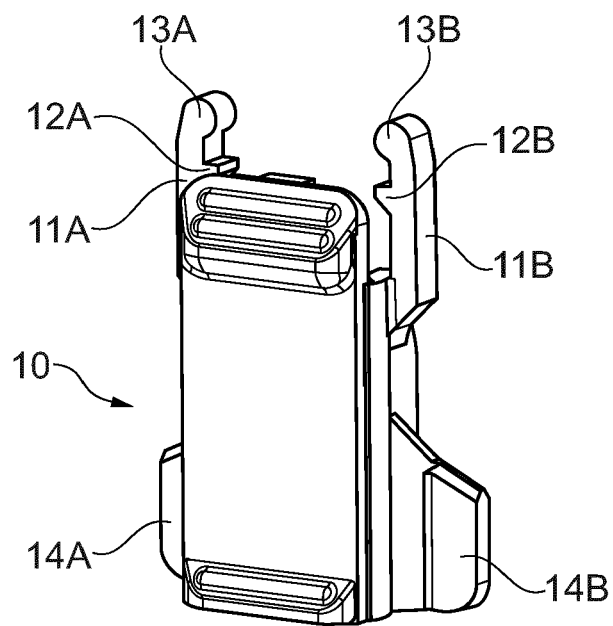


Fig. 4

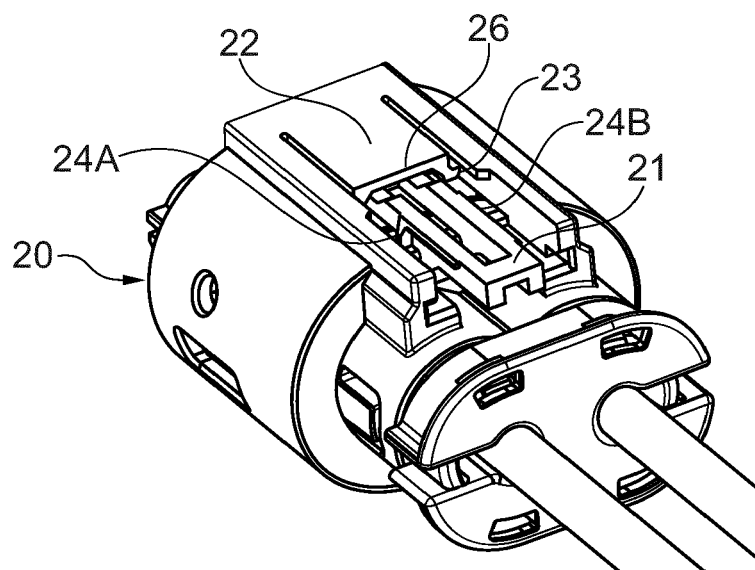


Fig. 5

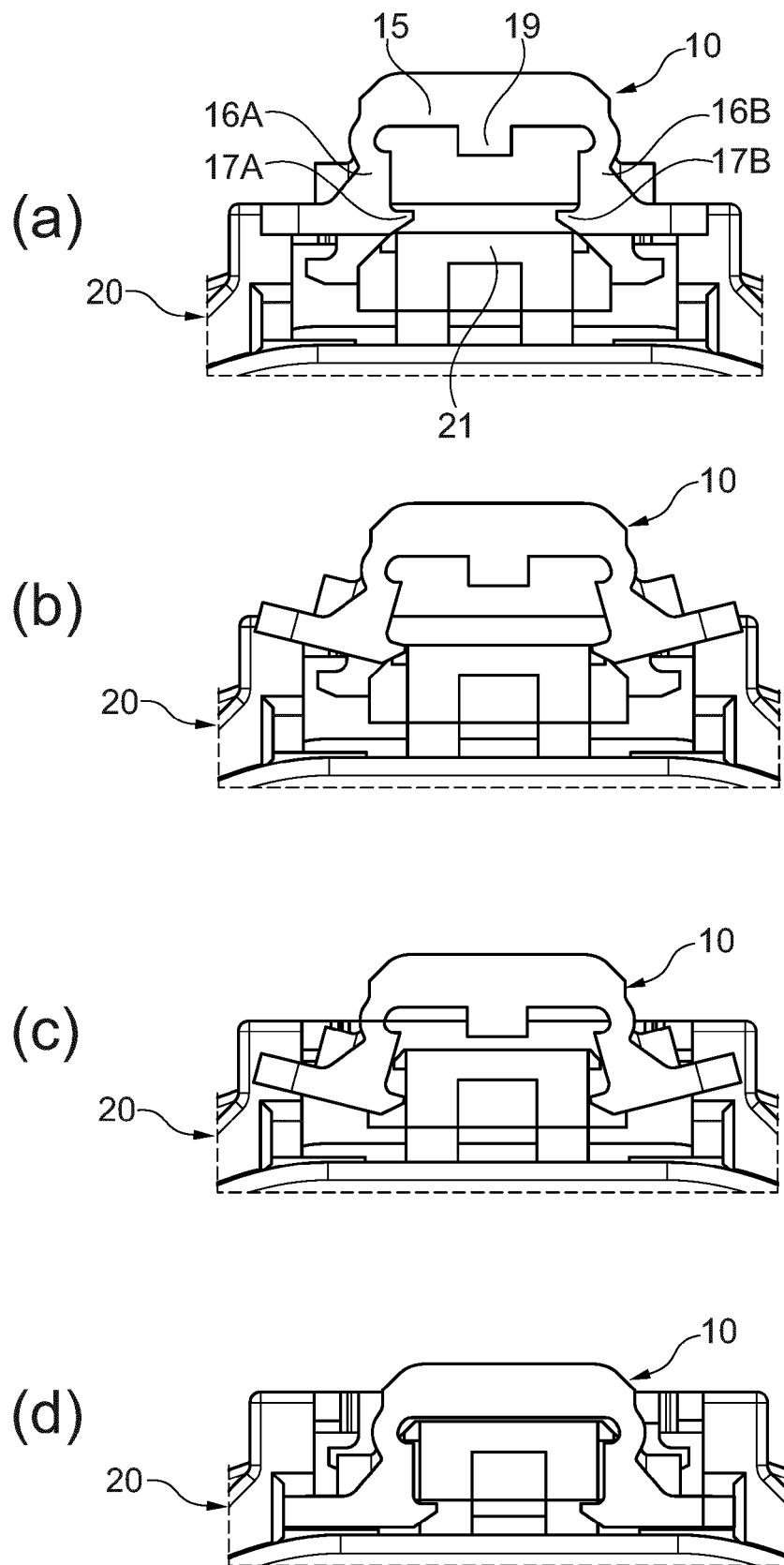


Fig. 6

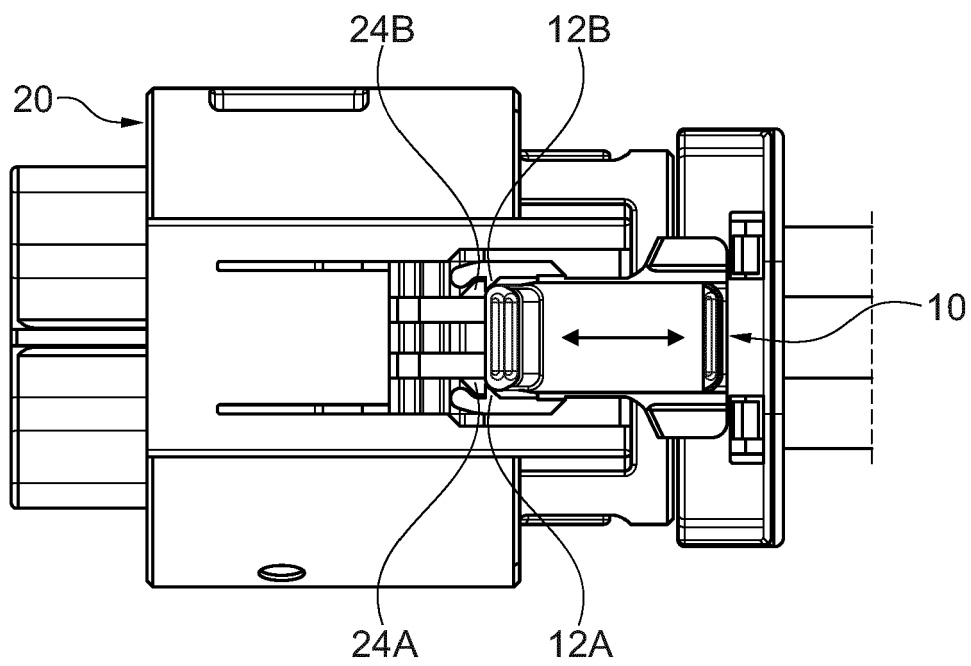


Fig. 7

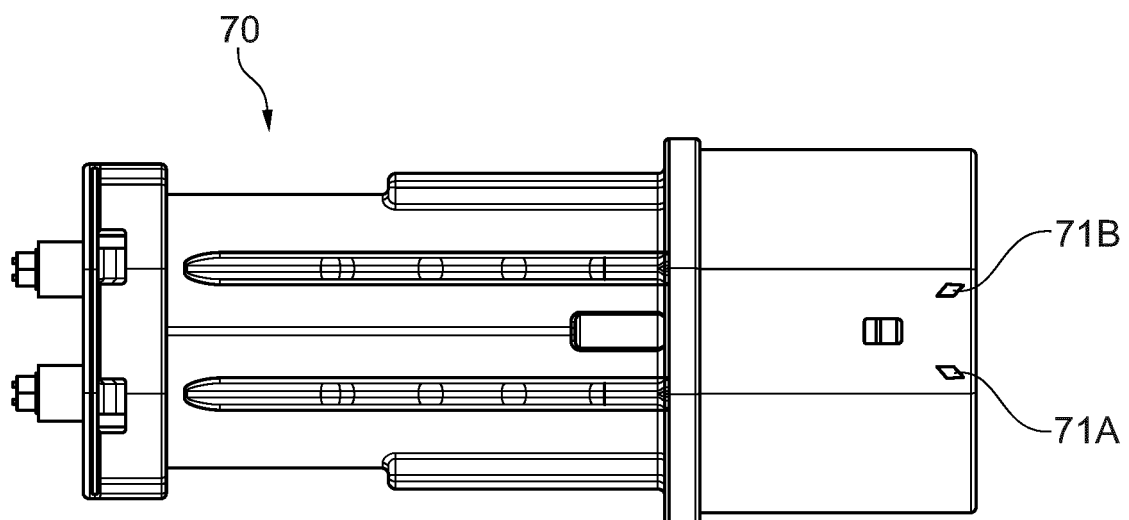


Fig. 8

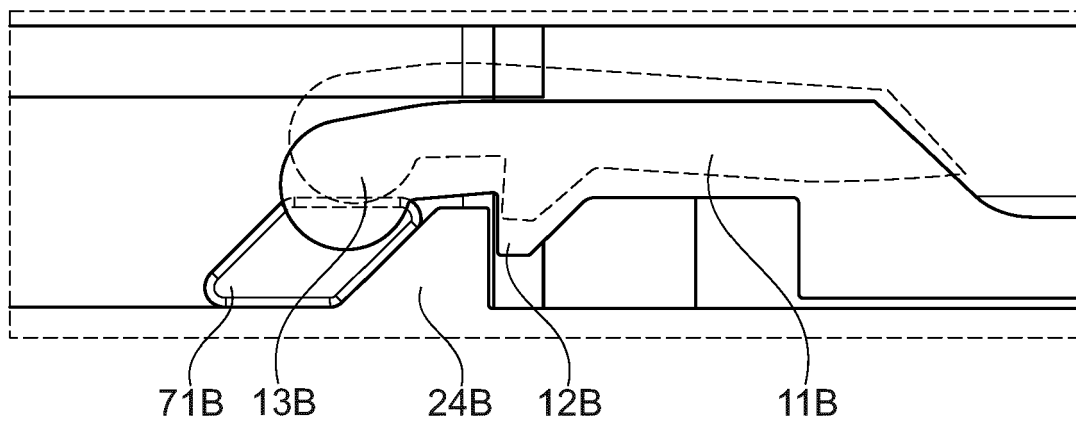


Fig. 9

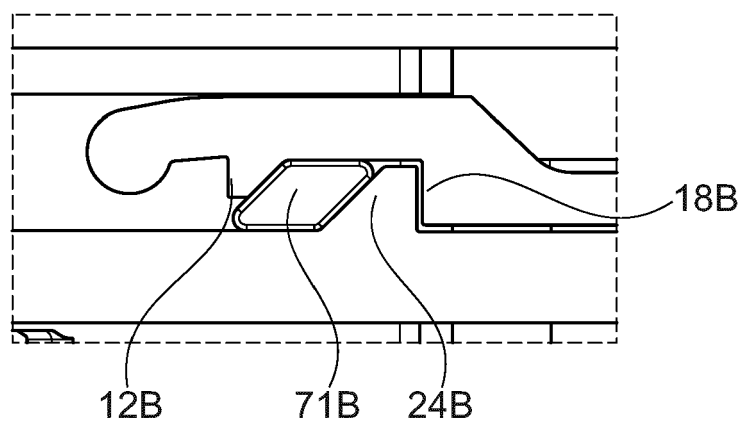


Fig. 10

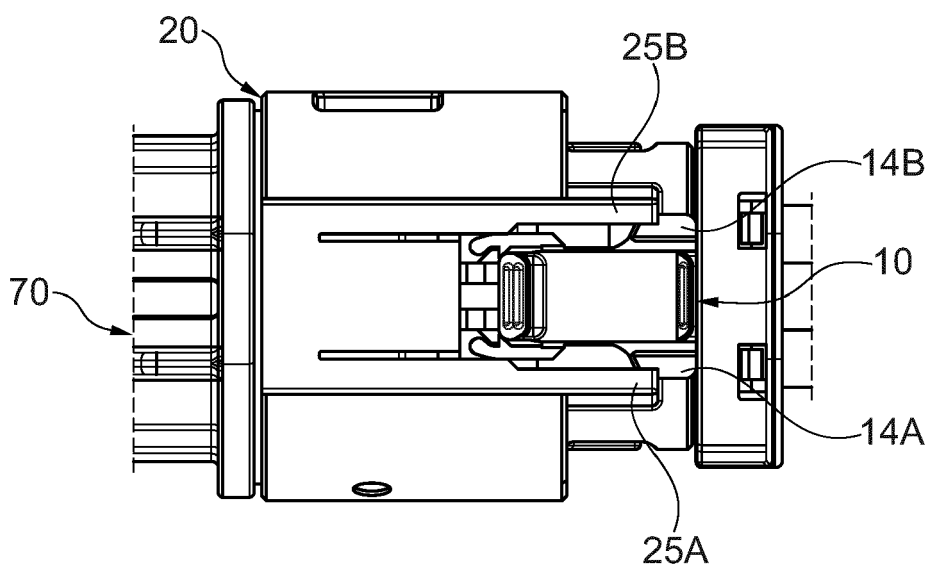


Fig. 11

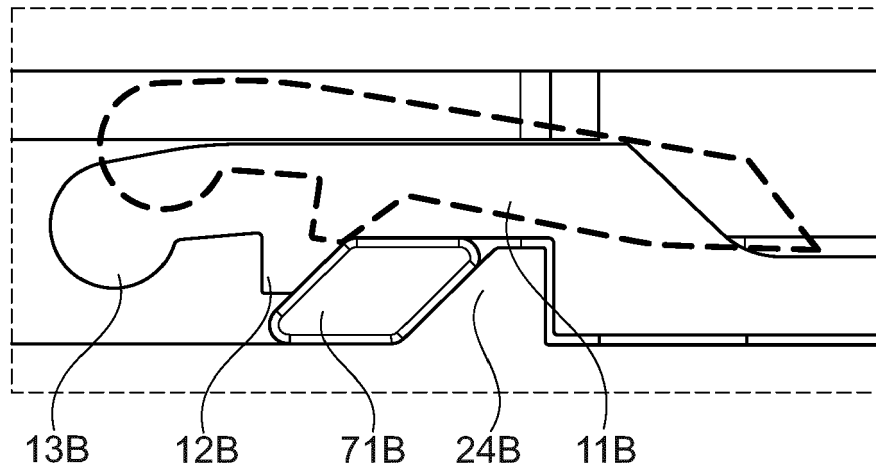


Fig. 12

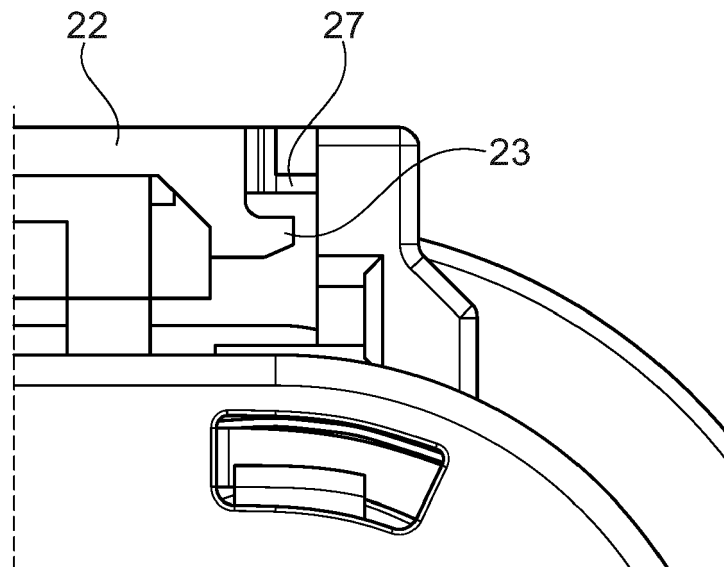


Fig. 13

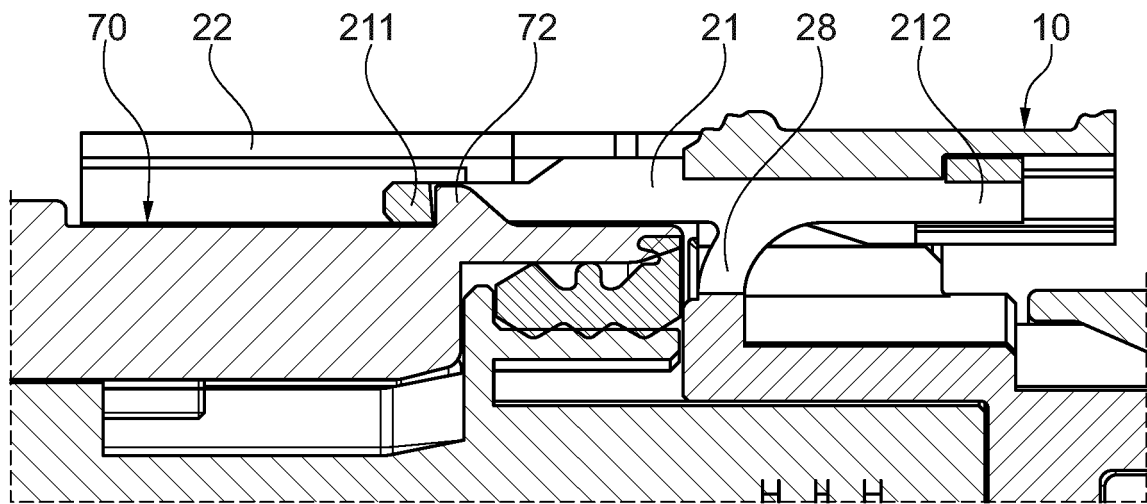


Fig. 14

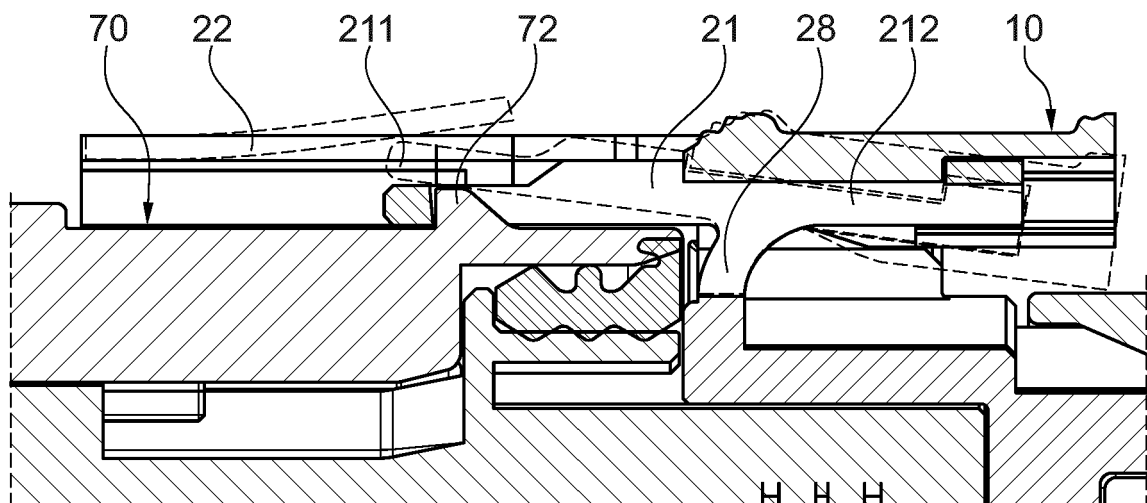


Fig. 15



EUROPEAN SEARCH REPORT

Application Number

EP 23 16 9794

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X	US 2020/153148 A1 (ANNEQUIN SÉBASTIEN [FR] ET AL) 14 May 2020 (2020-05-14)	1-12, 15	INV. H01R13/639
A	* paragraph [0015] - paragraph [0025]; figures 1,2,3, 3B,4A, 4B,4C *	13,14	H01R13/641
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X	US 2016/118741 A1 (SCHMIDT RAINER [DE] ET AL) 28 April 2016 (2016-04-28)	1	
A	* paragraph [0034] - paragraph [0038]; claim 1; figures 3,4,5,6,7 *	10-13	

A	US 6 491 542 B1 (ZEREBILOV ARKADY Y [US]) 10 December 2002 (2002-12-10) * the whole document *	1-15	

			TECHNICAL FIELDS SEARCHED (IPC)
			H01R
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 5 October 2023	Examiner Mateo Segura, C
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	

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

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5 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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05-10-2023

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