

(19)



(11)

EP 4 531 210 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
02.04.2025 Bulletin 2025/14

(51) International Patent Classification (IPC):
H01R 13/506 ^(2006.01)

(21) Application number: **23200258.4**

(52) Cooperative Patent Classification (CPC):
H01R 13/506

(22) Date of filing: **27.09.2023**

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

(72) Inventors:
• **PORTIER, Vincent**
28110 Lucé (FR)
• **MANNE, Ramakrishna**
522257 Pedapulivarru (IN)

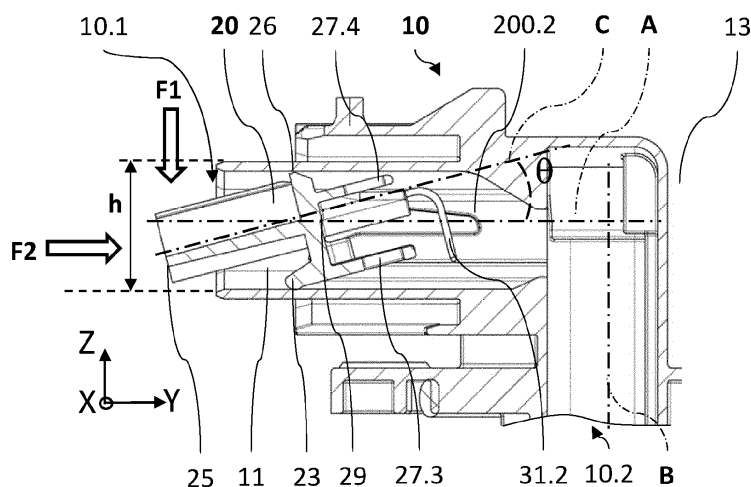
(74) Representative: **INNOV-GROUP**
209 Avenue Berthelot
69007 Lyon (FR)

(71) Applicant: **Aptiv Technologies (2) S.à r.l.**
1882 Luxembourg (LU)

(54) **ANGULAR ELECTRICAL CONNECTOR ASSEMBLY AND ELECTRICAL CONNECTOR COMPRISING SAME**

(57) Integrity of terminals (31.4) and reduction of the space required in a rear cavity (11) of a connector housing (10) are obtained by engaging a terminal holder (20) fitted with the terminals into the cavity with a tilt, and pushing the tilted holder within the cavity in the direction of its longitudinal axis (A). The holder (20) is continuously guided in longitudinal displacement into the cavity (11). The necessary tilt is automatically obtained through guiding means, which can include a lower support-foot (23), an upper contact-head (26) and/or lateral guide-pins of the holder. The tilt is then automatically and smoothly

nullified by way of an upper hook (27.4) sliding down a declining ramp (221.4) which is arranged in the top walls of the cavity (11). Finally, the holder (20) is latched in its operational position. In this position, the longitudinal axis (C) of the holder (20) is aligned with the axis (A) of the cavity (11), and a straight portion (31.2) of the terminals which is angled by 90° with respect to the axis (C) of the holder protrudes in a front cavity (12) of the connector housing (10), is centered therein, and aligned with the longitudinal axis (B) thereof.

**Fig.8B**

Description**BACKGROUND****Technical Field**

[0001] The present disclosure generally relates to electrical connectors, and more particularly to an angular electrical connector assembly, and to an electrical connector comprising same. It finds non-limiting applications, for example, in the automotive industry.

Related Art

[0002] The approaches described in this section could be pursued, but are not necessarily approaches that have been previously conceived or pursued. Therefore, unless otherwise indicated herein, the approaches described in this section are not prior art to the claims in this application and are not admitted to be prior art by inclusion in this section. Similarly, a problem mentioned in this section or associated with the subject matter of this section should not be assumed to have been previously recognized in the prior art.

[0003] Electrical systems long-existing in vehicles (such as starter, lightings, ignition, fuel injection pump and calculator, wiper motors, climate control, and others) are more and more sophisticated and ever more electrical power-consuming. In addition, new on-board systems which have been recently appearing in modern vehicles (such as various additional safety and comfort systems, infotainment and convenience electronics, and the like) are all additional electrical, namely electrically powered and power consuming systems. Also, the rapid emergence of electrical or hybrid vehicles comes with higher requirements for electrical harnesses having enhanced current capacity and increased size and complexity. Globally, the requirements for electrical connectors in the automotive industry has been increasing both in number, and in terms of interconnect complexity as well as design variety.

[0004] These trends lead, amongst other, to a need for electrical connectors with higher power features and increased variety of design, including angled connection features. In the same time, a need also exists for conserving the overall dimensions of the on-board interconnect, for obvious reasons of lack of room in vehicles.

[0005] Electrical connectors comprise mating connector terminals which are held together and electrically isolated one from the other by at least one, and at least partially surrounding connector housing. Such electrical connectors for largely mass-production market are usually made by over-moulding plastic material around metallic terminals, with the advantage that a single piece is thus obtained, which is adapted to be used as a connector socket in conjunction with at least one corresponding plug for connecting electrical units. Over-moulding eliminates many of the constraints tied to the fabrication of complex connectors, such as referencing, manipulating and mounting together a plurality of separate elements. On the other hand, connectors thus produced have the advantage of compacity. For applications calling for production in a lesser scale, on the other hand, the high investments required to design and fabricate moulds have the consequence that over-moulding techniques for making a single-piece connector assembly are not a cost-effective option for the fabrication of connectors.

[0006] Stated otherwise, some applications require forming a connector assembly comprising at least an outer connector housing and an inner terminal holding module as separate pieces, which are assembled together. Each of the connector housing and the terminal holder can be made by plastic material injection techniques. The connector housing has at least one cavity extending along a longitudinal axis of said housing. This cavity is configured to receive the terminal holder fitted with the electrically conducting terminals. To that end, the terminal holder is adapted for accommodating the electrically conducting terminals, for instance by force-fitting said terminals into receiving passages formed within the plastic body of the terminal holder. Once the terminals have been secured into the terminal holder, the terminal holder so equipped can be inserted into the cavity of the connector housing, along the longitudinal axis of said housing. Usually, inner module is assembled straightly inside the outer housing.

[0007] To summarize, there is a need in the art for conserving the increase in the dimensions of angular connectors compared to flat connectors, also in the case of connectors comprising an assembly of separate pieces including at least an outer connector housing and an inner terminal holding module fitted with terminals used as mating connector pins.

[0008] Document DE19805708C2 discloses a plug-in device for motor vehicle electronic equipment, having a contact pin rail adapted for plugging into the electronic equipment. The pin rail has a pin rail housing and a pin carrier for holding a number of contact pins. The pin rail housing has two angled openings. The angle between the two openings of the pin rail housing is preferably 90 degrees. The pin carrier can be arranged in a cavity of the pin rail housing so that a portion of each contact pin runs through the cavity. In one embodiment, the pin carrier is over-moulded with housing in an injection moulding process. In another, alternative embodiment, however, the pin carrier is inserted into the housing via one of the openings, and is latched in position there. To that end, the pin carrier has snap-in elements which can be brought into engagement with corresponding snap-in components of the housing. In the latter embodiment, the pin carrier is fitted with

the contact pins before it is introduced into the housing. In addition, the pin carrier is provided with a rotating device which, when it is inserted into the housing, engages with the latter and allows the pin carrier to be pivoted in the housing. The rotation device consists of two pivot pins. More specifically, the pin carrier is inserted into the opening of the housing in a 45° position until the turning device, i.e. the two pivot pins, each engage in a guide groove provided in the housing. This guide groove is cylindrical at the end in order to form, together with the pivot pins, a pivot point for the pin carrier in the housing. In other words, the pin carrier is not assembled straightly inside the the housing, but mainly pivotably instead. When the pin carrier has reached its latching position after pivoting, its main plane is perpendicular to the plane of the opening through which it has been inserted into the housing. Thus, the pin carrier is rotated by an angle from 45° to 90° degrees within the pin rail housing. Thus, the cavity must be large enough for allowing insertion of the pin carrier with a 45° orientation with respect to the longitudinal axis of the cavity, and its rotation to a final angle of 90°. In addition, positioning the pin carrier in the housing so that both of the pivot pins take place in the guide groove is a delicate operation. On a separate note, DE19805708C2 further discloses that a plug can be inserted through another, second opening the housing. Protrusions extending from the main plane of the pin carrier, parallel to the longitudinal axis of said second opening, form guide elements together with the inner wall of the housing, to ensure the guidance of such a plug so that female mating elements of the plug can engage with the contact pins without damage to said pins. These guide elements, however, play no role with respect to the prior insertion of the pin carrier into the pin rail housing through the first mentioned opening.

[0009] In view of the above art, and associated drawbacks and inconvenient, there is proposed a solution to create an angular electrical connector assembly for, e.g. a right angle connector, which occupies a limited space.

SUMMARY

[0010] The invention aims to remedy all or some of the disadvantages of the above identified prior art.

[0011] To address these needs, a first aspect of the proposed solution relates to an angular electrical connector assembly according to claim 1.

[0012] Advantageous embodiments of the angular electrical connector assembly thus proposed are defined by the dependent claims 2 to 14.

[0013] A second aspect relates to an angular electrical connector comprising such an electrical connector assembly, as defined in claim 15.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] Embodiments of the present invention are illustrated by way of example, and not by way of limitation, in the figures of the accompanying drawings, in which:

- Figure 1A is an exploded perspective view of the angular electrical connector assembly according to embodiments.
- Figure 1B is a cross-sectional view of the angular electrical connector assembly of Figure 1A with the terminal holding module arranged in position within the terminal housing.
- Figure 2 is a perspective view showing the inner space of the rear portion of the terminal connector, seen from the first opening, that is to say from the rear, and slightly from top to bottom and from the right to the left.
- Figure 3 is a perspective view similar to the view in Figure 2, showing the inner space of the rear portion of the terminal connector, still seen from the first opening, that is to say from the rear, but slightly from the bottom to the top and from the left to the right.
- Figure 4A is perspective view showing a terminal close to the terminal holding module, from the front to the rear, and slightly from the bottom to the top and from the left to the right.
- Figure 4B is perspective view similar to the view in Figure 4A, showing a terminal close to the terminal holding module, from the rear to the front, from the right to the left and slightly from the bottom to the top.
- Figure 4C is side view of the terminal holder fitted with the terminals, in a configuration wherein the longitudinal axis of said holder is horizontal.
- Figure 4D is side view similar to Figure 3C, in another configuration wherein the longitudinal axis of said holder is tilted with respect to the horizontal.

- Figure 5A is a perspective view of the terminal holding module, standing vertically from the rear to the front.
- Figure 5B is side view of the terminal holding module of Figure 5A in a longitudinal plane.
- 5 - Figure 5C is top view of the terminal holding module of Figure 5A in a longitudinal plane.
- Figure 5D is bottom view of the terminal holding module of Figure 5A in a longitudinal plane.
- Figure 5E is side view of the terminal holding module of Figure 5A in a transverse plane, seen from the front.
- 10 - Figure 5F is side view of the terminal holding module of Figure 5A in a transverse plane, seen from the rear.
- Figure 6A and Figure 6B are cross-sectional views, in a vertical and longitudinal plane at transversal level of the end of the guide-pin of the terminal holder and in a transversal symmetry plane of said terminal holder, respectively, showing the terminal holder at a later step of the assembly process just before its entry into the rear portion of the terminal housing.
- 15 - Figure 7A and Figure 7B are cross-sectional views which are similar to the views in Figure 6A and in Figure 6A, respectively, showing the terminal holder at a later step of the assembly process just after its entry into the rear portion of the terminal housing.
- 20 - Figure 8A and Figure 8B are cross-sectional views, which are similar to the views in Figure 7A and in Figure 7A, respectively, showing the terminal holder at a later step of the assembly process when the lateral guide pins of the terminal holder have just engaged into the longitudinally extending guide-rails provided on each side, respectively, of the inner surface of the rear portion of the terminal housing.
- 25 - Figure 9A and Figure 9B are cross-sectional views, which are similar to the views in Figure 8A and in Figure 8B, respectively, showing the terminal holder at a later step of the assembly process just before the terminal holder changes tilt and aligns itself with the longitudinal axis of the rear portion of the terminal housing.
- 30 - Figure 10A and Figure 10B are cross-sectional views, which are similar to the views in Figure 9A and in Figure 9B, respectively, showing the terminal holder at a later step of the assembly process after the terminal holder has aligned itself with the longitudinal axis of the rear portion of the terminal housing, but before reaching the operational position close to the curved portion of the terminal housing.
- 35 - Figure 11A and Figure 11B, finally, are cross-sectional views which are similar to the views in Figure 10A and in Figure 10B, respectively, showing the terminal holder at the last step of the assembly process when the terminal holder has reached the operational position close to the curved portion of the terminal housing.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0015] The figures and the following description illustrate specific exemplary embodiments only. It will thus be appreciated that those skilled in the art will be able to devise various arrangements that, although not explicitly described or shown herein, embody the principles of said embodiments and are included within the scope of the appended claims. Furthermore, any examples described herein are intended to aid in understanding the principles of these embodiments and are to be construed as being without limitation to such specifically recited examples and conditions. As a result, the teachings herein are not limited to the specific embodiments or examples described below, but solely by the claims and their technical equivalents.

[0016] In the figures of the accompanying drawings, like reference numerals refer to same or similar elements. In addition, unless specifically indicated to the contrary, the disclosures contained in the entire description can be applied analogously to the same parts with the same reference signs or the same component identifiers. In the following description, functions or constructions well-known by those skilled in the art are not described in detail since they would obscure the description in unnecessary detail.

[0017] For the purpose of the following description, there is defined a direct three-dimensional orthogonal reference system XYZ, where X- and Y-axes form a horizontal plane XY parallel to a main plane of the rear portion 11 of the housing 10 along which it extends, and are oriented along the width and length of said rear portion, respectively, and where the Z-axis is oriented along the vertical direction that is perpendicular to said horizontal plane XY.

[0018] The expression "three-dimensional space" (or 3D) characterizes the space surrounding the user, as perceived

by his vision, in terms of width, depth and height. In mathematics, this notion corresponds to Euclidean geometry in space, according to which space is marked by three orthogonal axes, whereas a plane is made up of only two dimensions (2D) and is marked by only two of said three orthogonal axes. The three geometric dimensions thus are:

- width along the X-axis, oriented by way of convention from the left to the right;
- depth along the Y-axis, oriented by way of convention from the rear to the front; and,
- height along the Z-axis, oriented by way of convention from the bottom to the top.

[0019] For the sake of clarity, axes X, Y and/or Z are represented by arrows on the figures of the drawings, where appropriate.

[0020] In addition, and unless explicitly stated otherwise, the terms and expressions in quotation marks below (and all derived terms, as well as semantically equivalent expressions) are used in the present disclosure according to the following convention:

- "left", "right", "side" or "lateral", are used in reference to the direction of the transverse axis X, which is oriented horizontally from the left to the right in the figures of the drawings; and,
- "rear" and "front", "behind" and "ahead", "backside" and "frontside", "backward" and "forward", and derivatives such as "in (the) front of", an "in the rear of" as well as associated verbs and derived nouns or expressions, are used in reference to the direction of the longitudinal axis Y, which is oriented horizontally from the rear to the front on the figures of the drawings; and,
- "bottom" and "top", "below" and "above", "under" and "over", the verbs "to decline" and "to rise" and any derivatives, synonyms or equivalents, as well as the terms "superior" and "inferior", as well as associated verbs and derived nouns or expressions, are used in reference to the direction of the vertical axis Z, which is oriented vertically from the bottom to the top on the figures of the drawings.

[0021] Referring to Figure 1, there is shown therein an exploded view of the main elements of an angular connector assembly 1 according to embodiments.

[0022] First, the connector assembly 1 comprises a housing 10, more precisely an angular housing having a first portion 11 and a second portion 12 which are angled one respective to the other. In embodiments as shown in the drawings and described herein, the rear portion 11 and the front portion 12 of the housing 10 are hollow portions which communicate one with the other at level of a common, that is, shared curved portion 13. Curved portion 13 is preferably a hollow portion as well. Portions 11, 12 and 12 of the terminal housing 10 can be formed integrally, e.g. by plastic injection moulding. Longitudinal directions A and B of the first portion 11 and of the second portion 12, respectively, of the terminal housing 10 are angled directions. In the non-limiting example as shown, directions A and B are cross directions, that-is-to-say they are angled by an angle of 90°.

[0023] First portion 11 and second portion 12 of the terminal housing 10 each have, for instance, a substantially tubular shape which is adapted for receiving or for plugging into respective matching counter-connectors (not shown), by insertion along the direction of their respective longitudinal directions A and B, respectively. In a variant, electrically conducting wires, instead of a counter-connector, can be directly inserted into one or both of the first and second portions 11 and 12 of the terminal connector assembly 1, to connect with the terminals there.

[0024] By way of convention, each element of the subject angular electrical connector assembly 1 is represented in the drawings with such spatial orientation that, with reference to the above defined direct three-dimensional orthogonal reference system XYZ, the longitudinal direction A of the first portion 11 of the housing 10 extends along the longitudinal axis Y and is oriented from the rear to the front, whereas the longitudinal direction B of the second portion 12 of the housing 10 extends along the vertical axis Z and is oriented from the bottom to the top.

[0025] The first tubular portion 11 of the housing 10 has a first opening 10.1, opposite to the curved section 13 of said housing, along the longitudinal axis Y. This first opening 10.1 extends in a vertical plane XZ, at level of the rear end of the first tubular portion 11 of the housing 10. Similarly, the second tubular portion 12 of the housing 10 has a second opening 10.2, opposite to the curved section 13, of said housing along the vertical axis Z. This second opening 10.1 extends in a horizontal plane XY, at level of the bottom end of the second tubular portion 12 of the housing 10.

[0026] With reference to the above convention, and for the purpose of making the present description more easily readable for a skilled person with a technical background, first portion 11 and second portion 12 of the terminal housing 10 shall be named the rear portion 11 and the front portion 12, respectively, of said housing. It will further be noted that, for reasons of conciseness of the present description, the inner tubular space of the rear part 11 of the housing 10 shall

sometimes be referred to as a/the cavity 11. Similarly, the inner tubular space of the front part 12 of the housing 10 shall sometimes be referred to as a/the cavity 12.

[0027] In the non-limiting example as shown in the drawings, the cross-section of the rear tubular portion 11 of the housing has a rounded shape, for example a circular or elliptical shape. In addition, the rear tubular portion 11 of the housing 10 can be circled by an outer skirt of similar shape but with larger dimensions, which is adapted to aid at the plugging of a counter-connector into the rear opening 10.1 of the connector housing. With further reference to the embodiments as illustrated by the appended drawings, the cross-section of the tubular front portion 12 of the housing has a polygonal shape, for example a square or rectangular shape. In other embodiments, conversely, the tubular rear portion 11 can have a polygonal cross-section whereas the tubular front portion 12 can have a rounded cross-section. Any other configurations can be envisioned, for example, both the rear portion 11 and the front portion 12 of the connector housing 10 can have a rounded cross-section, or else a polygonal cross-section.

[0028] The connector assembly 1 further comprises at least one conducting terminal such as terminal 31 as shown. In most applications, there will be a plurality of such terminals in the electrical connector assembly 1, electrically insulated one from the other, for transmitting data and/or power. Embodiments of the angular electrical connector assembly as described herein comprise two parallel and longitudinally extending terminals like conducting terminal 31. These terminals are positioned close one to the other, for instance in one or more rows along the direction of the transverse axis X and/or in one and more columns along the vertical axis Z. In order not to overfill the drawing figures to the detriment of their clarity, however, solely terminal 31 as shown is represented in the drawings, where appropriate. In what follows, reference numeral 31 shall sometimes be used to refer collectively to the plurality of these terminals, where appropriate.

[0029] According to embodiments, terminal 31 has first and second straight mating sections 31.1 and 31.2, which extends in respective directions. In the non-limiting example as considered herein, the angle between said straight sections 31.1 and 31.2 is a right angle, that-is-to-say an angle of 90°. Stated otherwise, each of the contact pins of the subject electrical connector assembly such as contact pin 31 as shown, has a mid-portion 31.3 having a bend with an angle of, e.g., 90°. As will be noted, the angle between the first and second straight mating sections 31.1 and 31.2 of the terminal 31 substantially corresponds to the angle between the longitudinal direction A of the rear portion 11 and the longitudinal direction B of the front portion 12 of the housing 10. That way, when the terminal holding module 20 fitted with the terminals 11 has been accommodated within the terminal housing 10, by insertion therein through the first opening 10.1 of the terminal housing 10 and displacement to an operational position within said terminal housing which is located close to the curved portion 13 of said terminal housing, the first direction of extension of the first straight mating section (31.1) is substantially aligned with the first direction A of the first portion 11 and the second direction of extension of the second straight mating section 31.2 is substantially aligned with the second direction B of the second portion 12, respectively, of the terminal housing 10.

[0030] The one with ordinary skills in the art will appreciate, however, that embodiments are not intended to be limited to example of angular value as indicated in what precedes. For example, an angular electrical connector assembly with an angle comprised within, e.g., between 30° and 90°, preferably between 45° and 90°, and more preferably between 60° and 90° can be considered, and shall fall within the scope of the appended claims. Actually, the specific angular value which determines the orientation of the front portion 12 of the connector housing 10 with respect to the rear portion 11 of said housing is not limited but by the technical advantages in terms of management of space in the context of the the specific application, which are expected to be obtained from the implementation of the proposed solution. Such advantages are only a matter of degree, in the context of any particular application concerned.

[0031] Electrically conducting terminals like terminal 31 as shown can be formed from an electrically conducting material, such as stainless steel, copper or an alloy comprises copper such as brass or chrome brass, for example. They can be cut on a laser punching machine from a solid and plane blank, and then each bended at the desired angle at level of the mid-section 31.3, in order to form the two angled mating sections 31.1 and 31.2 or respective lengths.

[0032] Finally, the connector assembly 1 further comprises a terminal holding module 20, which is adapted for firmly holding the terminals, said terminals being arranged, e.g., in parallel one to another, for instance in a row or in a plurality of juxtaposed rows. The terminal holding module 20 further has as technical function to electrically insulate the terminals one from the others, in order to avoid any short-circuits therebetween. The terminal holding module 20 fitted with terminals 31 is adapted for being accommodated into the terminal housing 10, in a given operational position where the terminals 31 are firmly hold in place with respect to the terminal housing 10. For reasons of conciseness of the description, the terminal holding module 20 shall sometimes be referred to as a/the holder 20 in what follows.

[0033] According to embodiments which shall be described in more detail below, the above defined main elements 10, 31 and 20 of the electrical connector assembly 1 are assembled together such that the holder 20, once fitted with the terminals 31, is fed into the cavity 11 through the rear opening 10.1, and is moved along the longitudinal axis A of said cavity 11 towards the curved portion 13 of the connector housing, up to its operational position, where it is latched in order to being firmly accommodated there.

[0034] In the cross-sectional view of Figure 1B, the terminal holding module 20 with the terminal 31 fitted therein, is shown arranged in its operational position within the angular housing 10 of the connector. The cut plane for this view is a

longitudinal and vertical plane YZ, namely a plane comprising the longitudinal axis Y and the vertical axis Z, at the lateral end of the first pivot protrusion 21.1.

[0035] In that position, one end 31.1 of each of the terminals 31 are protected and exposed inside the rear portion 11 of the angular housing 10 wherein they extend longitudinally from the front to the rear, and are accessible through the rear cavity opening 10.1. These ends 31.1 of the terminals form contact pins which can be plugged by, e.g., respective wire cables (not shown) or by any suitable counter-connector through the rear opening 10.1 of the connector housing 10.

[0036] The other end 31.2 of the terminals 31 are protected and exposed inside the front portion 12 of the angular housing 10 wherein they extend vertically from top to bottom, and are accessible through the front cavity opening 10.2. These other ends 31.2 of the terminals 31 can protrude from the bottom plane or down apex of the rear portion 11 of the housing 10 so that these ends of the terminals 31 form contact pins which can be plugged by, e.g., respective wire cables (not shown) or by any suitable counter-connector through the front opening 10.2 of the connector housing 10.

[0037] The one with ordinary skills in the art will appreciate that either ones of the ends 31.1 and ends 31.2 of the terminals 31 can be protruding outside of the first opening 10.1 or the second opening 10.2, respectively, and thus be adapted for being soldered in a printed circuit board of an electronic control unit. Embodiments are not intended to be limited by the respective length of the straight sections 31.1 and 31.2 of the terminals 31, along the longitudinal axis Y and along the vertical axis Z, respectively.

[0038] With reference more specifically to Figures 4A and 4B, the terminal holding module 20 includes one or more longitudinal sleeves such as the two sleeves 21.1 and 21.2 as shown, for accommodating the first straight section 31.1 of the terminals 31. Sleeves 21.1 and 21.2 extend longitudinally in an horizontal plane XY

[0039] According to peculiarities of embodiments as taught herein, the terminal holding module 20 and the inner surface of the terminal housing 10 comprise associated guiding means, which are mutually adapted for longitudinally guiding the terminal holding module 20 along a mounting path having a direction of mounting from the first opening 10.1 of the terminal housing 10 toward the operational position of the terminal holding module 20. These guiding means further have the function to vary the tilt of the terminal holding module 20 with respect to the first direction A of the rear portion 11 of the terminal housing 10. More specifically, this tilt is varied as a function of the provisional position of the terminal holding module 20 in its mounting path, along the longitudinal axis during its mounting process. Finally, these guiding means are further adapted to set the a.m. tilt to zero where the terminal holding module 20 reaches its operational position close to the curved portion 13 of the connector housing 10. Stated otherwise, in the operational position of the terminal holding module 20, the longitudinal direction of said module is aligned with the longitudinal direction A of the rear portion 11 of the connector housing 10.

[0040] Embodiments of the above-mentioned guiding means shall now be described with reference, inter alia, to Figure 5A to Figure 5F. These figures show details of the terminal holding module 20, and the following description shall be made with reference to this group of figures as a whole.

[0041] The terminal holding module 20 comprises a main plate 29, which substantially extends in a transversal plane XZ. The shape and dimensions of plate 29 in this plane substantially suit the shape and dimensions, respectively, of the inner space in the rear portion 11 of the terminal housing 10.

[0042] The aforementioned longitudinal sleeves 21.1 and 21.2 for accommodating the terminals 31 mainly have a frontside extension which extends longitudinally from the base plate 29, in a forward direction - namely, from the rear to the front - perpendicularly to said base plate 29. Also, the sleeves 21.1 and 21.2 have a backside extension, here of shorter longitudinal length than the frontside extension, which extends from the base plate 29 in a backward direction - namely, from the front to the rear - in continuity with the main, frontside extension, that-is-to-say along the same longitudinal axis which is perpendicular to the base plate 29. The inner dimensions of any cross section of the sleeves 21.1 and 21.2 suit the dimensions of the cross section of the terminals 31. Actually, each terminal 31 can have a retaining area 31.4 as shown in particular in Figure 4A, said retaining area 31.4 having slightly expanded dimensions within the horizontal plane - with respect to the rear section 31.1 - and having a barbed or toothed periphery which is adapted to secure the terminal in place within the corresponding longitudinal sleeve by scuffing or scratching the plastic material of which the sleeves are made. The retaining area is located on the rear portion 31.1 of terminal 31, close to the bended portion 31.3 of said terminal. As the one with ordinary skills will appreciate, any terminal 31 can be fitted into a sleeve of the holding module 20 by inserting it by its rear section 31.1 into the sleeve from the front side to the rear side, and for force-fitting the terminal when it comes to inserting the retaining area 31.4. Once the retaining area has been forced into the sleeve, the terminal 31 cannot be easily move in either sense along the longitudinal direction A of the rear portion 11, whereby firm and secure holding of the terminal 31 is obtained.

[0043] The terminal holding module 20 further comprises a tail portion 25, which extends longitudinally from the base plate 29 in a backward direction perpendicular to said base plate. This tail portion has as main technical function to provide rigidity to the module 20, and thereby to allow the transmission to the base plate 29 of the manually exerted mechanical forces to move the module 20 within the rear portion 11 of the terminal housing 10, from the opening 10.1 to the curved portion 13 of said housing. In the example as shown in the drawings, the tail portion 25 has a cross-sectional shape of the letter "H", each of the superior bars of the "H" being outwardly bended laterally.

[0044] There will now be described further features of the terminal holding module 20 which, either individually and/or in any combination one with another, form guiding means in cooperation with associated means of the inner surface of the rear portion 11 of the terminal housing 10. These guiding means are adapted for guiding the insertion from the rear opening 10.1 and the longitudinal displacement of the terminal holding module 20 within the rear portion 11 of the terminal housing 10, in direction of and up to its operational position, close to the curved portion 13 of said housing 10.

[0045] In some embodiments, the aforementioned guiding means can include an inferior or lower support foot 23. This support foot 23 extends from the main plate 29 substantially longitudinally from the front to the rear, and possibly also slightly from the top to the bottom. Preferably, the apex of the support foot 23 in the down oriented vertical direction of the vertical direction, is the lowest point of the terminal module 20 - when said terminal module is considered lying horizontally that-is-to-say with its longitudinal axis extending within the horizontal plane XY. In particular, the inferior support foot 23 can extend from the lowest zone of the periphery of the base plate 29. On the contrary, the tail portion 25 of the terminal holding module 20 preferably extends longitudinally, in the same direction as the inferior support foot 23 that-is-to-say from the front to the rear, but from the superior half of the base plate 29. This way, even when the longitudinal axis C of the terminal holding module 20 is tilted by a limited angle with respect to the longitudinal axis A of the rear portion 21 of the terminal housing 10 (let us say by a maximum angle between 10° and 30° in the example as shown in the drawings) a contact with an horizontal plane XY containing the bottom of the inner surface of said portion 21 is limited to the inferior support foot 23.

[0046] The above features are to be seen, in particular, in the views of Figure 5B, 5E and 5F. Thanks to these features, the contact forces when the terminal holding module 20 slides against the inferior portion of the inner surface of the rear portion 11 of the terminal housing 10 are kept minimal, even when the longitudinal axis C of said module 20 is tilted with respect to the longitudinal axis A of said rear portion 21.

[0047] As will become apparent from the description of the method of mounting the terminal holding module 20 in the rear part 11 of the connector housing 10, the lower support foot 23 can be made to slide on the bottom of the inner surface of the tubular rear part 11 of the connector housing 10 while the holder 20 is moved forwards along the longitudinal direction A of the said rear part 11, from the rear towards the front. Advantageously, the support foot 23 can have a rounded end, which increases the sliding capacity of said foot by reducing the contact forces.

[0048] In some embodiments, the guiding means further comprise a superior or upper contact head 26 which, in the illustrated example, is defined by the upper apex of the periphery of the base plate 29. Due to the general symmetry of the holder 20 with respect to its longitudinal axis C, the upper contact head 26 corresponds to the central point of said periphery with respect to the direction of the transverse axis X. This is apparent, in particular, in the views of Figures 5A and 5C. From a functional standpoint, the upper contact head 26 of the holder 20 is adapted to come into contact with the top of the inner walls of the rear part 11 of the connector housing 10, upon insertion of the former into the latter, i.e., when the terminal holding module 20 is moved forward along the mounting path. As will become apparent from the description of the process of inserting the holder 20 into the said rear part 11, this enables the holder 20 to be stabilised and its angle of inclination to be controlled during insertion.

[0049] According to embodiments, the guiding means can further include one or more longitudinally extending notches 28.1 and 28.2, arranged in the base plate 29 of the terminal support module 20. These are adapted to cooperate with associated guide rails 210.1 and 210.2 which extend longitudinally from the inner surface of the rear portion 11 of the terminal housing 10 as shown in Figures 2 and 3, to guide the longitudinal displacement of said module 20 within said rear portion 11. By way of preference, the notches are provided in the lower part of the periphery of the base plate 29 of the terminal holding module, at a level lower than the tail portion 25 of said module, given that a force F2 is exerted vertically, from top to bottom, on said tail portion 25 during insertion (see below). And, correlatively, the guide rails 210.1 and 210.2 are provided in respective associated positions in the low area of the inner surface of the rear cavity 11, i.e., of the rear part 11 of the connector housing 10. In the example as shown in the drawings (see again, in particular, the views of Figure 5B, 5E and 5F), two notches 28.1 and 28.2 are formed within the lower arc of the base plate 29, preferably on either side, for stability reasons, of a middle point of that arc with respect to a direction transverse to the longitudinal axis C of the axis X of said module 20. This way, the notches extend longitudinally (with respect to axis C) on either side (considered with respect to said direction transverse to axis C) of the lower support foot 23 as shown, in particular, in Figure 5F. This provides good stability to the holder 20 when it is moved forward along the mounting path.

[0050] For the purpose of providing the expected guiding effect, the cross-section in a transverse plane XZ of each one of notches 28.1 and 28.2 fits, namely matches with the cross-section in said plane XZ of the associated one of guide rails 210.1 and 210.2 at the inner surface of the rear portion 11 of the terminal housing 10.

[0051] In a possible embodiment, the respective cross-sections of notches 28.1 and 28.2 differ one from the other, for instance in shape and/or in dimensions (and correlatively the respective cross-sections of the associated rails 210.1 and 210.2 also differ one from the other). This way, the notches 28.1 and 28.2 in the terminal holding module 20 and the guiding rails 210.1 and 210.2 at the inner surface of the rear portion 11 of the terminal housing 10, can be used as a means of polarisation ensuring correct insertion of said module 20 into said rear portion 11. Advantageously, an error of polarity of the interconnect including the terminal connector assembly can thus be avoided.

[0052] In addition, the associated guiding means of the electrical terminal assembly 1 comprise two guide-pins 22.1 and

22.2 which extend laterally from either side of the transverse base plate, and which are adapted to engage into respective longitudinal slots 200.1 and 200.2 provided at the inner surface, i.e., on the inner walls of the rear portion 11 of the terminal housing 10. These pins are adapted to act as sliding pivots for allowing tilt variation of the terminal holding module 20 with respect to the longitudinal axis A of the rear portion 21 of the terminal housing 10, all along its longitudinal path as set out by the slots 200.1 and 200.2.

[0053] With reference specifically to Figure 2 and 3, in one embodiment the rear end of slots 200.1 and 200.2 comprises a ramp 201.1 and 201.2, respectively, which has a rising slope with respect to the direction of the longitudinal axis A oriented from the rear towards the front. This rising slope forces the guide-pins 22.1 and 22.2 to raise when the terminal holding module 20 is displaced along the longitudinal axis A, from the rear to the front. Assuming, further, that the lower support foot 23 be simultaneously maintained in contact with the bottom of the inner surface of the rear portion 11 of the terminal housing 10 by the above-mentioned vertical force F1 exerted from the top towards the bottom at the rear end of the rear tail 25 of said module 20, it follows that the terminal holding module 20 is additionally forced to tilt up with respect to the longitudinal axis A, by pivoting around the guide-pins 22.1 and 22.2 as it moves forward along said axis A.

[0054] Stated otherwise, the guide-pins 22.1 and 22.2 of the terminal holding module 20 in cooperation with the slots 200.1 and 200.2, respectively, of the terminal housing 10 and along with their associated rising slopes 201.1 and 201.2, respectively, have the function of a cam for controlling both the longitudinal displacement and the angular orientation (tilt) of the terminal holding module 20 with respect to the longitudinal axis A of the electrical terminal housing 10. More precisely the guide-pins 22.1 and 22.2 operate as longitudinally sliding pivots allowing to let the tilt of the holder 20 vary along the longitudinal run of said holder within the rear cavity 11 towards its operational position at the front end of said cavity. In addition, the inferior support foot 23 and the superior contact head 26 have the technical effect of constraining the determined value of the tilt angle θ between the longitudinal direction A of extension of the rear cavity 11 of the connector housing 10 and the longitudinal direction C of extension of the terminal holding module 20.

[0055] It will be appreciated that, according to embodiments, slots 200.1 and 200.2 are also blocking grooves to the extent that, whereas they are opened on the rear side to allow entry therein of the guide-pins 22.1 and 22.2 by ramping up the rising slopes 201.1 and 201.2, they each include a cul-de-sac 202.1 and 202.2, respectively, on the front side. These cul-de-sacs, or forward (or front) abutments 202.1 and 202.2, are so localised along the longitudinal axis A of the rear part 11 of the connector housing 10 that they are adapted to stop the terminal holding module 20, as the result of the guide-pins 22.1 and 22.2 abutting same, which corresponds to said module 20 having reached its operational position. To put it another way, the forward abutments 202.1 and 202.2 are adapted to limit and bring to an end the insertion run of the terminal holding module 20 into the connector housing 10, notwithstanding any persistence of the longitudinal force F1 exerted from the rear towards the front at the rear portion 25 of said module, as the case may be. Thus, any damage to the electrically conducting terminals 31 is avoided, which could happen if the holder 20 was not prevented from bumping into the walls of the curved portion 23 of the connector housing 10, for instance.

[0056] Finally, the mutually associated guiding means of the electrical terminal assembly 1 comprise a lower pad 220.3 and/or an upper pad 220.4, at the front end of the rear part 11 of the connection box 10. These pads are designed to cooperate with a lower latching hook 27.3 and with an upper latching hook 27.4, respectively, of the terminal holding module 20. In particular, the upper pad 220.4 has a ramp 221.4 with a decreasing slope with respect to the direction of the longitudinal axis A oriented from rear to front.

[0057] With reference to Figures 5A, 5B, 5C, 5D and 5F, the lower hook 27.3 extends longitudinally from the base plate 29 of the terminal support module 20, from rear to front. More specifically, in the illustrated example, hook 27.3 extends from the lowest, laterally central point of the periphery of the base plate 29, in exactly the same way as the lower support foot 23, but in the opposite direction, i.e. from rear to front. This is illustrated, in particular, in the view in Figure 5D of the drawings. Similarly, the upper hook 27.4 extends longitudinally from the base plate 29 of the terminal holding module 20, from the rear towards the front. In the shown example, it thus extends from a laterally central point in the upper part of the base plate 29.

[0058] In embodiments as illustrated, each of the hooks 27.3 and 27.4 comprises a through hole in the horizontal plane XY, which forms a hooking loop extending in said plane. This loop is adapted to cooperate with the inferior pad 220.3 and with the superior pad 220.4, respectively, which are arranged at the inner surface of the rear portion 11 of the terminal housing 10, to latch the terminal holding module 20 in its operational position inside said rear portion 11 close to the curved portion 23 of said housing 10. Stated otherwise, the electrical connector assembly has mutual latching means for securing the terminal holding module 20 in position within the connector housing 10, and these means comprise the inferior pad 220.3 and/or the superior pad 220.4 formed on the inner surface of the rear portion 11 of the housing 10 near the curved portion 13 thereof, on the one hand, and the hooks 27.3 and 27.4 extending longitudinally from the front of the module 20, on the other hand.

[0059] Given their cantilever design, on the one hand, and the existence of the through holes forming the hooking loops, on the other hand, the hooks 27.3 and 27.4 have a relative capacity to bend. This enables them to fulfil their technical function as elastically deformable elements for causing automatic latching of the terminal holding module 20. As can be noted, the inferior pad 220.3 and the superior pad 220.4 are fixed elements on the side of the rear portion 11 of the

connector housing 10, and the hooks 27.3 and 27.4 are the mobile latching elements on the side of the terminal module 20 and are also the elements having some elastic deformation capacity to allow the latching to occur.

[0060] The superior pad 220.4 and its declining slope 221.4 are arranged at the front end of the rear portion 11 of the terminal housing 10, in such a manner that the superior hook 27.4 contacts with the slope 221.4 when the terminal holding module 20 covers the last portion of its longitudinal insertion run. As a result of the declining slope 221.4 and as the terminal holding module 20 is still moved in the forward direction (that is, along the longitudinal axis A, from the rear to the front) within the rear portion 11 of the terminal housing 10, the overall terminal holding module 20 is forced to tilt down, towards the longitudinal axis A of said rear portion 11. Thus, the longitudinal axis C of the terminal holding module 20 tends to align with the longitudinal axis A of the rear portion 11 of the connector housing 10.

[0061] The one with ordinary skills in the art will observe that the upper hook 27.4 has thus as further technical function to operate as a transmission arm for converting the sliding contact force opposed by the slope 221.4 of the upper pad 220.4 into a tilting movement of the terminal holding module 20 which tends to align its longitudinal axis C with the longitudinal axis A of the rear portion 11 of the connector housing 10. Stated otherwise, the declining slope 221.4 of the upper pad 220.4 is configured to and adapted for progressively zeroing the tilt angle θ of the terminal holding module 20 with respect to the rear portion 11 of the connector housing 10, as the terminal holding module 20 runs the last portion of its longitudinal insertion path within said rear portion 11. It will be noted that the bending capacity of the upper hook 27.4 is not an obstacle to this further technical function thereof. In addition, the skilled person will appreciate that the guide-pins 22.1 and 22.2, whatever their instantaneous position along the longitudinal axis A of the rear portion 11 of the connector housing 10, allow here again the adjustment of the tilting of the terminal module 20 by offering sliding pivot points.

[0062] It will also be noted that, though having the same structure and the same arrangement as the upper pad 220.4, the lower pad 220.3 does not contribute to tilting down the terminal module towards the longitudinal axis A of the rear portion 11 of the connector housing 10. It does only operate as the fixed latching element which is associated with the lower hook 27.3 acting as mobile latching element. This stems from the fact that the lower pad 220.3 is positioned farther frontwards than the upper pad 220.4. Therefore, when the lower hook 27.3 gets in contact with the raising slope 221.3 of the lower pad 220.3, the holder module 20 has already aligned itself with the longitudinal axis A of the rear cavity 11 (i.e., $\theta = 0^\circ$).

[0063] In Figures 5B and 5F, as well as in Figure 4C, the total height of the terminal support module 20 is indicated by the capital letter "H". This height corresponds to the distance between the lower apex of the lower support foot 23, on the one hand, and the upper apex of the upper contact head 26, on the other hand, of the raw terminal support module 20.

[0064] In some implementations, as shown in Figure 4C, when the terminals 31 have been mounted in the sleeves 21.1 and 21.2 of the support 20, the total height $H+$ of the assembly thus obtained can be greater than H (namely, we have $H < H+$). This is because the end of the straight parts 31.2 of the terminals 31 extending (downwards in the example shown) orthogonally to the longitudinal axis C of the said support 20 projects further downwards than the lower apex of the lower support foot 23. In other words, the total vertical bulk of the assembly formed by the support 20 fitted with the terminals 31 can be greater than that of the support 20 alone. As a result, there is a risk that the pins will be bent, or even broken, by rubbing against the internal walls of the rear cavity 11 of the connector housing 10, when the support 20 is inserted into said cavity.

[0065] According to embodiments, this risk is eliminated by the fact that the support 20 is inserted at a given angle relative to the longitudinal axis A of the rear cavity 11 of the housing 10. As shown in Figure 4D, indeed, assuming that the holder 20 is tilted by a given angle θ with respect to the longitudinal axis A of the rear cavity 11, then the total vertical bulk of the assembly formed by the support 20 fitted with the terminals 31, which is denoted by lower-case letter "h" in the drawings, is reduced. Namely, we have $h < H < H+$, and thus $h < H+$, which is one advantage of the proposed embodiments. Both heights H and $H+$, as well as height h are considered along the direction of the vertical axis Z. It can indeed be mathematically demonstrated, assuming the angle between straight portions 31.1 and 31.2 of terminals 31 is 90° , that:

$$h = H \times \cos(\theta) \quad (1)$$

which gives $h < H$.

[0066] As illustrated in Figures 7A and 7B, the height "h" of the tilted holder 20 fitted with the terminals, determines the minimum height (still considered along the direction of the vertical axis Z) of the internal space which must be available inside the rear portion 11 of the connector housing 10.

[0067] As will become more apparent from the description which follows of the process of insertion of the terminal holding module 20 within the connector housing 10, embodiments as proposed herein allow designing the rear portion 11 of said housing 10 with a height h less than the height $H+$ of said module 20 fitted with terminals 31 as considered herein. This advantageous result is attained thanks to the proposed means for insertion of the terminal holding module 20 through the opening 10.1 of the rear portion 11 of the connector housing 10 and for its displacement along the longitudinal axis A thereof with a given tilt, while said module 20 is forced back to horizontal orientation when eventually reaching its operational position at the front end of the rear portion 11, close to the curved portion 13, of the connector housing 10.

[0068] As will be appreciated, embodiments allow both prevention of damages to the terminals during the insertion of the terminal holding module 20 within the rear portion 11 of the connector housing 10, and reduction in the dimensions of the internal space that is necessary within said rear portion 11, whereby the connector assembly 1 can be efficient with respect to quality and compact.

[0069] In Figures 6A and 6B, Figures 7A and 7B, Figures 8A and 8B, Figures 9A and 9B, Figures 10A and 10B, and finally Figures 11A and 11B, respective steps of the process for accommodating the terminal holding module 20 into the rear portion 11 of the connector housing 10 are successively presented. In what follows, only the elements of the electrical connector assembly which are of interest for describing any step of the process shall be discussed, whereas many other elements can be labelled in the corresponding figures of the drawings, which may prove useful for enhancing the description of the embodiments in view of

[0070] As shown in Figures 6A and 6B, the terminal support module 20 is presented from the front, i.e. with the sleeves 21.1 and 21.2 in front, in front of the opening 10.1 of the rear part 11 of the connector housing 10. This can be done by an operator, or by an industrial robot as the case may be. As illustrated, the terminals 31 have been previously mounted in the holding module 20, by inserting their longest straight part 31.1 into their respectively dedicated sleeves 21.1 and 21.2 on the holder 20, from the front to the rear of said sleeves. In this way, and as shown in Figure 6A, the bent part 11.3 of the terminals is close to the front end of the sleeves 21.1 and 21.2, and the shorter straight part 31.2 of the terminals extends orthogonally to the longitudinal axis C of the holder 20.

[0071] With reference now to Figures 7A and 7B, the holder 20 is pushed into the inner tubular space of the rear part 11 of the housing 10 by exerting a force F2 longitudinally from the rear towards the front, on the backside of the tail portion 25 of the holder 20. This is symbolised by a horizontal arrow in the figure. Simultaneously, a force F1 is also applied vertically, from top to bottom, over the rear of the tail portion 25 of the holder 20, as further symbolised by a vertical arrow in the figure. This way, there is obtained and maintained a given tilt of the holder 20 with respect to the housing 10, as the support foot 23 is made to enter into contact with the lower portion of the inner surface of the rear portion 11 of the housing 10 and the contact head 26 also enters into contact with the top of the inner surface of the cavity 11. Both the support foot 23 and the contact head 26 of the holder 20 start sliding over said surface, as the holder is pushed further inside the cavity 11. In the drawings, there is indicated the tilt angle θ of the longitudinal axis C of the holder 20 with respect to longitudinal axis A of rear portion 11 of the housing 10.

[0072] The next step of the process is illustrated by the views in Figures 8A and 8B. The operator (or the robot) further exerting both the vertical force F1 and the longitudinal force F2, the holder 20 is allowed to progress along the longitudinal direction of axis A towards the front, while the tilt angle θ is more or less kept constant. As illustrated in Figure 8A, the guide-pins 22.1 and 22.2 are thus engaged within the longitudinal guiding grooves 200.1 and 200.2, respectively, and more particularly, first, are brought in contact with the lower edge of their rising slopes 201.1 and 201.2, respectively.

[0073] There comes a time when the entire support 20 has entered the tubular cavity 11 of the housing 10, as shown in Figures 9A and 9B. In other words, at some point in time and as a result of the forces F1 and F2 having been maintained to keep the holder 20 in move towards the front, the rear part of the tail 25 of the support 20 no longer protrudes outside the cavity, at the rear of said cavity. Thus, it is not possible to continue exerting the vertical force F1 over the rear of the tail portion of the holder 20. It follows that only the longitudinal force F2 can be exerted further. This can be achieved, for instance, by pressing the rear of the tail portion 25 of the holder, with a finger through the opening 10.1 of the cavity 11.

[0074] It is preferably only from that time on, that the front of the upper hook 27.4 enters in contact with the upper pad 220.4 as shown in the Figures 9A and 9B, and starts sliding down the declining slope 221.4 of said pad 220.4 as the insertion is continued further. This way, the automatic down tilting of the holder 20 around the guide-pins 22.1 and 22.2 which is caused by the upper hook 27.4 sliding down the declining slope 221.4, is not jeopardized by any other force than the acting force F1 applied longitudinally from rear to front. This result can be achieved by any appropriate design of the terminal holding module, in particular by correct dimensioning of the backward length of the tail portion 26, the frontward length of the upper hook 27.7, and the position of the upper pad 220.4 along the longitudinal axis Y.

[0075] As it will be noted by the one skilled in the art, further, the design rules can be such that, when the terminal holding module 20 starts tilting down towards the longitudinal axis A of the cavity 11, the shorter straight portion 31.2 of the terminals 31 which extends perpendicularly to the longitudinal axis C of said module 20 has reached the longitudinal level of the common edge between the rear cavity 11 and the front cavity 12, namely the virtual border between the rear portion 11 and the front portion 12 of the connector housing 10, which belongs to the curved portion 13 of said housing. This way, as the holder 20 continues moving forward with the consequence that the shorter straight portion 31.2 of the terminals 31 could scratch on the lower portion of the inner surface of the cavity 11, this actually does not happen since said portion 31.2 of the terminals 31 is already ahead of the front end of said rear cavity 11. Instead, the straight portion 31.2 of the terminals 31 enters the front cavity 13 with no risk of bumping into a plane surface or any other obstacle. Thus, any damage to the terminals 31 is avoided.

[0076] At the later step as illustrated in Figures 10A and 10B, the alignment of longitudinal axis C of the holder 20 with the longitudinal axis A of the rear cavity 11 is over. Stated otherwise, the longitudinal axis C of the holder 20 is fully aligned with the longitudinal axis A of the rear cavity 11. In one embodiment this happens, as shown, even before the completion of the

longitudinal run of the holder 10 within said rear cavity 11, i.e., before the guide-pins 22.1 and 22.2 abut against the cul-de-sacs 202.1 and 202.2 of the longitudinal guide-grooves 200.1 and 200.2, respectively. In this situation, as shown in the figures, the shorter straight portion 31.2 of the terminals 31 is aligned with the longitudinal axis B of the front cavity 12, though not being centred yet within said front cavity 12.

[0077] In the embodiments as shown in Figure 10B, the front edge of the longitudinal sleeves 21.1 and 21.2 in which the terminals 31 are accommodated, is close to or at the limit between the rear cavity 11 and the front cavity 12, i.e., at the rear entry side of the curved cavity 13, of the terminal housing 10.

[0078] Further, still with reference to Figure 10B, the lower longitudinal hook 27.3 and the upper longitudinal hook 27.4, which extend from the front of the holder 20, are slightly bent towards the longitudinal axis A of said holder 20. This slight bending is caused by the reaction of the declining slope 221.3 of the lower pad 220.3 and by the declining slope 221.4 of the upper pad 220.4, respectively, to the force F2 being still exerted on the rear of the tail portion 25 of the holder 20. As the skilled person will appreciate, this bending prepares the latching of the holder 20 within the terminal housing 10.

[0079] In the final step, i.e. at the end of the insertion process as illustrated in Figures 11A and 11B, the through hole in the horizontal plane XY of each of the hooks 27.3 and 27.4 has clipped over the pin of the associated lower pad 27.3 and of the associated upper pad 27.4, respectively, which are integral with the inner surface of the rear cavity 11 of the connector housing 10. This way, the terminal holding module 20 gets latched in its operational position inside said cavity 11, close to the curved portion 23 of the terminal housing 10. This latching occurs as, or just before the guide-pins 22.1 and 22.2 abut the cul-de-sacs 202.1 and 202.2, respectively, of the guiding grooves 200.1 and 200.2, respectively. This way, even if a strong force F2 were further applied from rear to front at the rear of the holder 20, this would not result in unlatching said holder - by the hooks 27.3 and 27.4 jumping over the pin of pads 221.3 and 221.4, respectively. This would be prevented, indeed, as the guide-pins 22.1 and 22.2 would be blocked by the end of the grooves 2001.1 and 200.2, respectively.

[0080] As will be noted, in addition, and as shown in Figures 11A and 11B, the dimensioning of the design is such that whenever the holder 20 has been latched by hooks 27.3 and 27.4, it stands securely in its operational position. In this position, the straight portions 31.2 of the terminal, here angled by 90° with respect to the other straight portions 31.1 thereof which are in alignment with the longitudinal axis A of the rear cavity, are not only aligned with the longitudinal axis B of the front cavity 12 as was readily the case at the step illustrated by Figures 10A and 10B, but now are further centered within said cavity 12.

[0081] To summarize, embodiments provide insertion of the terminal holding module 20 with constraint tilt by a determined angle θ with respect to the longitudinal axis A of the rear cavity 11, and further provides smooth nullification of said tilt just before or upon reaching its fully inserted operational position wherein the angled portion 31.2 of the terminal 31 extend along the longitudinal axis B of the front cavity 12 and is centered therein. This allows preventing any damages to the terminals during the insertion of the terminal holding module 20 within the rear portion 11 of the connector housing 10, and further allows conserving the dimensions of the internal space within said rear portion 11, whereby the connector assembly 1 gains in quality and compactness. Overall, this is achieved very easily and conveniently in a smooth manner while the terminal holding module 20 is being continuously guided in longitudinal displacement along the longitudinal axis A of the rear cavity 11. All the operator has to do is to engage into the front cavity 11, the holder 20 fitted with the terminals 31, by front and with a tilt somehow consistent with the tilt angle θ which is determined by design (hence the vertical force F1), and then to push the tilted holder within said cavity 10 mainly in the direction of the longitudinal axis A of thereof (hence the force F2). The exact tilt is automatically obtained through the guiding of the holder by the lower support-foot 23, the upper contact-head 26 and the lateral guide-pins 22.1 and 22.2 (in cooperation with the internal walls of the rear cavity 11, including the longitudinal grooves 200.1 and 200.2 along with their ramps 201.1 and 201.2), and is then automatically and smoothly nullified by way of the upper hook 221.4 (in cooperation with the declining ramp 221.4 of the upper pad 220.4), before the holder is stopped in its operational position by the guide-pins 21.1 and 21.2 being stopped in abutment (by the stop ends 202.1 and 202.2 of the grooves 200.1 and 200.2) and is latched there by the lower hook 27.3 and the upper hook 27.4 (in combination with the fixed pads 220.3 and 220.4).

[0082] As the skilled person will appreciate, it may happen that, at some point(s) of the longitudinal insertion path of the holder 20 within the rear portion 11 of the terminal housing 10, the contact head 26 may lose contact with the upper portion of the inner surface of said rear portion 11. This is less likely to happen, yet not impossible, to the lower support foot 23 with respect to the bottom of the inner surface of the rear portion 11 of the housing 10. At least, this should not happen as long as some vertical force F1 keeps being exerted towards the bottom on the tail portion 25 of the holder 20. Even when no vertical force is specifically applied by the operator, and even when it cannot be exerted anymore since the entire tail portion 25 of the holder 20 has penetrated the rear cavity 11 (as it is the case in the situation illustrated in Figures 9A and 9A and in any subsequent figures of the drawings), the gravity force exerted naturally on the holder 20 tends to keep the lower support foot 23 in contact with the lower part of the inner surface of the rear portion 11 of the housing 10. In any case, it is noticeable that the design of the holder 20 and of the rear cavity 11 is such that, whatever the vertical component of the forces applied or not by the operator onto the tail portion 25 of the holder 20, any contact between the holder 20 and the inner surface of the rear portion 11 of the connector housing 10 is limited to a contact by the lower support foot 23, the upper contact head 26 and/or the guide-pins 22.1 and 22.2. In this way, the integrity of the terminals 31 is preserved as they never contact the

internal surface of the housing 10, and any jamming of the support 20 in the tubular cavity 11 of the connector housing 10 is avoided before the support 20 reaches its operating location close to the curved part 13 of said housing 10 and is latched there.

[0083] While there has been illustrated and described what are presently considered to be the preferred embodiments, it will be understood by those skilled in the art that various other modifications may be made, and equivalents may be substituted, without departing from the true scope of the present description. For instance, whereas a right angled electrical connector has been considered, i.e. a connector with rear and front cavities extended at 90° one to the other, the one with ordinary skills in the art will appreciate that the teachings disclosed herein can be implemented in other angular connectors, namely connectors having various angle values.

[0084] Additionally, many modifications may be made to adapt a particular situation to the teachings as disclosed in the present description without departing from the central inventive concept described herein. Furthermore, an embodiment may not include all of the features described above. Therefore, it is not intended that the patent scope be limited to the particular embodiments disclosed, but that protection encompasses all embodiments falling within the scope of the appended claims.

[0085] Expressions such as "comprise", "include", "incorporate", "contain", "is" and "have" are to be construed in a non-exclusive manner when interpreting the description and its associated claims, namely construed to allow for other items or components which are not explicitly defined also to be present. Reference to the singular is also to be construed in be a reference to the plural and vice versa.

[0086] A person skilled in the art will readily appreciate that various parameters disclosed in the description may be modified and that various embodiments disclosed and/or claimed may be combined without departing from the scope of protection. It is stipulated that the reference signs in the claims do not limit the scope of the claims, but are merely inserted to enhance the legibility of the claims.

Claims

1. Angular electrical connector assembly (1) comprising:

- a connector housing (10) having:

- a first portion (11) of tubular shape extending along a first direction (A),
- a second portion (12) of tubular shape extending along a second direction (B), different from and angled with the first direction (A) of extension of the first portion (11),
- a curved portion (13) linking said first and second portions (11,12) of said terminal housing (10),
- a first opening (10.1) at one end of the first portion (11) opposite to the curved portion (13), as well as
- a second opening (10.2) at one end of the second portion (11) opposite to the curved portion (13),

- at least one electrically conducting terminal (31) having:

- a first straight mating section (31.1) extending into a first direction of extension,
- a second straight mating section (31.2) extending into a second direction of extension, different from and angled with the direction of extension of the first straight mating section (31.1), wherein the angle between said respective angled directions of extension of said first and second mating sections (31.1,31.2) of the terminal substantially correspond to the angle between the first direction (A) and the second direction (B) of the first portion (11) and of the second portion (12), respectively, of the connector housing (10);

- a terminal holding module (20) adapted to accommodate the terminal, and further adapted to be accommodated within the connector housing (10) by insertion therein through the first opening of the terminal housing (10) and to be displaced up to an operational position within said terminal housing which is located near the curved portion (13) of said terminal housing and wherein the first direction of extension of the first straight mating section (31.1) is substantially aligned with the first direction (A) of the first portion (11) towards the first opening (10.1) whereas the second direction of extension of the second straight mating section (31.2) is substantially aligned with the second direction (B) of the second portion (12) towards the second opening (10.2), respectively, of the connector housing (10);

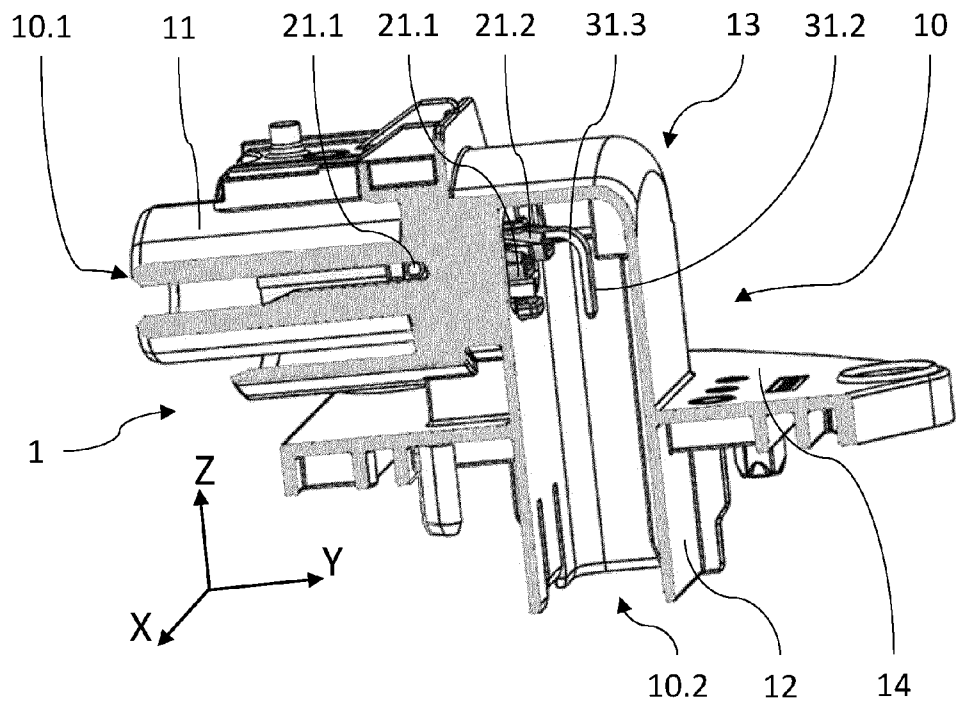
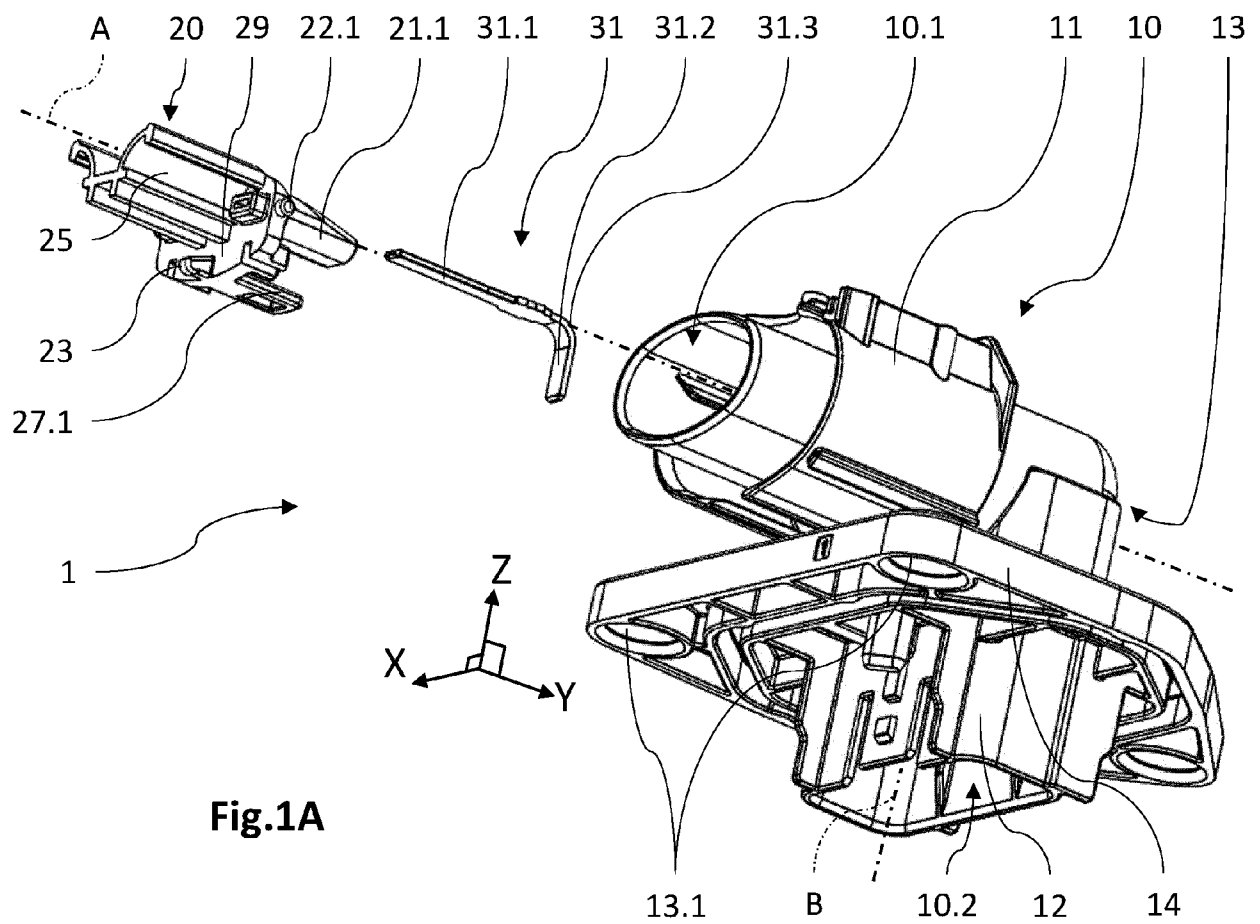
characterised in that inner walls of the first portion (11) of the terminal housing (10) on one hand, and the terminal holding module (20) on the other hand, comprise mutually associated guiding means which are adapted for, responsive to a longitudinal force (F2) applied from rear to front of the terminal holding module (20):

- longitudinally guiding the terminal holding module (20) along a mounting path from the first opening (10.1) of the connector housing (10) toward the operational position of the terminal holding module (20);
- varying, along said mounting path, the tilt of the terminal holding module (20) with respect to the first direction (A) of the first portion (11) of the connector housing (10); and,
- setting said tilt to zero where the terminal holding module (20) reaches the operational position.

2. Angular electrical connector assembly (1) according to claim 1, wherein the mutually associated guiding means comprise two guide pins (22.1,22.2) extending laterally from either side of a base plate (29) of the terminal holding module (20), and adapted to engage into respective longitudinal slots (200.1,200.2) of said associated guiding means provided in the inner walls of the first portion (11) of the connector housing (10) and adapted to longitudinally guide the tilted terminal holding module (20) along the mounting path within the connector housing (10), in cooperation with said guide pins (22.1,22.2).
3. Angular electrical connector assembly (1) according to claim 2, wherein the longitudinal slots (200.1,200.2) of the mutually associated guiding means comprise ramps (201.1,201.2) (200.1,200.2) respectively arranged at the rear end of said slots (200.1,200.2) and each having a rising slope with respect to the direction (A) of extension of the first portion (11) of the connector housing (10) oriented from the rear towards the front of said first portion (11).
4. Angular electrical connector assembly (1) according to anyone of claims 1 through 3, wherein the mutually associated guiding means further comprise an inferior support foot (23) at the terminal holding module (20), the apex of said inferior support foot (23) in the down oriented vertical direction when a direction (B) of extension of the terminal holding module (20) is oriented horizontally being the lowest end point of said terminal holding module (20), said inferior support foot (23) being adapted to slide on the bottom of inner walls of the rear portion (11) of the connector housing (10) when the tilted terminal holding module (20) is moved forward along the mounting path.
5. Angular electrical connector assembly (1) according to anyone of claims 1 through 4, wherein the mutually associated guiding means further comprise a superior contact head (26) at the terminal holding module (20), which corresponds to upper end point of said terminal holding module (20), said superior contact head (26) being adapted to come into contact with and to slide on the top of inner walls of the rear portion (11) of the connector housing (10), when the tilted terminal holding module (20) is moved forward along the mounting path.
6. Angular electrical connector assembly (1) according to claim 5, wherein the superior contact head (26) is defined by the upper apex of the outer periphery of a transverse base plate (29) of the terminal holding module (20).
7. Angular electrical connector assembly (1) according to claim 6, wherein the superior contact head (26) of the terminal holding module (20) corresponds to the central point of the outer periphery of the transverse base plate (29) of said terminal holding module (20) with respect to a direction transverse to the direction (C) of extension of said module (20).
8. Angular electrical connector assembly (1) according to anyone of claims 1 through 7, wherein the mutually associated guiding means further include at least one, and preferably two longitudinally extending notch (28.1,28.2) arranged in the terminal holding module (20), which are adapted to cooperate with an associated guide-rail (210.1,210.2) of the mutually associated guiding means which extend longitudinally from inner walls of the rear portion (11) of the connector housing (10).
9. Angular electrical connector assembly (1) according to claim 8, wherein the notches are provided in the lower part of the periphery of the base plate (29) of the terminal holding module (20) at a level lower than the rear tail portion (25) of said module (20), and wherein the associated guide rails (210.1,210.2) are provided in respective correlative positions in the low area of the inner walls of the rear portion (11) of the connector housing (10).
10. Angular electrical connector assembly (1) according to any one of claims 8 and 9, wherein the two notches (28.1,28.2) are formed within a lower arc of the base plate (29) of the terminal holding module (20), on either side of a central point middle point with respect to a direction transverses to the longitudinal axis (C) of the axis X of said module (20).
11. Angular electrical connector assembly (1) according to any one of claims 1 through 10, wherein the mutually associated guiding means further comprise an upper pad (220.4) extending downwardly from the top of inner walls of the connector housing (10) and having a ramp (221.4) with a declining slope with respect to the rear to front oriented direction (A) of extension of the rear portion (11) of the connector housing (10), which is adapted to cooperate with an associated element of the guiding means formed by a frontward extending upper latching hook (27.4) of the terminal

holding module (20), so that, when a front end of said upper latching hook (27.4) slides down said ramp as the result of the terminal holding module (20) moving forward along the mounting path, the direction (C) of extension of the terminal holding module (20) progressively aligns itself with the direction (A) of extension of the connector housing (10) and the second straight mating section (31.2) of the terminals (31) enters the second portion (12) of the connector housing (10) and progressively aligns there with the direction (B) of extension of said second portion (12), and so that full alignments of directions, namely both the alignment of the direction (C) of extension of the terminal holding module (20) with the direction (A) of extension of the connector housing (10) and the alignment of the second straight mating section (31.2) of the terminals (31) with the direction (B) of extension of the second portion (12) of the connector housing (10), be completed before the terminal holding module (20) reaches its operational position.

12. Angular electrical connector assembly (1) according to claim 11, wherein the upper latching hook (27.4) of the terminal holding module (20) comprises a through hole adapted to cooperate with a pin of upper pad (220.4) extending downwardly from the top of inner walls of the connector housing (10) to latch said terminal holding module (20) in its operational position within said connector housing (10), when said operational position of the terminal holding module (20) is reached.
13. Angular electrical connector assembly (1) according to any one of claims 1 through 12, wherein the first part of the connector housing (10) comprises a lower pad (220.3) extending upwardly from the bottom of inner walls of said connector housing (10) and having a ramp (221.3) with a rising slope with respect to the rear to front oriented direction (A) of extension of said rear portion (11) of the connector housing (10), which is adapted to cooperate with an associated frontward extending lower latching hook (27.3) of the terminal holding module (20) to latch said terminal holding module (20) in its operational position within said connector housing (10), when said operational position of the terminal holding module (20) is reached.
14. Angular electrical connector assembly (1) according to either one of claims 1 through 13, wherein the longitudinal slots (200.1,200.2) of the mutually associated guiding means each include a cul-de-sac (202.1,202.2), on their front side, which form abutments defining the front end of the mounting path, being adapted to stop forward movement of the terminal holding module (20) along the longitudinal direction (A) of the rear portion (11) of the terminal housing (10) as the result of the guide-pins (22.1,22.2) abutting same, when said module (20) has reached its operational position.
15. Electrical connector comprising an electrical terminal assembly according to any one of Claims 1 to 14.



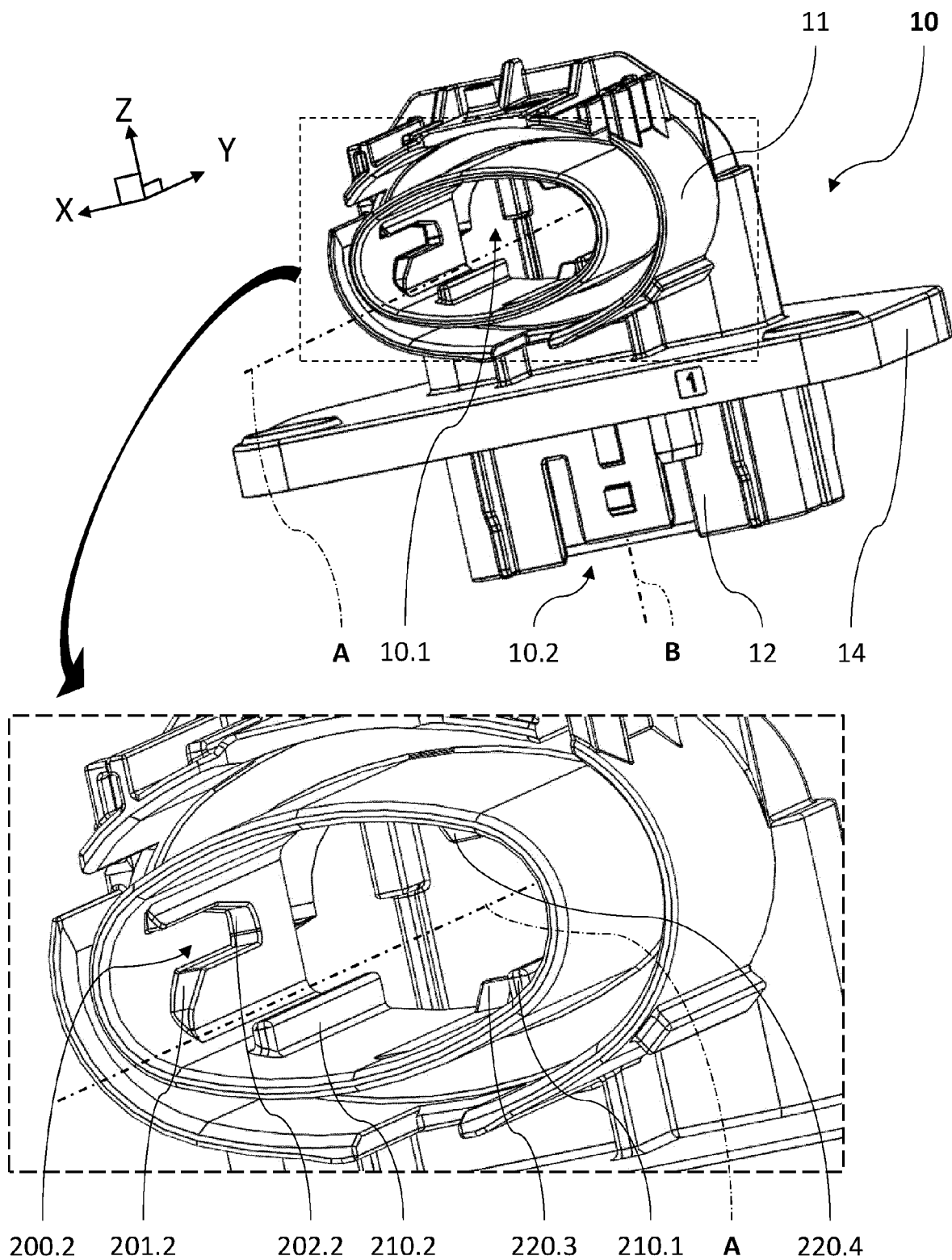


Fig.2

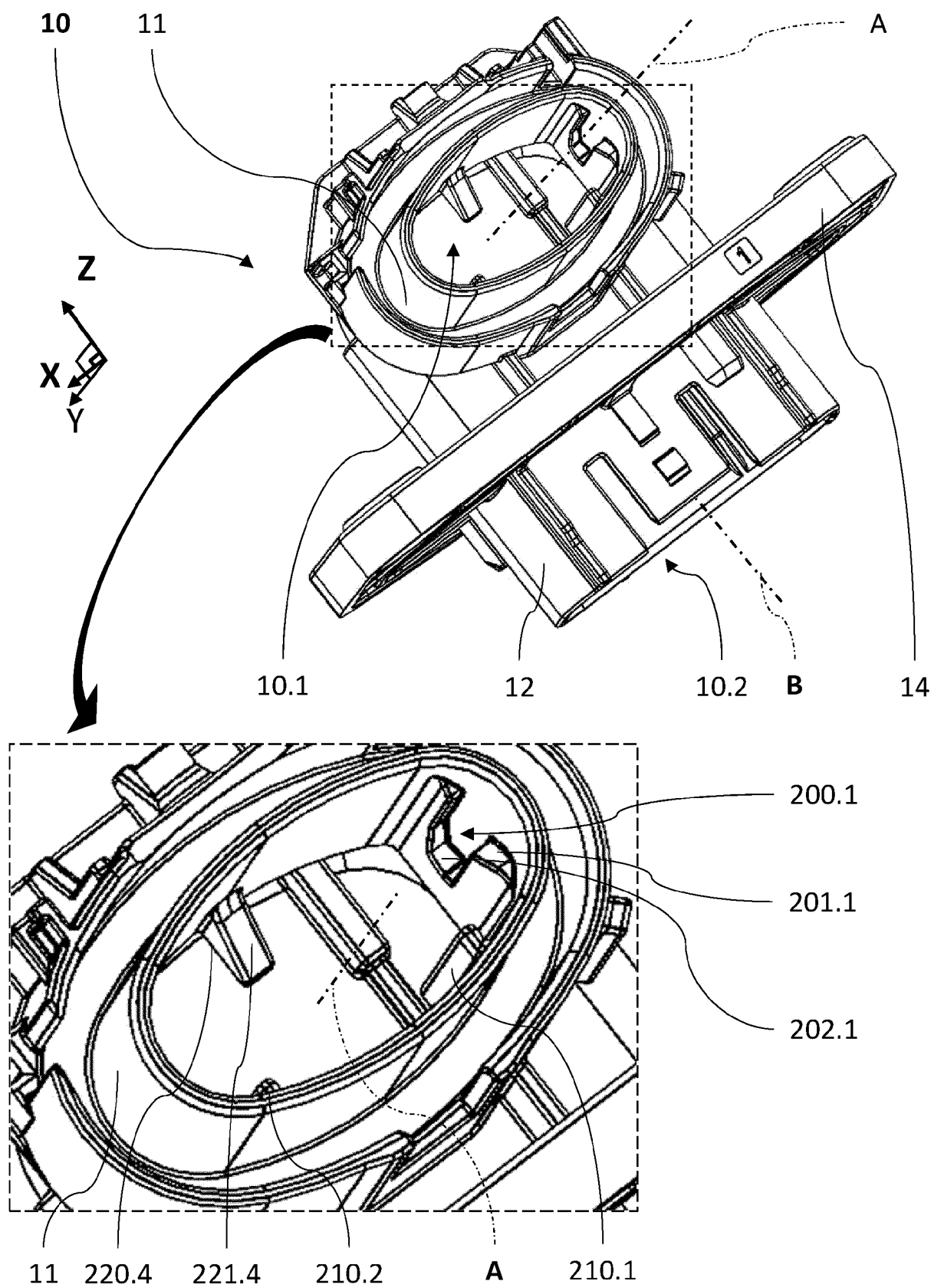


Fig.3

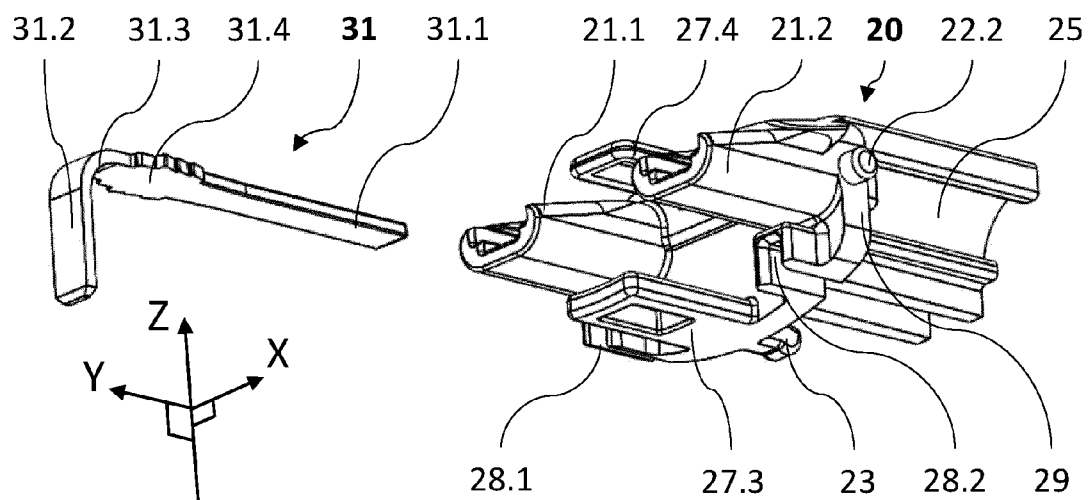


Fig.4A

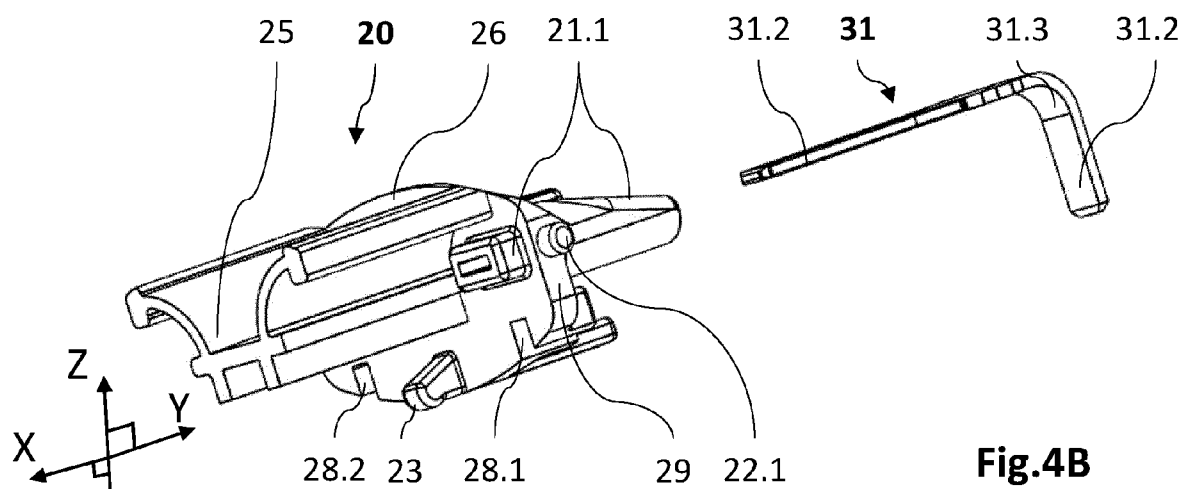


Fig.4B

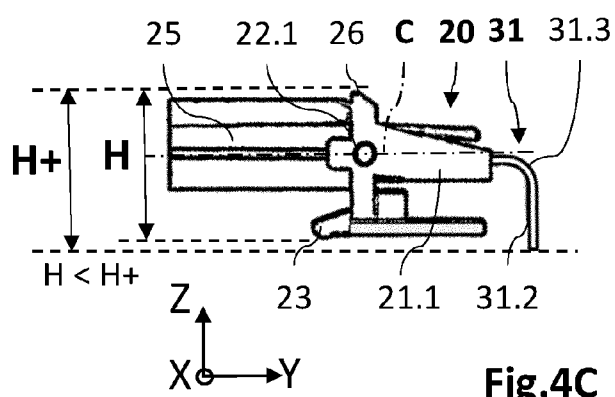


Fig.4C

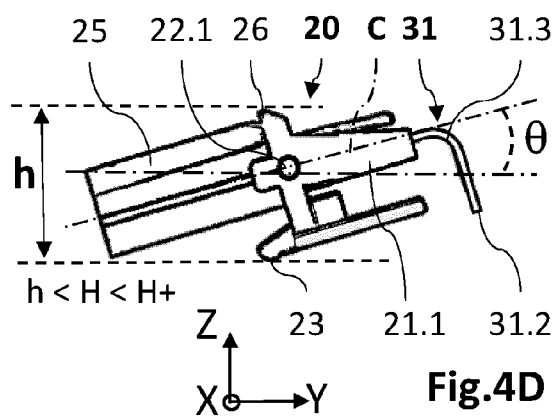


Fig.4D

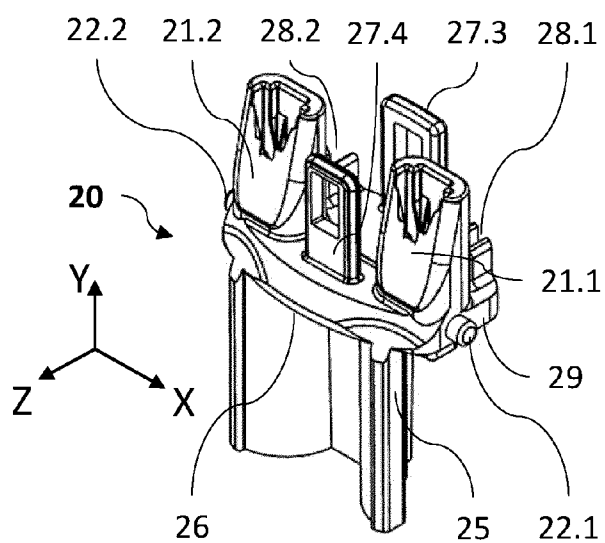


Fig. 5A

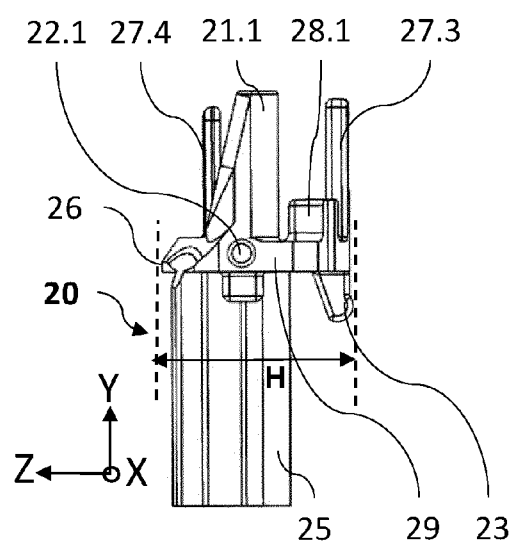


Fig. 5B

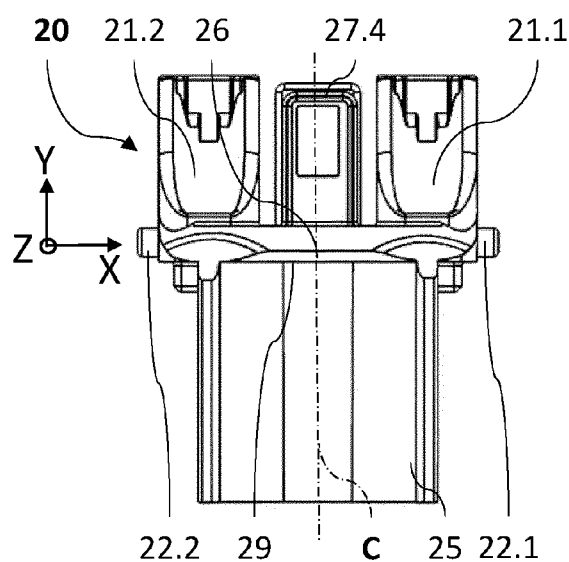


Fig. 5C

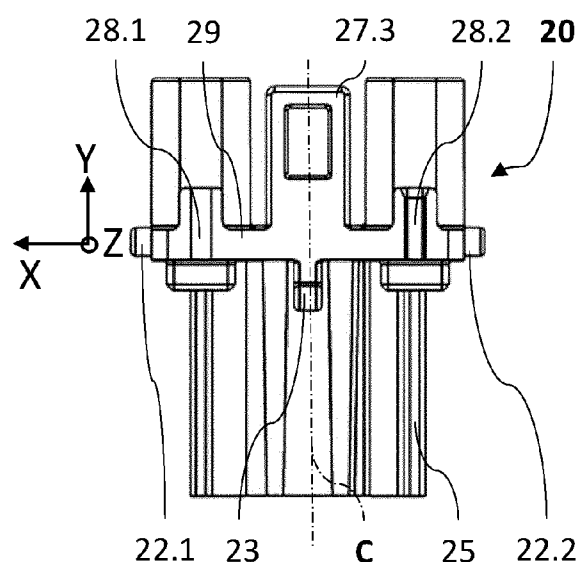


Fig. 5D

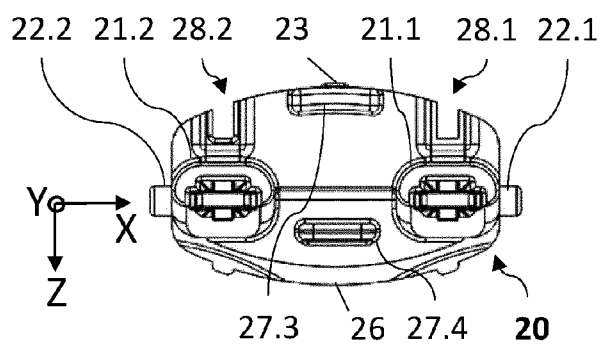


Fig. 5E

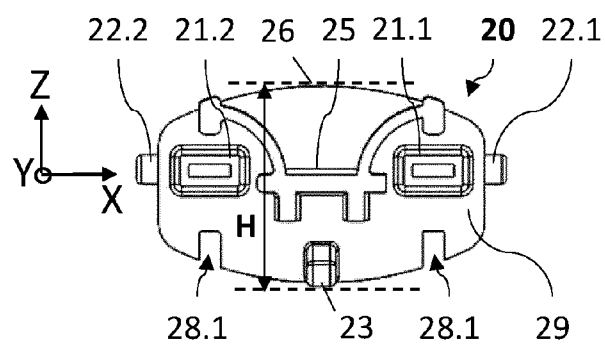


Fig. 5F

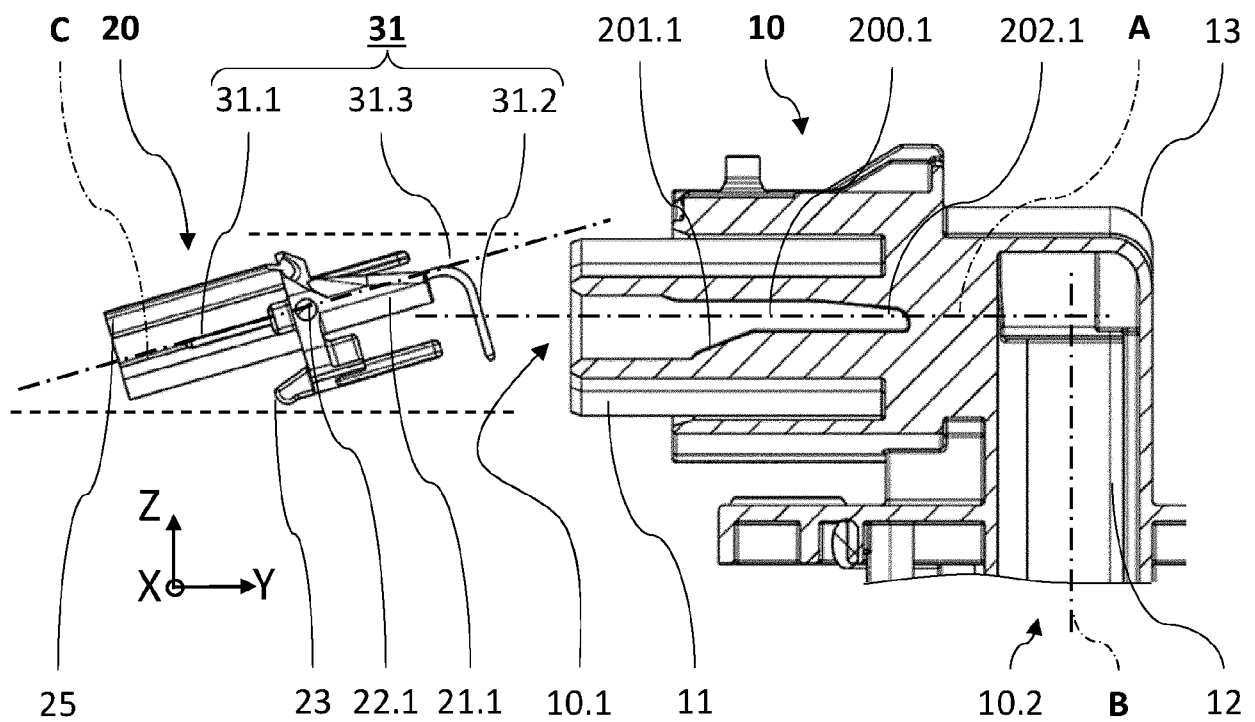


Fig.6A

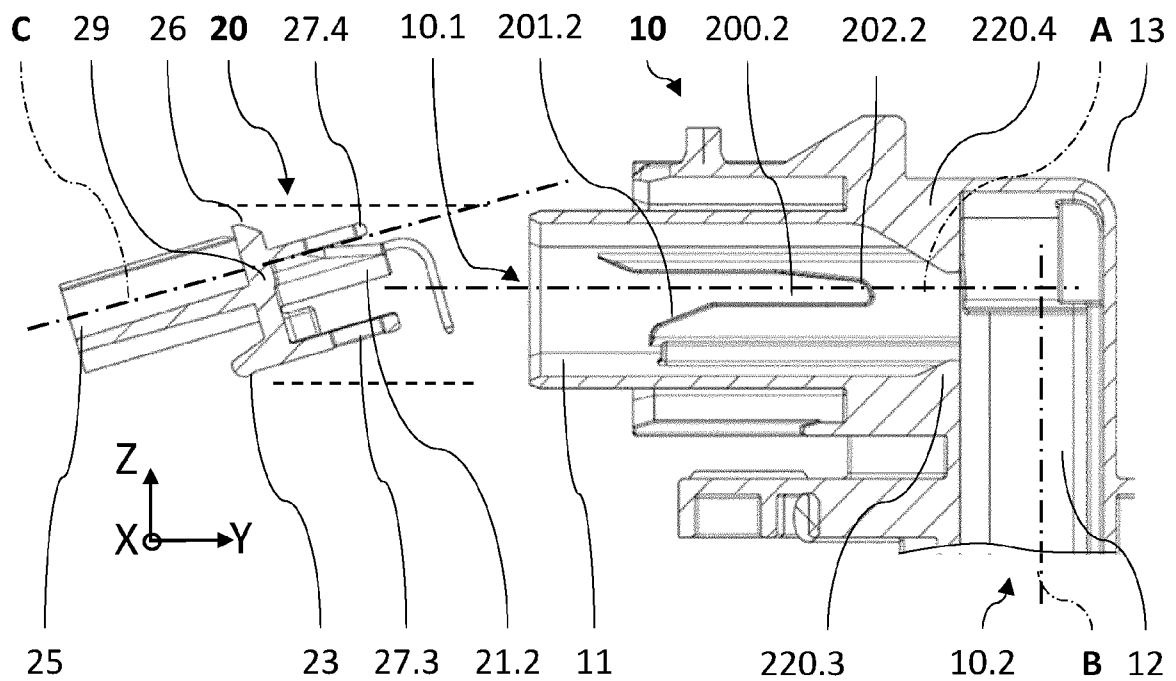


Fig.6B

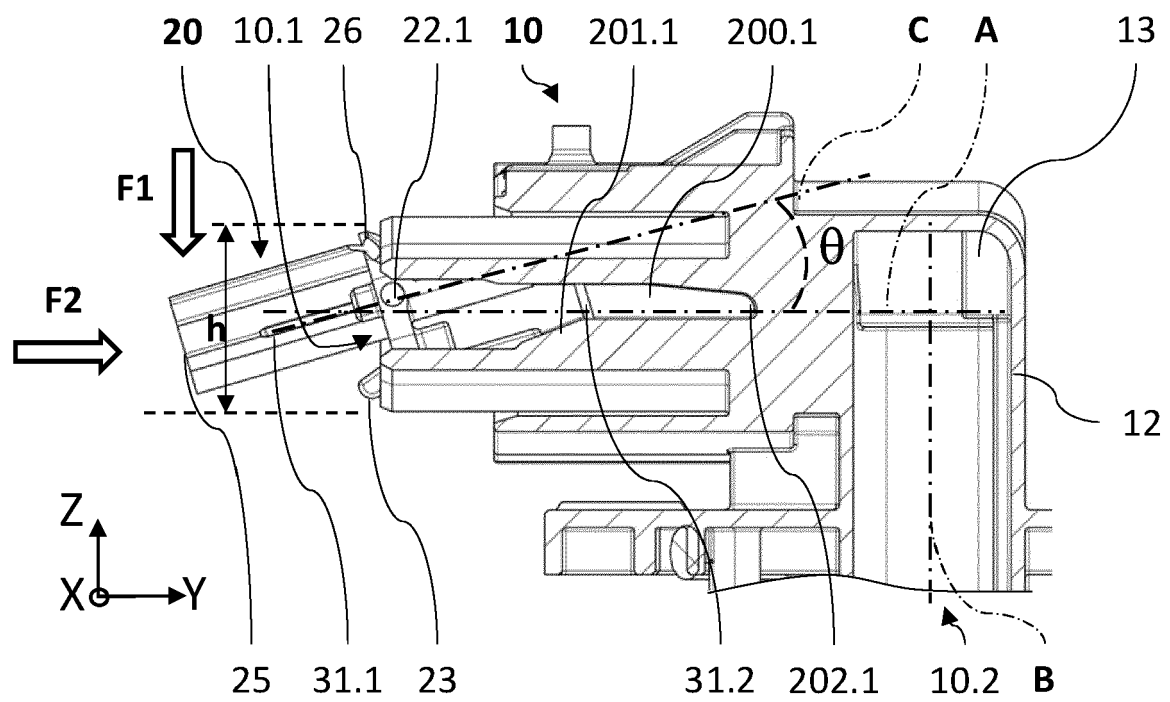


Fig.7A

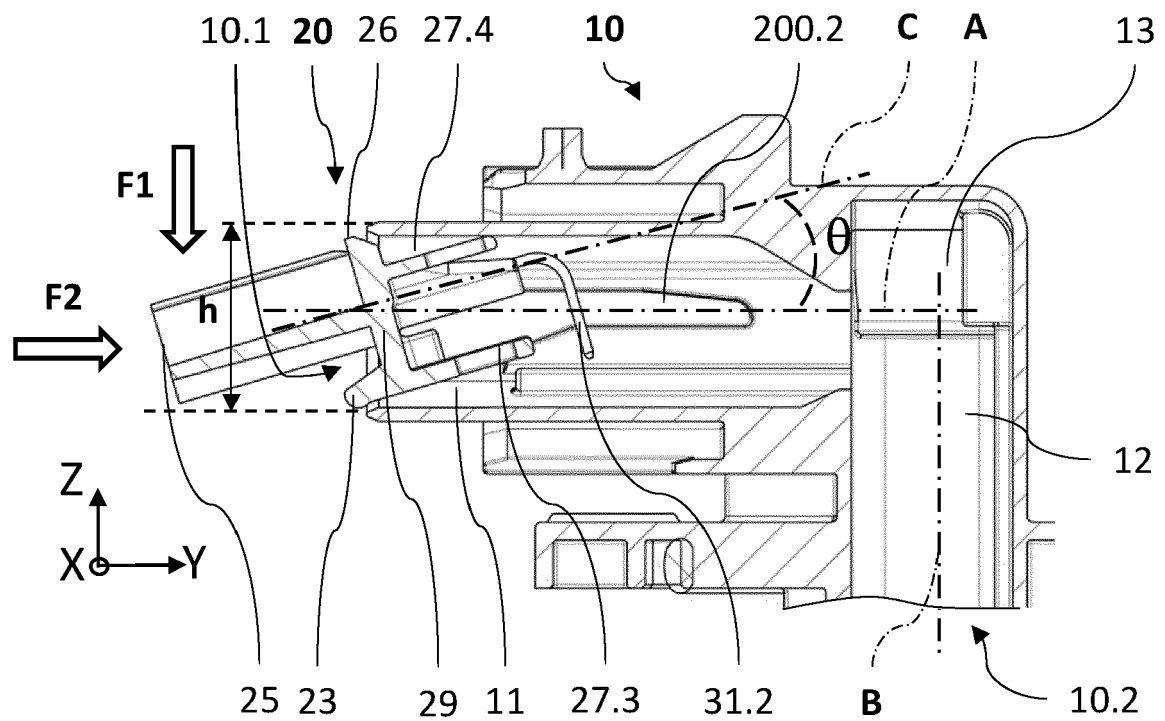


Fig.7B

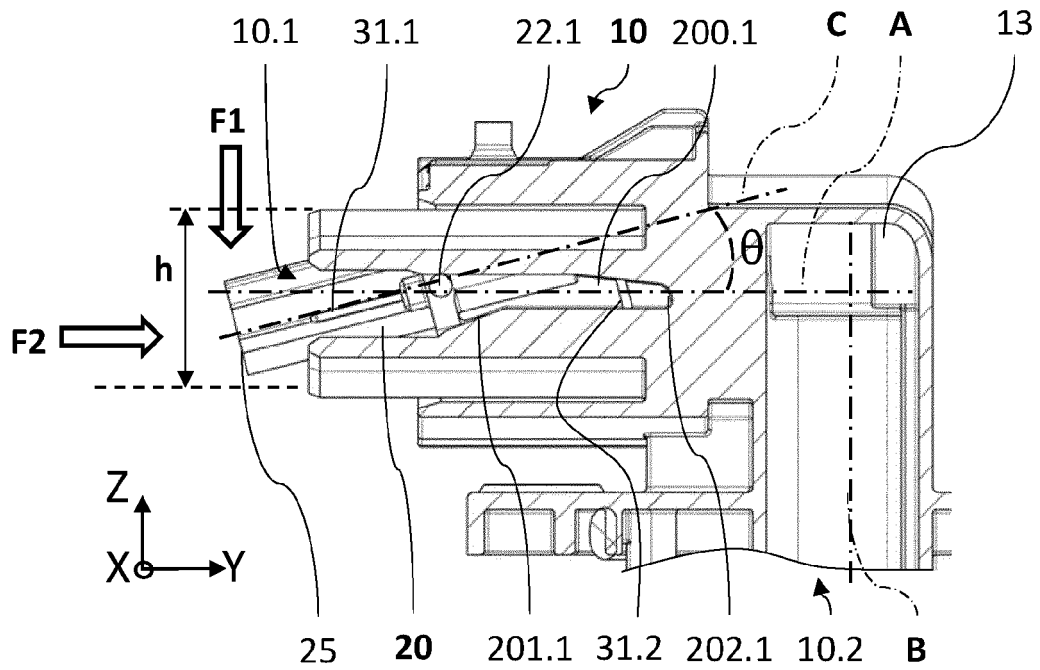


Fig.8A

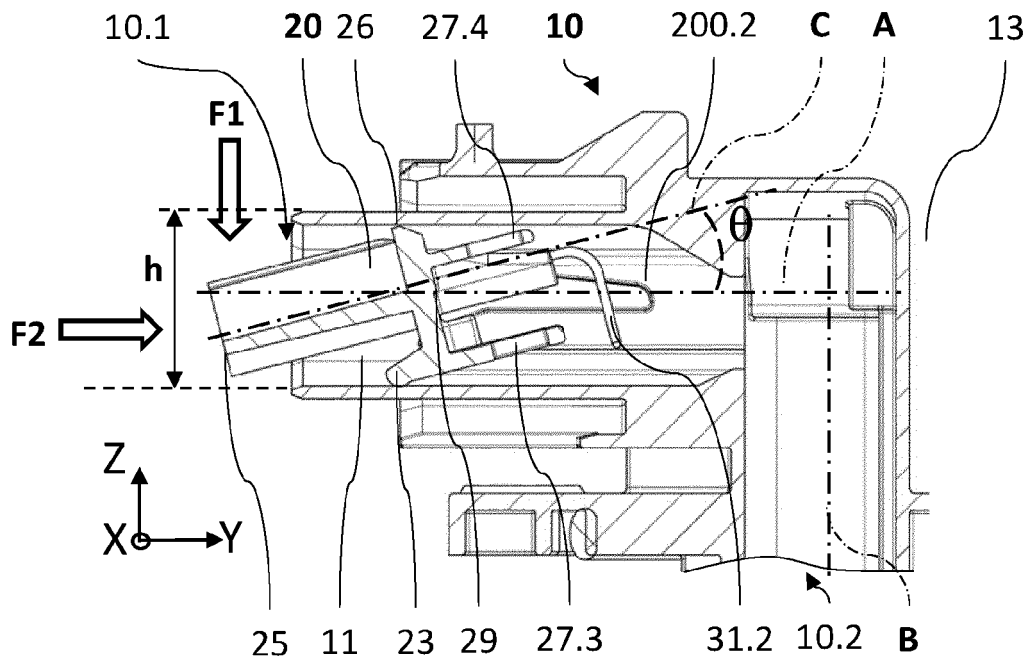


Fig.8B

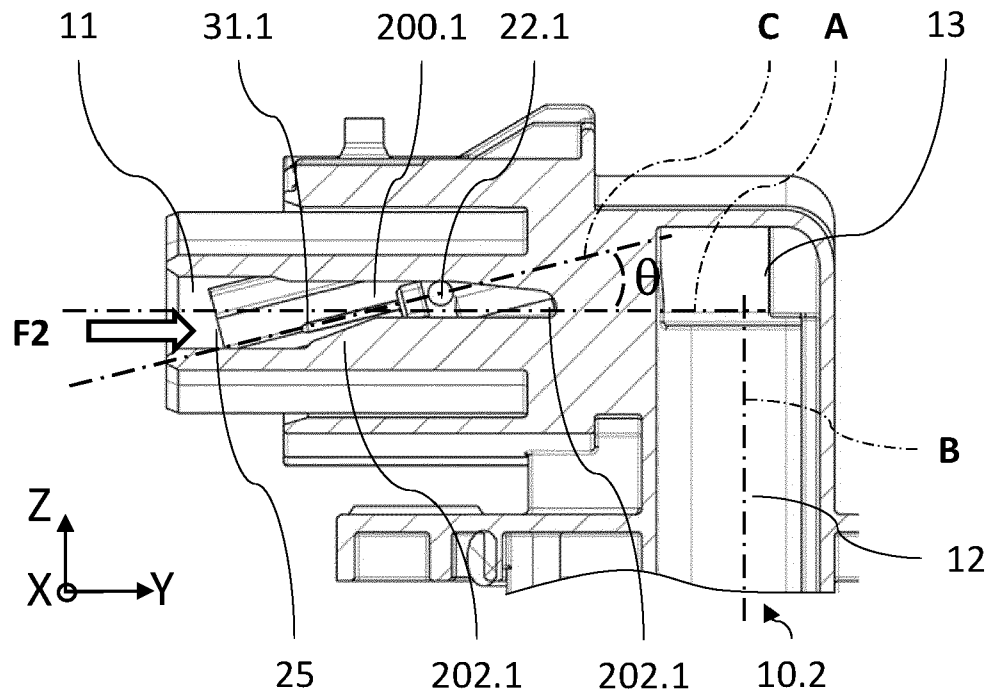


Fig.9A

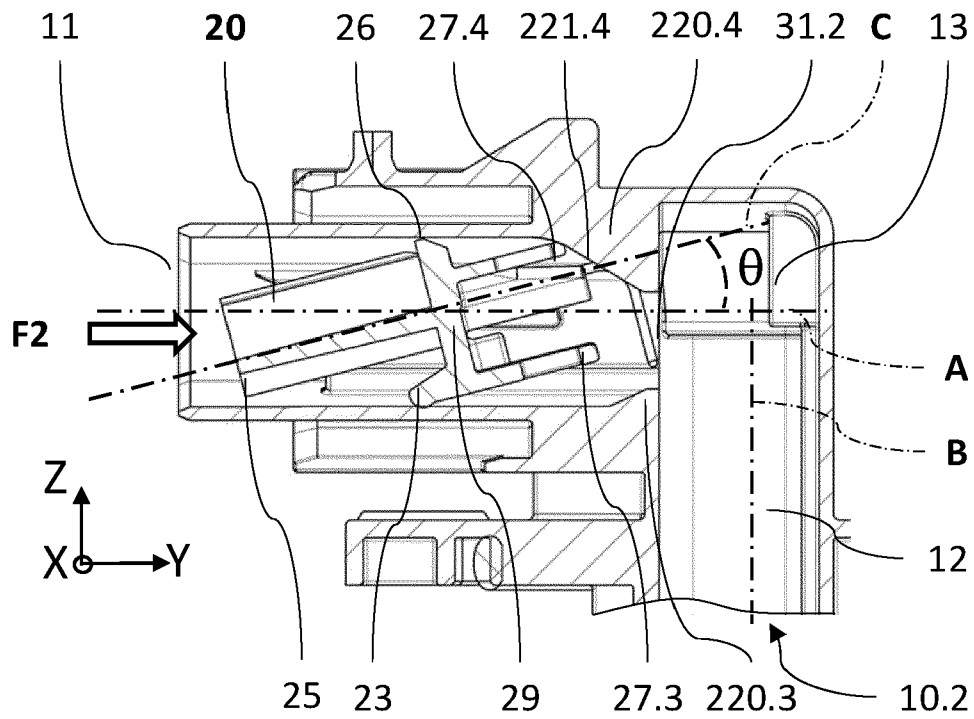


Fig.9B

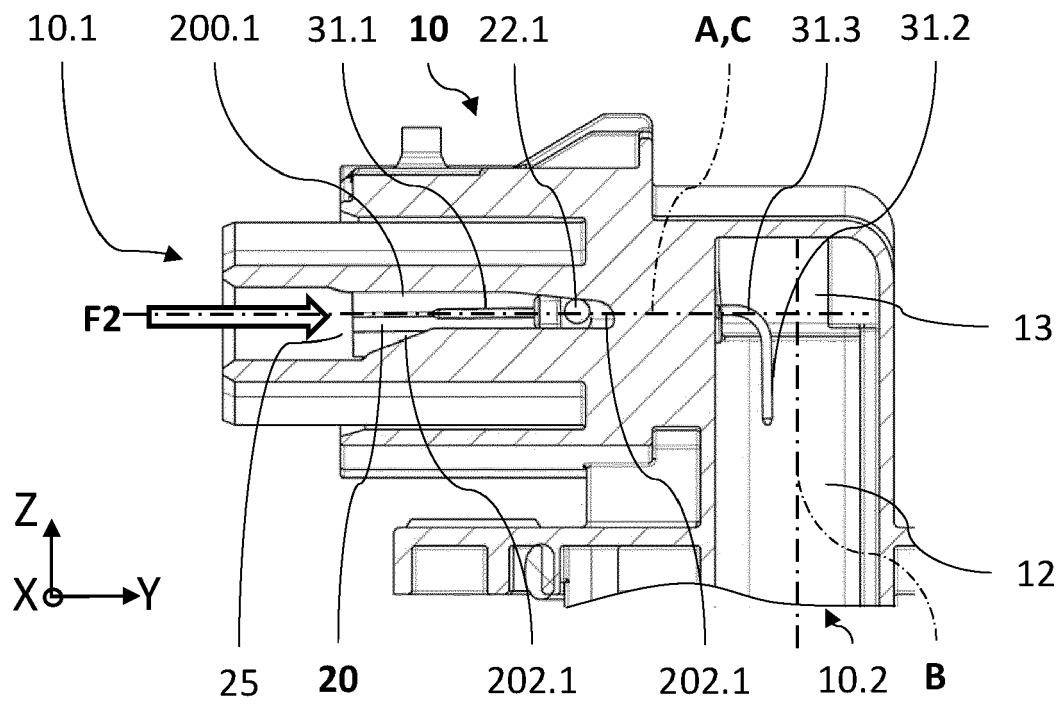


Fig.10A

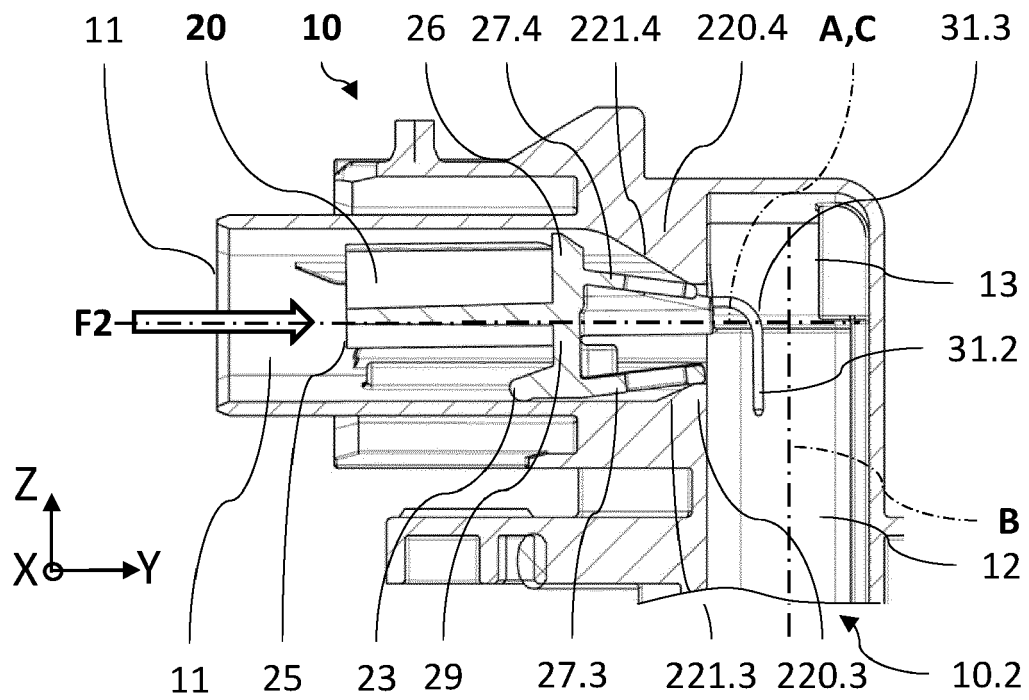


Fig.10B

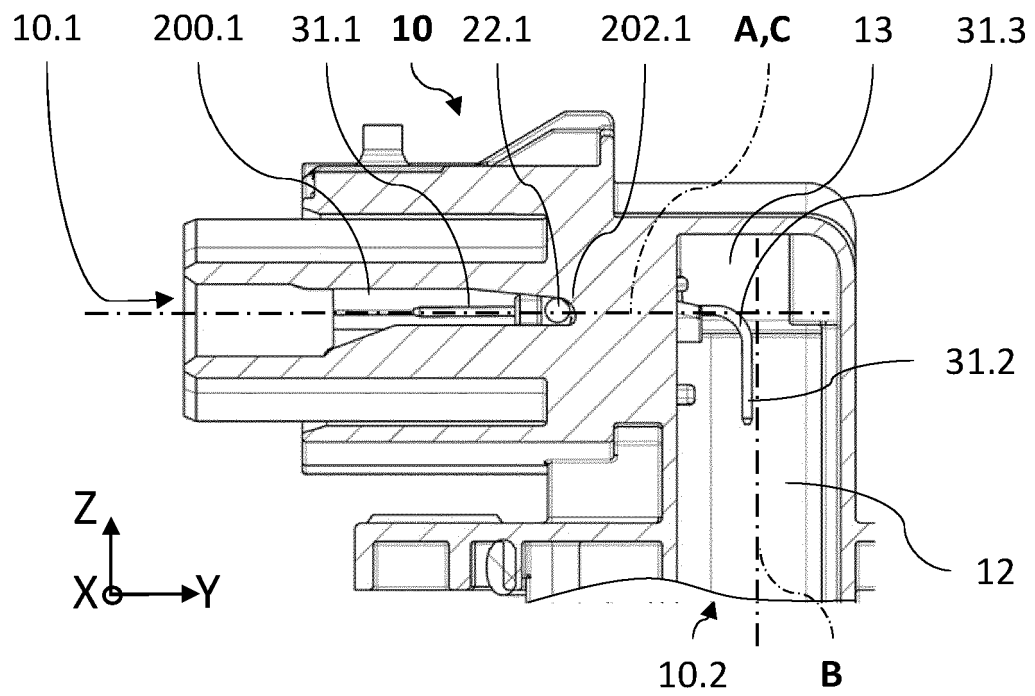


Fig.11A

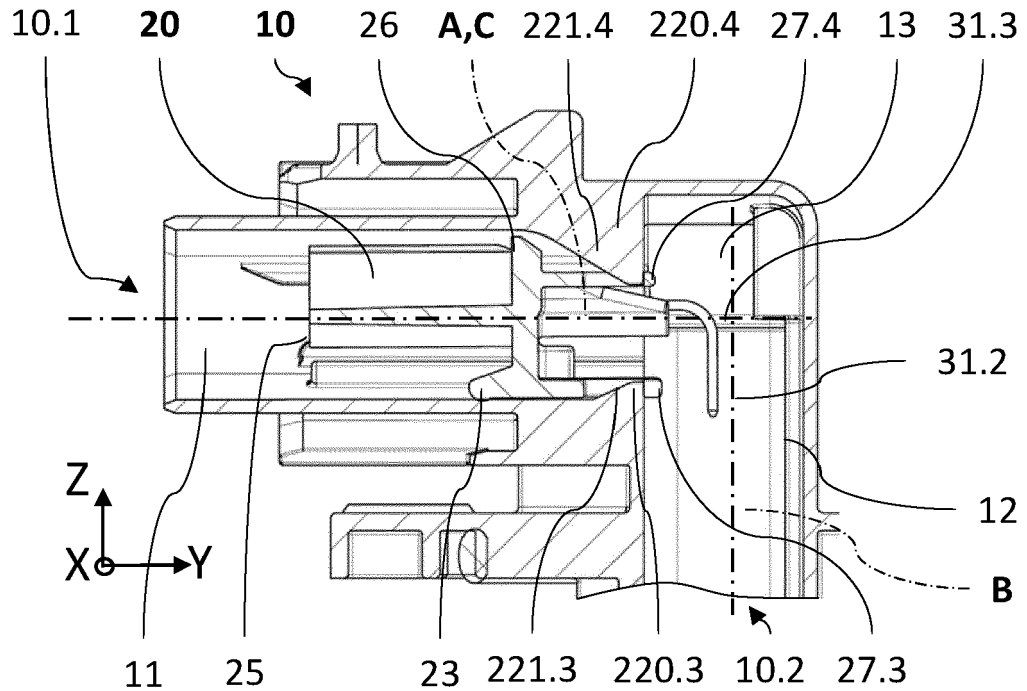


Fig.11B



EUROPEAN SEARCH REPORT

Application Number

EP 23 20 0258

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	DE 198 05 708 C2 (TYCO ELECTRONICS LOGISTICS AG [CH]) 6 March 2003 (2003-03-06) * figures 1-12 *	1-15	INV. H01R13/506
A	EP 3 866 277 A1 (APTIV TECH LTD [BB]) 18 August 2021 (2021-08-18) * paragraphs [0011] - [0013]; figures 1-7 *	1-15	
A	EP 3 338 326 B1 (HARTING ELECTRIC GMBH & CO KG [DE]) 26 January 2022 (2022-01-26) * paragraph [0036]; figures 1-5 *	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 7 March 2024	Examiner Teske, Ekkehard
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	

EPO FORM 1503 03.82 (P04C01)

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

EP 23 20 0258

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

07-03-2024

10

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 19805708	C2	06-03-2003	NONE

EP 3866277	A1	18-08-2021	CN 113270749 A
			EP 3866277 A1
			US 2021257778 A1

EP 3338326	B1	26-01-2022	CN 107925183 A
			DE 102015113786 A1
			EP 3338326 A1
			US 2018241147 A1
			WO 2017028844 A1

25

30

35

40

45

50

55

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- DE 19805708 C2 [0008]