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(71) Applicant: **TE CONNECTIVITY GERMANY GMBH** [DE/DE]; Ampèrestrasse 12-14, 64625 Bensheim (DE).

(72) Inventors: **KONRAD, Stefan**; In den Hausgaerten 21, 73037 Goeppingen-Holzheim (DE). **VOLKMANN, Daniel**; Roemerweg 17, 64686 Lautertal (DE).

(74) Agent: **FASSIO, Valeria**; Murgitroyd & Company, Piazza Borromeo 12, 20123 Milan (IT).

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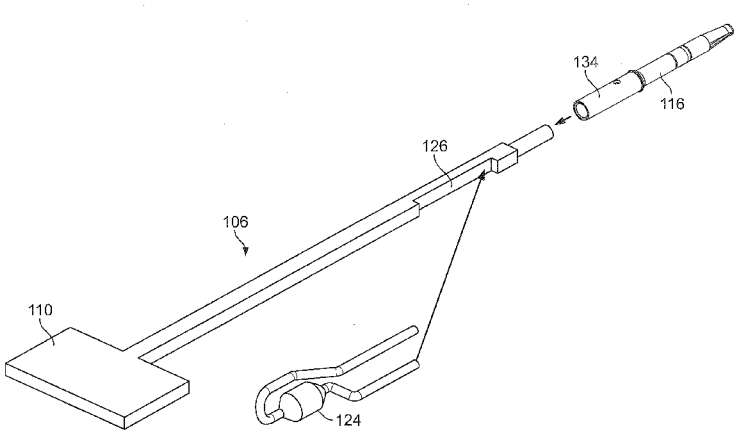


Fig. 1

(57) Abstract: The present invention relates to an antenna arrangement with an antenna unit and a connector unit for electrically connecting the antenna arrangement to a corresponding mating connector unit. The antenna unit has a conductor element and a ground element, the conductor element having at its tip a level conductor surface protruding to the side, and the ground element having two level ground planes lying opposite one another. In addition, the connector unit comprises a coaxial connector with an inner conductor and an outer conductor, the conductor element being connected electrically to the inner conductor, and the ground element to the outer conductor of the coaxial connector. The conductor element and the ground element are arranged in relation to one another within the antenna unit such that the conductor surface is orientated substantially at a right angle to the two ground planes. The invention additionally relates to a production method for an antenna arrangement with an antenna unit and a connector unit for electrically connecting the antenna arrangement to a corresponding mating connector unit.

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ANTENNA ARRANGEMENT WITH ANTENNA UNIT AND CONNECTOR UNIT AS WELL AS PRODUCTION METHOD

The present invention relates to an antenna arrangement with an antenna unit and a connector unit for electrically connecting the antenna arrangement to a corresponding mating connector unit.

Such antennas are widely used, especially in the automotive domain, and serve to transmit a wide variety of signals. Monopole antennas are often used nowadays, in particular for multimedia applications with high data rates. In its simplest form this type of monopole antenna consists of a straight cylindrical conductor that is stimulated towards earth at a base point. The electrical properties of such antennas depend upon the geometry of both the monopole element and the ground plane. The length of the monopole is approximately a quarter of the wavelength that is to be transmitted.

In general, for example for communication in vehicles, special antenna elements are used that enable wireless communication between devices within such vehicles or with a central unit within the vehicle. This type of device can be, for example, movement sensors, speed sensors, sensors for detecting vehicle-specific operating states, tyre pressure sensors, multi-media devices, hands-free equipment, computers and mobile telephones of the passengers. Moreover, in recent times it has been desired more and more frequently to offer to all of the passengers in a vehicle mobile Internet which can be accessed by means of a mobile telephone, notebook or, for example, screens in the headrests.

Therefore, particular requirements are made of antennas as used for communication.

On the one hand, stringent requirements are made of this type of antenna as regards the dimensions and the form of the antenna element, and in particular it is mostly required that the size is as small as possible and that the antenna element can fit into existing housings of, for example, vehicle-specific electronic devices, the available space mostly being small.

Furthermore, with these types of antenna arrangement there is mostly a need to connect the latter to an already provided mating connector, in particular a coaxial plug connector, by means of a connector arrangement.

There is therefore a need to specify an antenna arrangement that can be contacted via a connector arrangement and that can be miniaturised to a large extent.

In addition, with a miniaturised antenna arrangement it is very important to optimise the antenna performance in order to guarantee an optimal, interruption-free exchange of information with a consistently high data rate. At the same time, this type of performance-optimised antenna arrangement should be produced in the simplest and most efficient way possible in order to remain competitive on the market.

This object is achieved by the subject matter of the independent claims. Advantageous further developments of the present invention are the subject matter of the dependent claims.

The present invention is based on the idea of configuring an antenna arrangement such that optimal function and performance is achieved by a special arrangement of a monopole antenna with a rectangular tip and a three-dimensional ground plane that acts as a ground element and that can be attached to a connector unit of the antenna arrangement by means of a crimp connection. The efficient production of this type of optimised antenna arrangement is achieved in particular by a metallic stamped part, that then serves as a ground element, being bent into a special three-dimensional, wing-like W-shape, and then being crimped around an outer

conductor of the connector unit together with a resistor in a single crimping process and at the same time an electrical connection being established between the ground element, the resistor and the outer conductor of the connector unit.

In particular, the antenna unit has a conductor element and a ground element, according to the present invention the conductor element having at its tip a level conductor surface, protruding to the side, and the ground element having two level ground planes lying opposite one another. This rectangular conductor surface, protruding to the side, contributes to improved emission characteristics and improved performance of the antenna unit, with at the same time the possibility of shortening the antenna unit and the conductor element.

The connector unit comprises a coaxial connector with an inner conductor and an outer conductor, the conductor element being connected electrically to the inner conductor, and the ground element to the outer conductor of the coaxial connector.

According to the invention the conductor element and the ground element are arranged in relation to one another within the antenna unit such that the conductor surface is orientated substantially at a right angle to the two ground planes. Due to the special form of the bent and stamped part that the ground element (ground plane) constitutes, and the right-angled arrangement of essential parts of the ground element with regard to the plane of the conductor surface of the conductor element, the antenna arrangement has improved antenna performance and increased efficiency. In addition, this antenna arrangement constitutes a simplified design and allows efficient and inexpensive production.

According to one advantageous further development of the present invention the antenna unit is designed such that at least part of the conductor element is surrounded by the two ground planes of the ground element at the side. In particular, the two ground planes of the ground element are advantageously arranged the same predefined first distance (d1) away from the conductor element here.

An arrangement of the two ground planes of the ground element respectively along the conductor element provides improved antenna behaviour.

According to another advantageous further development of the present invention the antenna unit is designed such that the conductor surface is arranged a pre-defined second distance (d2) away from the ground element.

According to another advantageous further development of the present invention the conductor surface and the two ground planes respectively have a rectangular base area.

According to another advantageous further development of the present invention the ground element also has a fastening element that establishes the electrical and a mechanical connection between the ground element and the outer conductor. Due to this fastening element the ground element can easily be connected mechanically and electrically to the outer conductor of the coaxial connector by means of a crimp or solder connection. Thus, in a single crimping or soldering step, the fitting of the ground element and at the same time also the electrical connection can be established.

According to another advantageous further development of the present invention the ground element is produced in one piece. Since the ground element is e.g. initially stamped from a metallic sheet and is then bent into the desired shape, production can be implemented quickly and inexpensively or in a fully automated manner. Therefore, according to the invention the complicated connection of individual elements is not required because the element is produced in one piece.

According to another advantageous further development of the present invention the ground element also comprises two L-shaped connection elements which each connect one of the two ground planes to the fastening element and in which an arm respectively bordering the fastening element is formed along the conductor element and a respective other arm is formed transversely to the conductor element.

According to another advantageous further development of the present invention the antenna unit also comprises a resistor that connects the conductor element electrically to the ground element, the electrical connection to the conductor element being provided by securely soldering a corresponding connection wire of the resistor in a recess of the conductor element, and the electrical connection to the ground element being provided by securely crimping a corresponding connection wire of the resistor between the fastening element and the outer conductor.

According to another advantageous further development of the present invention the arms of the two connection elements bordering the fastening element are arranged a predefined distance (d3) away from one another so that a space thus produced between the connection elements allows the resistor to be accommodated.

According to another advantageous further development of the present invention the connector unit also comprises an electrically insulating housing that encloses the antenna unit. This housing advantageously serves as dust protection and protection against damage to the antenna unit.

According to another advantageous further development of the present invention there are located in the housing supporting ribs which support the conductor surface of the conductor element laterally and/or the two ground planes respectively having on the opposite edges detents which engage in corresponding recesses in the housing of the connector unit. The supporting ribs advantageously serve to fix the conductor surface of the conductor element securely in the housing. The detents advantageously serve to fix the housing securely to the ground element, and so to the antenna unit.

In the field of high frequency connector arrangements, in particular with coaxial cable connectors, various industrial standards are used in order to standardise the different connector arrangement types, in particular the interfaces for such connector arrangements. One of these standards is known under the name FAKRA (Fachkreis Automobil). FAKRA is the automotive circle of experts of the German Standardisation Institute that represents international standardisation interests in the automotive sector. The FAKRA standard provides a system based on mechanical coding and colour-coding for the correct fitting of connectors. With FAKRA connectors the same socket elevations can only be connected to identical plug recesses. Safe positioning of connector housing locking devices is facilitated by locking according to the FAKRA standard to the socket housing and a locking device that interacts with the latter on the plug housing.

An example of a plug connector that can be used in an antenna arrangement according to the present invention is described in detail in DE 10 2012 201565 A1, in particular with reference to Figs. 1, 3 and 5.

According to another advantageous further development of the present invention the coaxial connector is an SMBA (FAKRA, **F**ach**k**reis **A**utomobil) plug connector according to DIN 72594-1 and USCAR-18 or a coaxial screw connector.

The present invention can be used particularly advantageously in connection with WiFi applications, and it is advantageous here, for example, to dimension the antenna arrangement to receive frequencies of 2.4 GHz.

Needless to say however, any other required frequencies and also a number of frequencies can be transmitted with the aid of the antenna arrangement according to the invention.

The method according to the invention relates to the production of an antenna arrangement with an antenna unit and a connector unit for electrically connecting the antenna arrangement to a corresponding mating connector unit, the antenna unit comprising a conductor element and a ground element; the conductor element having at its tip a level conductor surface protruding to the side, and the ground element having two level ground planes lying opposite one another; and the connector unit having a coaxial connector with an inner conductor, and an outer conductor.

The production method according to the invention is implemented in the following advantageous manner. First of all, the conductor element of the antenna unit is connected electrically to the inner conductor of the connector unit. Next the ground element of the antenna unit is connected electrically to the outer conductor of the connector unit. After this, the conductor element and the ground element are arranged in the antenna unit such that the conductor surface is orientated substantially at a right angle to the two ground planes.

According to another advantageous further development of the present invention the production method additionally includes the electrical and mechanical connection of the outer conductor to a fastening element included by the ground element. Since this step takes place at the same time, a secure connection of the respective components can be produced in a simple, fast and cost-saving way, and at the same time an electrical connection can be produced.

According to another advantageous further development of the present invention the production method additionally includes securely soldering a connection wire of a resistor included by the antenna unit in a recess of the conductor element and securely crimping another connection wire of the resistor between the fastening element and the outer conductor so that the resistor connects the conductor element electrically to the ground element.

For better understanding of the present invention the latter is described in more detail by means of the exemplary embodiments shown in the following figures. Here identical parts are provided with the same reference numbers and the same component designations. Furthermore, some features or combinations of features from the different embodiments shown and described taken in their own right may also constitute independent inventive solutions or solutions according to the invention.

The figures show as follows:

Fig. 1 a perspective illustration of the conductor element according to the present invention;

Fig. 2 a perspective illustration of the conductor element with a fitted resistor according to the present invention;

Fig. 3 a perspective illustration of the conductor element with a fitted resistor and stopper according to the present invention;

Fig. 4 a perspective illustration of the conductor element with a fitted resistor and coaxial connector and the ground element according to the present invention;

Fig. 5 a top view of the still unshaped ground element according to the present invention;

Fig. 6 a perspective illustration of the conductor element with the fitted resistor, coaxial connector and fitted ground element according to the present invention;

Fig. 7 a sectional illustration of the housing of the antenna arrangement with a connector unit according to the present invention;

Fig. 8 sectional illustrations of all of the component parts of the antenna arrangement according to the present invention; and

Fig. 9 perspective external views of the antenna arrangement according to the present invention.

In the following the present invention will be described in detail with reference to the figures. With reference to Figures 1 to 4 and 6 the structure of the antenna unit 102 according to the invention will first of all be considered in more detail.

As can be gathered from **Figure 1**, which shows a perspective illustration of the conductor element 106 according to the present invention, the central element of the antenna unit 102 consists of a conductor element 106. Advantageously the conductor element 106 is produced by stamping, or for example also by laser cutting a metal plate or a plate/material containing metal or a conductive material. For example, the conductor element 106 that has been stamped or that has been cut out by means of a laser has a thickness of 0.8 mm. According to the invention the conductor element 106 has at the one end a plug-like, cylindrical end which is suitable for being pushed into an inner conductor 116 of a coaxial connector 114 and being soldered or crimped on. The inner conductor 116 here can be, for example, the socket of a FAKRA centre contact plug.

According to the invention the conductor element 106 comprises on its other end, as seen in the longitudinal direction of the conductor element 106, in the following referred to as the tip of the conductor element 106, a conductor surface 110. The tip of the conductor element 106 is defined here as the end of the conductor element 106 that is not connected to the inner conductor 116 of the coaxial connector 114. Therefore, this conductor surface 110 lies opposite the cylindrically shaped plug end that is introduced onto the FAKRA centre contact socket and is soldered or crimped on. Advantageously, this conductor surface 110 is a protruding, level conductor surface, protruding laterally in the sense of the invention being understood to mean transversely to the direction of extension or the longitudinal direction of the conductor element 106. For example, together with the conductor surface 110 the conductor element 106 has a T-shaped profile. The laterally protruding conductor surface 110 should be understood to the effect that it has a preferably rectangular base area that has a larger extension or protrusion transversely to the direction of extension/longitudinal direction of the conductor element 106 than the width of the conductor element 106, the width being defined here as transverse to the direction of extension of the conductor element 106.

According to the invention the conductor element 106 that includes the level conductor surface 110 is stamped in a single step so that the conductor element 106 is produced in one piece with the conductor surface 110. As can be gathered, furthermore, from Figure 1, there is additionally located on the one end of the conductor element 106 that lies opposite the tip of the conductor element 106 a recess 126 for accommodating a resistor 124. According to the invention, this type of resistor, which is for example a 50 kΩ resistor (bleed resistor) is connected to one of the two resistor connection wires either by means of a solder connection in the recess 126 with the conductor element 106 or is crimped into the recess 126.

Figure 2 shows a perspective illustration of the conductor element 106 with a fitted resistor according to the present invention. In particular this figure shows the fitting of the one connection wire of the resistor 124 in the recess 126. This resistor 124 can be crimped or also soldered into the recess. Furthermore, from this figure one can gather the fitting state in which the inner conductor 116 is already connected to the conductor element 106. According to one advantageous embodiment, a stopper 136 can optionally be applied to the inner conductor 116 which is positioned, for example, around the recess 126 and the connection wire of the resistor 124 fitted therein.

The fitted stopper 136 can be gathered from the perspective illustration in **Figure 3**. This stopper 136 serves, for example, to insulate or also to better guide the outer conductor 118 of the coaxial connector 114 to be pushed on afterwards. This stopper 136 can be produced, for example, as an injection moulded part made of plastic or also of rubber.

Figure 4 shows a perspective illustration of the conductor element 106 with a fitted resistor 124 and a coaxial connector 114 as well as a ground element 108 according to the present invention. In particular, it is shown in this figure that the coaxial connector 114 is pushed or placed on the end lying opposite the tip of the conductor element 106. In the embodiment shown the coaxial connector 114 is for example a coaxial plug connector with a socket element that is located in the inner conductor 116 on the corresponding end that lies opposite the tip of the conductor element 106. The mating plug connecter that is not shown contains the corresponding plug element. However, it is clear for a person skilled in the art that the conductor element 106 can also be connected to an inner conductor 116 that has a plug element on its side lying opposite the tip of the conductor element 106. Furthermore, in the present exemplary embodiment it is assumed that there is just one detachable plug connection. Alternatively however, other connectors can also be used. For example, the coaxial connector 114 can be realised by means of a coaxial screw connector. According to another embodiment of the invention the coaxial connector 114 can be a SMBA FAKRA plug connector according to DIN 72594-1 and USCAR-18. According to one advantageous embodiment of the invention the coaxial connector 114 is a FAKRA contact sub-assembly.

The coaxial connector 114 additionally comprises an outer conductor 118 which has on its end pointing towards the tip of the conductor element 106 a cylindrical end that has a knurled surface and is therefore ideally suited for an improved crimp or solder connection to a ground element 108 which will be described in more detail below.

In the following only the ground element 108 which is crimped onto the outer conductor 118 in the next step will be described in more detail. As can be seen from Figure 4, the ground element 108 is a moulded bent part that is advantageously a single stamped metal part, a material containing metal or a conductive material that is brought into a special shape according to the invention. This ground element 108 comprises two ground planes 112, the ground element 108 being bent such that the two ground planes 112 are parallel to one another. Furthermore, the ground element 108 has a fastening element 120 that is advantageously suitable for establishing the electrical and mechanical connection between the ground element 108 and the outer conductor 118.

In the following the ground element 108 will be described in more detail with reference to **Figure 5**. According to the invention the ground element 108 consists of a single stamped element, a metallic material being chosen both for the ground element 108 and for the conductor element 106 described above. Alternatively to the stamping, as already described for the conductor element 106, one can cut out from the base material using a laser. The material thickness of the stamped or lasered ground element 108 can be, for example, 0.8 mm.

As can be gathered from Figure 5, the ground element 108, which in this figure is illustrated in the stamped, still unbent state, comprises the previously described two ground planes 112, a fastening element 120 and two L-shaped connection elements 122 which each connect one of the two ground planes 112 to the fastening element 120. Advantageously the length of an arm of the connection elements 122 (length a+b) is greater than the other length (length d+e) of the respective other arm of the connection elements 122. Furthermore, two detents 132 can advantageously be attached to each of the ground planes 112, and these detents will be described in more detail at a later stage.

Preferably, the width e of the longer arm of the connection elements 122 is smaller than the width f of the shorter, other arm of the connection elements 122.

However, according to another embodiment the longitudinal proportions of the arms of the two L-shaped connection elements 122 and of the area and the form of the ground planes 112 can also have proportions and sizes different to those shown in Figure 5.

Furthermore, it is indicated in Figure 5 by means of the dashed lines at which points of the ground element 108 bending deformation takes place so that the shape of the ground element 108 shown in Figure 4 is achieved. Moreover, it should be mentioned that according to one advantageous embodiment of the invention the bent ground element 108 is securely crimped onto the outer conductor 118 such that the two longer arms of the L-shaped connection elements 122 run parallel to the conductor element 106.

Figure 6 shows a perspective illustration of the conductor element 106 with a fitted resistor 124, a fitted coaxial connector 114 and a fitted ground element 108 according to the present invention. In particular it should be mentioned that the solution according to the invention allows one to crimp the ground element 108 in a single crimping step of the still unbent fastening element 120 with the outer conductor 118 such that on the one hand a stable connection to the outer conductor 118 is established, and on the other hand the fastening element 120 encloses the outer conductor 118 in an annular shape on its knurled surface. It is thus achieved that the fastening element 120 at the same time also encloses the second connection wire of the resistor 124 and in a single step a secure contact connection is established between the fastening element 120, the second connection wire of the resistor 124 and the outer conductor 118. Thus, by means of this single process of crimping the ground element 108 onto the outer conductor 118, an electrical connection between the ground element 108, the second connection wire of the resistor 124 and the outer conductor 118 is established. The resistor 124 thus has with one of its connection wires an electrical connection to the conductor element 106 and with its other connection wire an electrical connection to the outer conductor 118 and the ground element 108.

According to another configuration of the invention the ground element 108 can also be soldered onto the outer conductor 118.

In the following the distances d_1 to d_3 given after the fitting of the ground element 108 will be explained in more detail. Advantageously, the distance d_1 relates to a symmetrical distance between the outer surfaces of the ground planes 112 of the ground element 108 and the conductor element 106. As can be gathered, furthermore, from Figure 6, the ground planes 112 are on the one hand parallel to one another and on the other hand, after fitting or after the crimping process, they are arranged on the outer conductor 118 such that the respective ground planes 112 are arranged at right angles to the conductor surface 110. Here the rectangular arrangement relates to the arrangement according to the invention of the ground element 108 according to which the plane of the ground planes 112 is arranged perpendicularly to the plane of the conductor surface 110. It should also be mentioned that the ground planes 112 are the

same distance d_1 away from the conductor element 106 over their entire length (as considered in the longitudinal direction of the conductor element 106).

The pre-defined second distance d_2 relates to a distance between the end of the conductor surface 110 facing the connector unit 104 and the coaxial connector 114 and the front edge of the two ground planes 112, the front edge constituting the edge of the ground planes 112 which is facing the tip of the antenna unit 102. Advantageously, the distance d_2 between each of the two ground planes 112 and the conductor element 110 is identical.

The distance d_3, which constitutes the third pre-defined distance, relates to the distance between the two longer arms (length a+b) of the connection elements 122, as results from the bending process, as can be seen from Figure 6. The distance d_3 is advantageously identical along the two longer arms (length a+b) of the connection elements 122.

Figure 7 shows a sectional illustration of a housing 128 that encloses the antenna unit 102. This housing 128 is advantageously an electrically insulating housing and also serves, for example, as dust protection for the antenna unit 102. The housing 128 also serves, for example, as a protective cap and so prevents damage to the antenna unit 102. As can be seen from Figure 7 the tip of the housing 128 on which the conductor surface 110 is located comprises two supporting ribs 130 which serve to accommodate the conductor surface 110. In addition, the housing 128 has recesses in which the detents 132 engage during fitting, and so the housing 128 is fastened securely to the antenna unit 102.

In addition, it can be seen from this figure that the connection unit 104, in addition to the coaxial connector 114 contained therein, also comprises a FAKRA housing assembly that enables fitting to the corresponding FAKRA mating plugs.

Figure 8 relates to sectional illustrations of all of the component parts of the antenna arrangement 100 according to the present invention.

Figure 9 shows perspective views of the antenna arrangement 100 according to the present invention with the fitted housing 128 and the fitted FAKRA housing assembly according to the present invention. The external views relate here in particular to a bottom view and a top view.

REFERENCE NUMBERS

100	Antenna arrangement
102	Antenna unit
104	Connector unit
106	Conductor element
108	Ground element
110	Conductor surface
112	Ground planes
114	Coaxial connector

116	Inner conductor
118	Outer conductor
120	Fastening element
122	Connection elements
124	Resistor
126	Recess
128	Housing
130	Supporting ribs
132	Detents
134	FAKRA centre contact
136	Stopper

CLAIMS

1. An antenna arrangement (100) with an antenna unit (102) and a connector unit (104) for electrically connecting the antenna arrangement (100) to a corresponding mating connector unit:

the antenna unit (102) comprising a conductor element (106) and a ground element (108); the conductor element (106) having at its tip a level conductor surface (110) protruding to the side, and the ground element (108) having two level ground planes (112) lying opposite one another;

the connector unit (104) comprising a coaxial connector (114) with an inner conductor (116) and an outer conductor (118); the conductor element (106) being connected electrically to the inner conductor (116), and the ground element (108) to the outer conductor (118) of the coaxial connector (114); and

the conductor element (106) and the ground element (108) being arranged in relation to one another within the antenna unit (102) such that the conductor surface (110) is orientated substantially at a right angle to the two ground planes (112).

2. The antenna arrangement (100) according to Claim 1, the antenna unit (102) being designed such that at least part of the conductor element (106) is surrounded by the two ground planes (112) of the ground element (108) at the side.

3. The antenna arrangement (100) according to Claim 1 or 2, the antenna unit (102) being designed such that the two ground planes (112) of the ground element (108) are arranged the same pre-defined first distance (d1) away from the conductor element (106).

4. The antenna arrangement (100) according to Claims 1 to 3, the antenna unit (102) being designed such that the two ground planes (112) of the ground element (108) are respectively arranged along the conductor element (106).

5. The antenna arrangement (100) according to Claims 1 to 4, the antenna unit (102) being designed such that the conductor surface (110) is arranged a pre-defined second distance (d2) away from the ground element (108).

6. The antenna arrangement (100) according to Claims 1 to 5, the conductor surface (110) and the two ground planes (112) respectively having a rectangular base area.

7. The antenna arrangement (100) according to Claims 1 to 6, the ground element (108) also comprising a fastening element (120) that establishes the electrical and a mechanical connection between the ground element (108) and the outer conductor (118).

8. The antenna arrangement (100) according to Claims 1 to 7, the ground element (108) being produced in one piece.

9. The antenna arrangement (100) according to Claims 1 to 8, the ground element (108) also comprising two L-shaped connection elements (122) which each connect one of the two ground planes (112) to the fastening element (120) and in which an arm respectively bordering the fastening element (120) is formed along the conductor element (106) and a respective other arm is formed transversely to the conductor element (106).

10. The antenna arrangement (100) according to Claim 9, the antenna unit (102) also comprising a resistor (124) that connects the conductor element (106) electrically to the ground element (108),

- the electrical connection to the conductor element (106) being provided by securely soldering a corresponding connection wire of the resistor in a recess (126) of the conductor element (106), and
- the electrical connection to the ground element (108) being provided by securely crimping a corresponding connection wire of the resistor between the fastening element (120) and the outer conductor (118).

11. The antenna arrangement (100) according to Claim 10, the arms of the two connection elements (122) bordering the fastening element (120) being arranged a pre-defined distance (d3) away from one another so that a space thus produced between the connection elements (122) allows the resistor (124) to be accommodated.

12. The antenna arrangement (100) according to Claims 1 to 11, also comprising an electrically insulating housing (128) that encloses the antenna unit (102).

13. The antenna arrangement (100) according to Claim 12, the housing (128) having supporting ribs (130) which support the conductor surface (110) of the conductor element (106) laterally, and/or the two ground planes (112) respectively having on the opposite edges detents (132) which engage in corresponding recesses in the housing (128).

14. The antenna arrangement (100) according to Claims 1 to 13, the coaxial connector (114) being an SMBA (FAKRA, **F**ach**kr**eis **A**utomobil) plug connector according to DIN 72594-1 and USCAR-18 or a coaxial screw connector.

15. A production method for an antenna arrangement with an antenna unit and a connector unit for electrically connecting the antenna arrangement to a corresponding mating connector unit, the antenna unit comprising a conductor element and a ground element; the conductor element having at its tip a level conductor surface protruding to the side, and the ground element having two level ground planes lying opposite one another; and the connector unit comprising a coaxial connector with an inner conductor and an outer conductor;

the method comprising the steps:

electrically connecting the conductor element of the antenna unit to the inner conductor of the connector unit;

electrically connecting the ground element of the antenna unit to the outer conductor of the connector unit; and

arranging the conductor element and the ground element in the antenna unit so that the conductor surface is orientated substantially at a right angle to the two ground planes.

16. The production method according to Claim 15, comprising the additional step:

electrically and mechanically connecting the outer conductor to a fastening element included by the ground element.

17. The production method according to Claim 16, comprising the additional steps:

securely soldering a connection wire of a resistor included by the antenna unit in a recess of the conductor element, and

securely crimping another connection wire of the resistor between the fastening element and the outer conductor,

so that the resistor connects the conductor element electrically to the ground element.

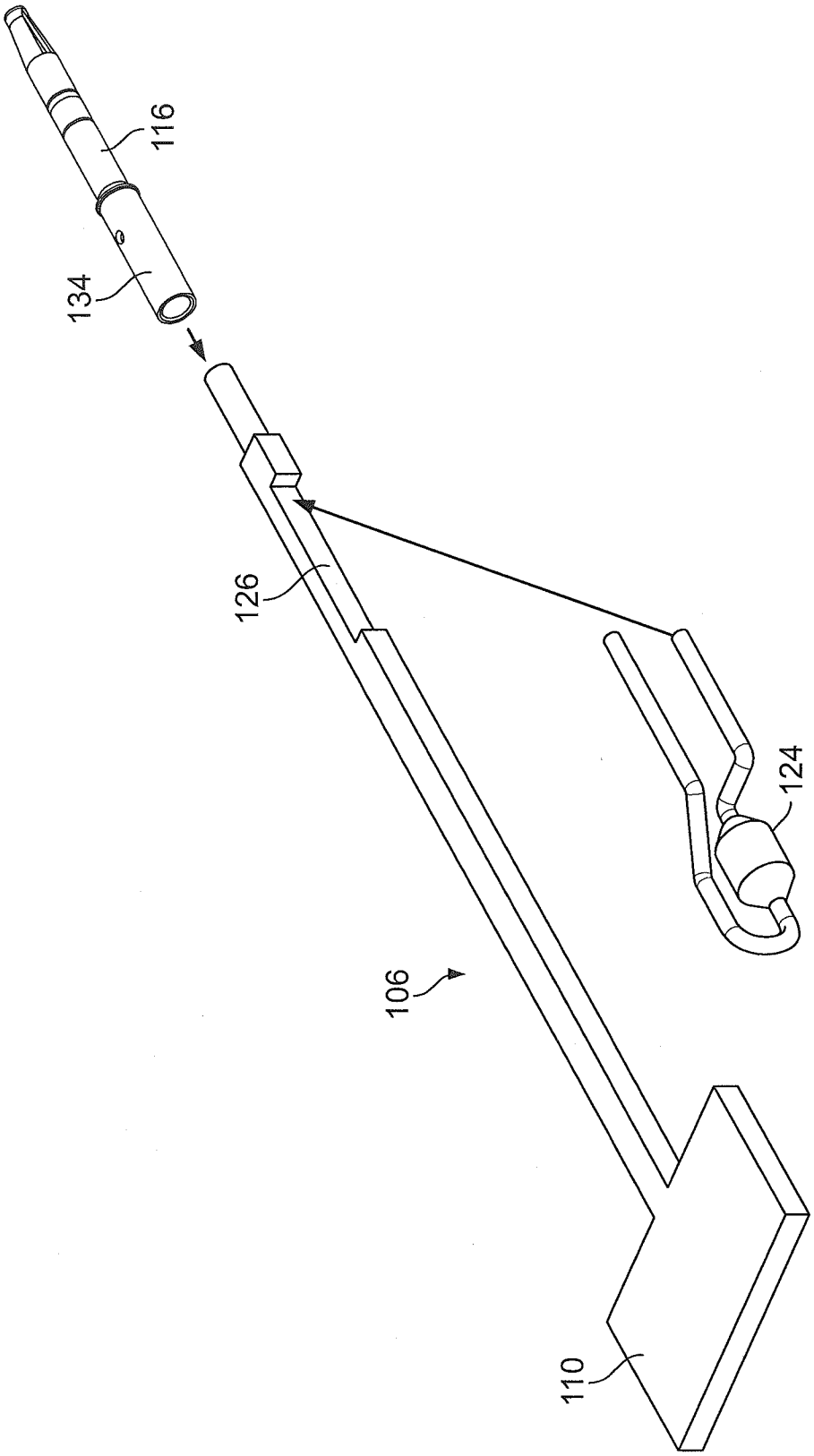


Fig. 1

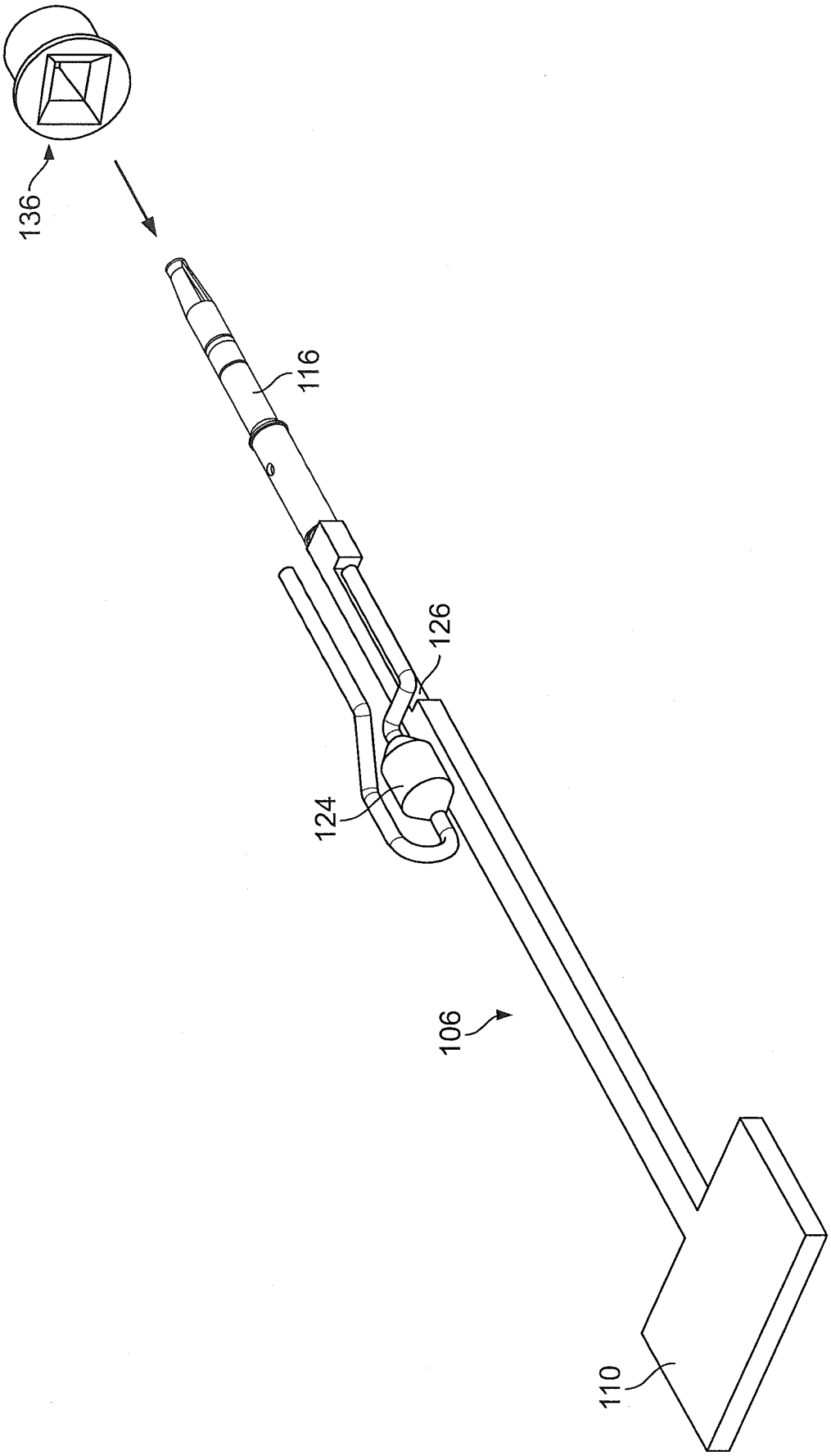


Fig. 2

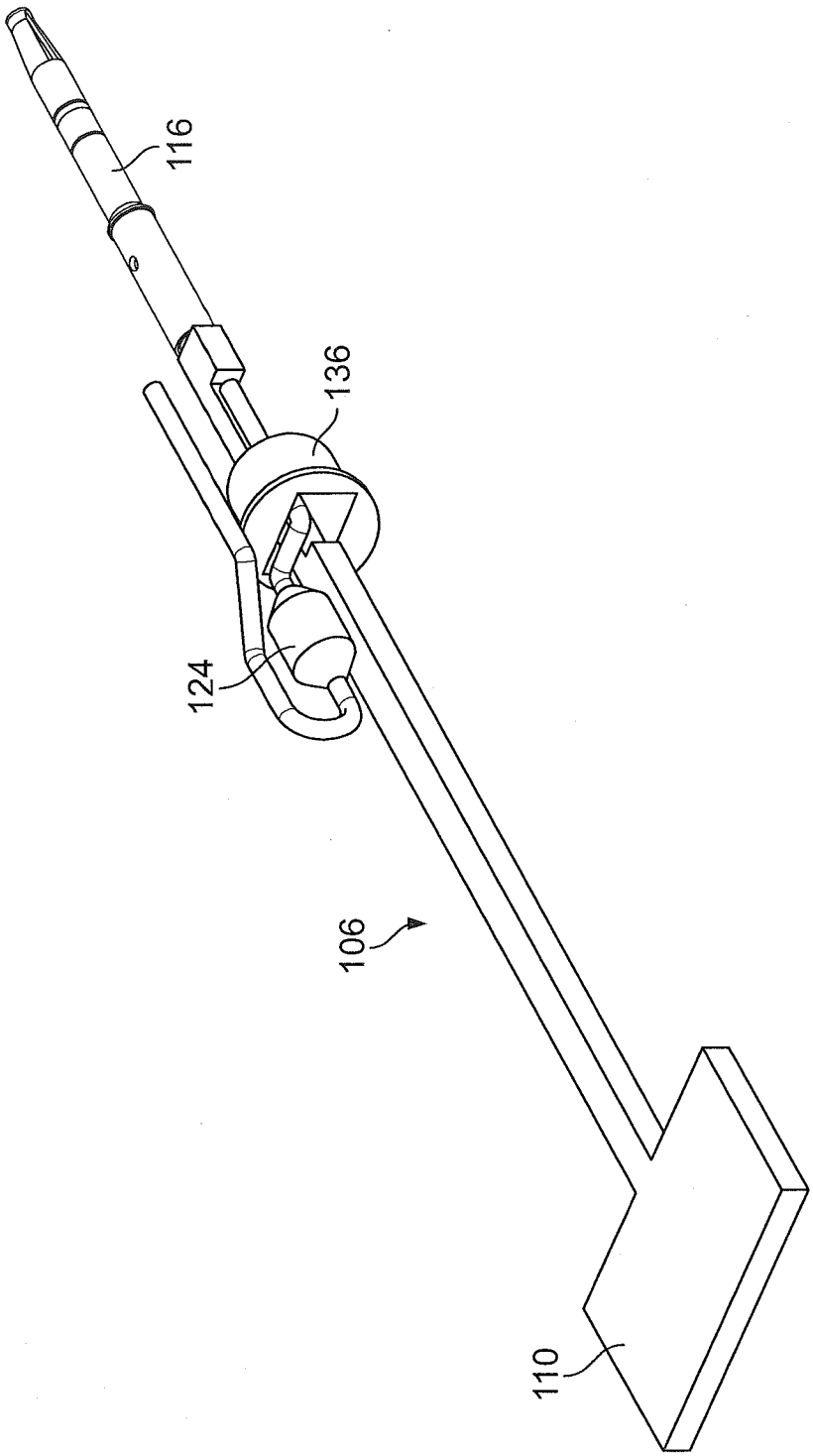


Fig. 3

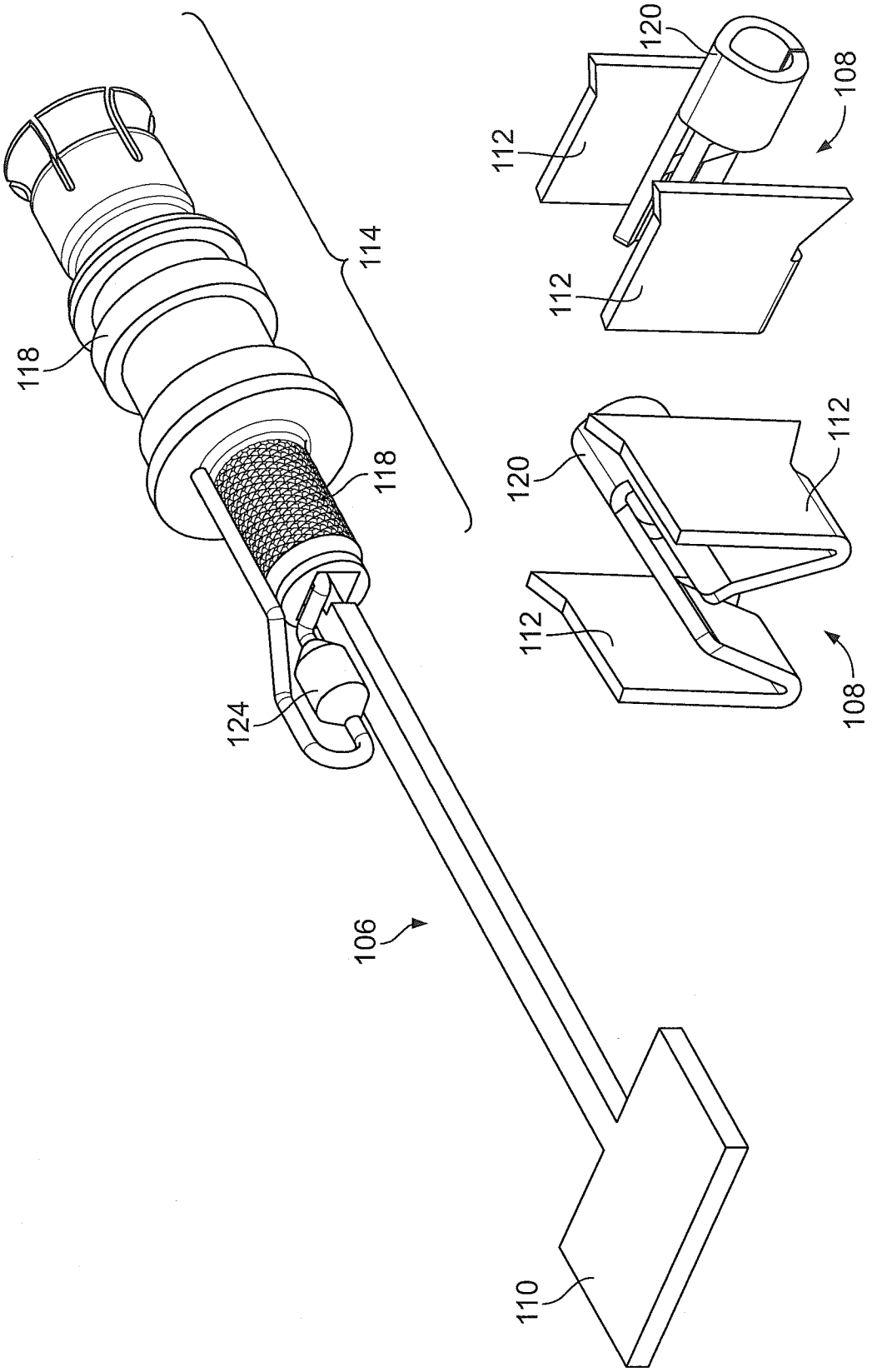


Fig. 4

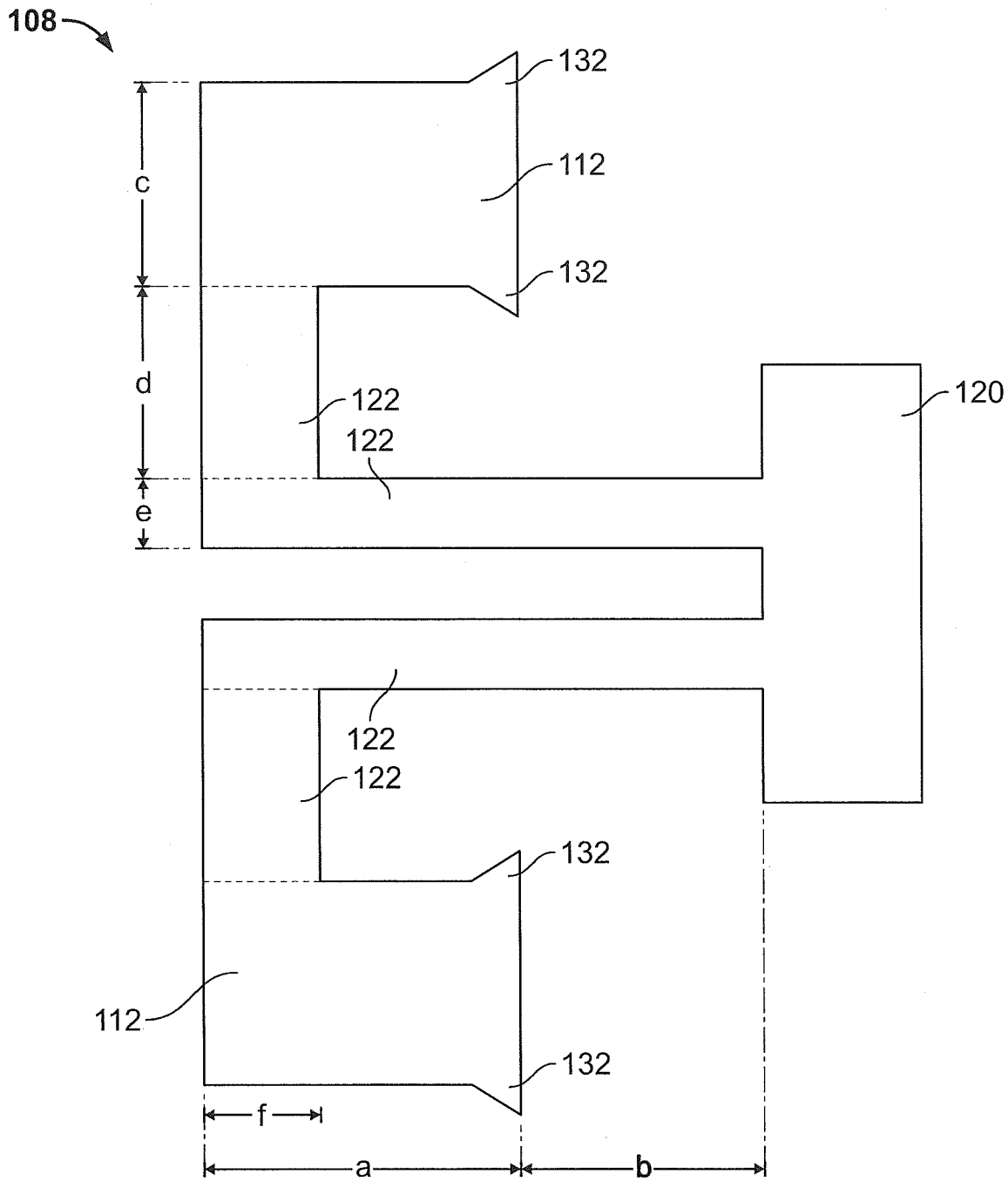


Fig. 5

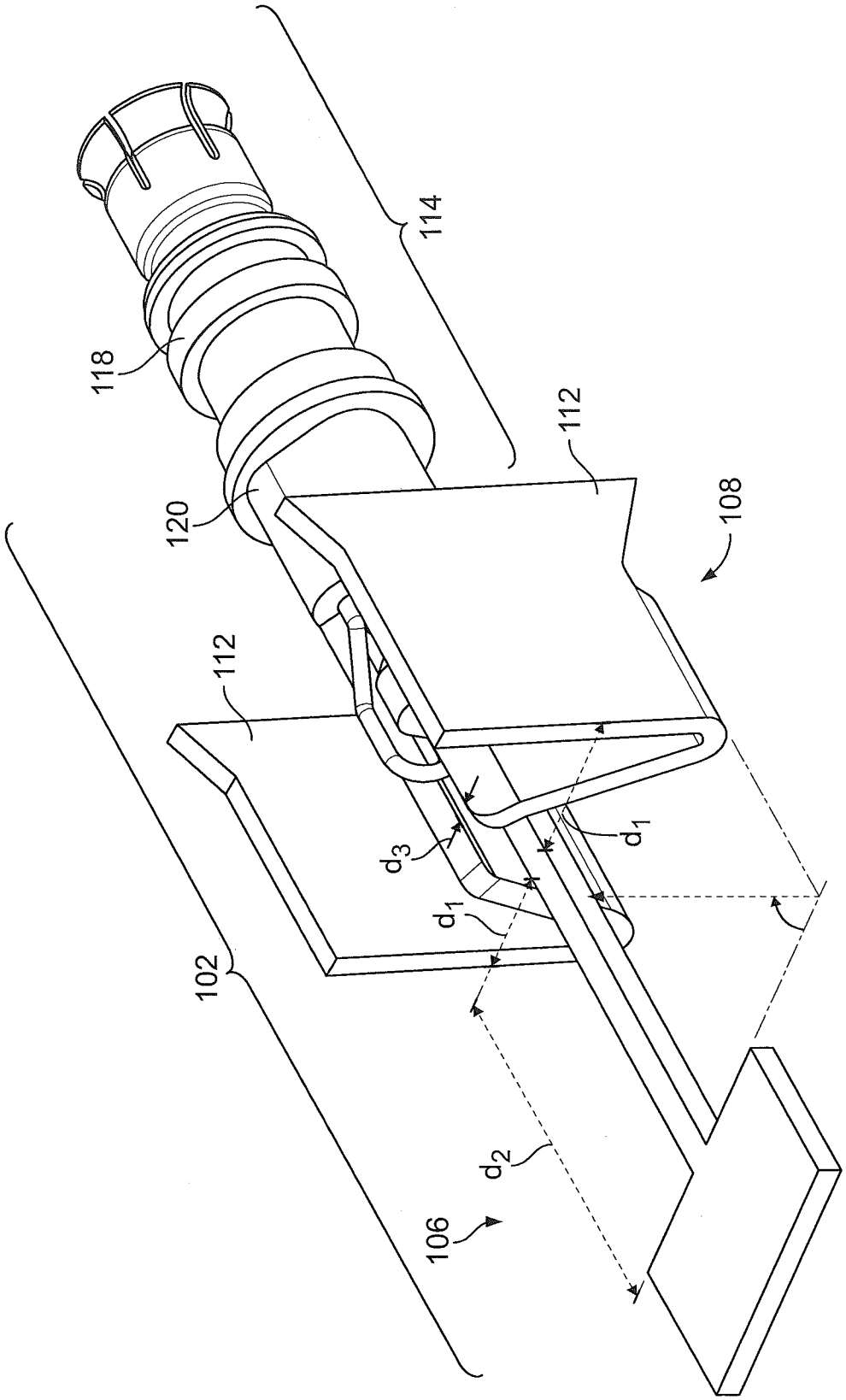


Fig. 6

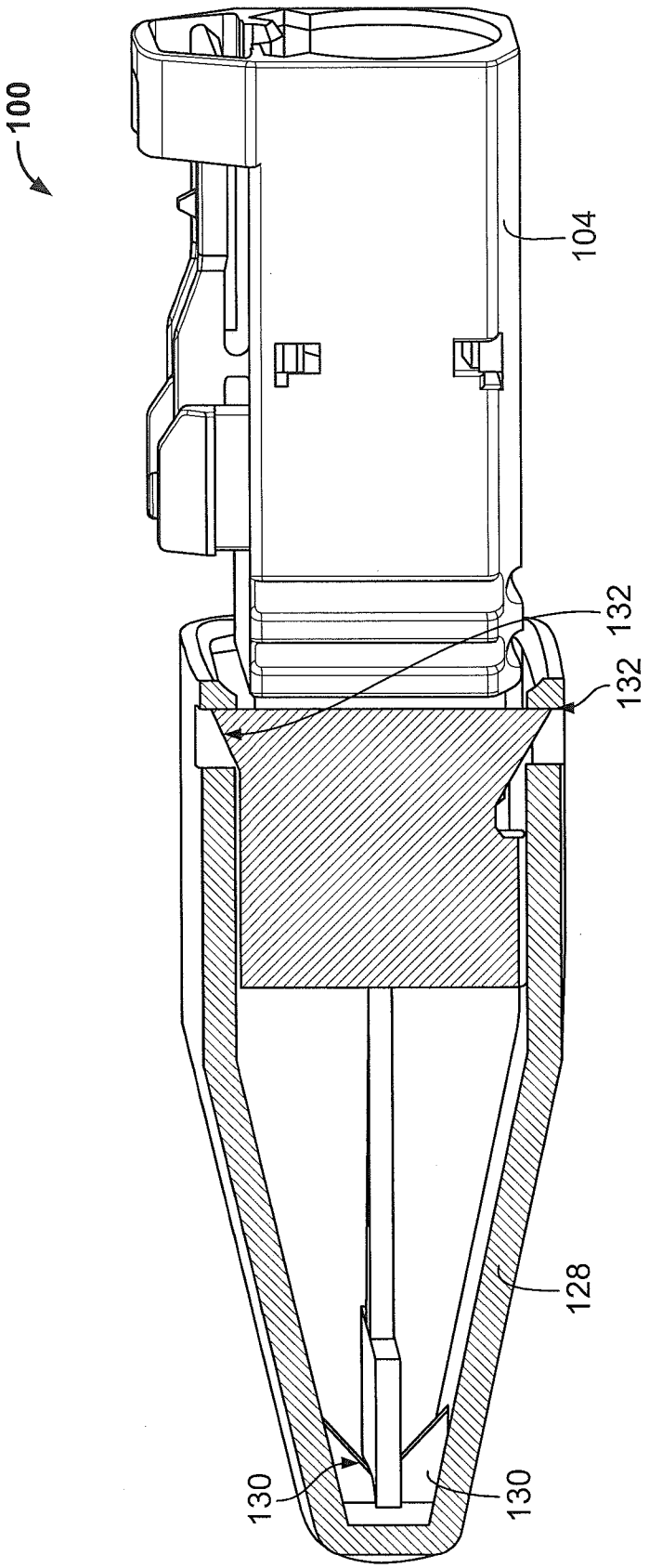
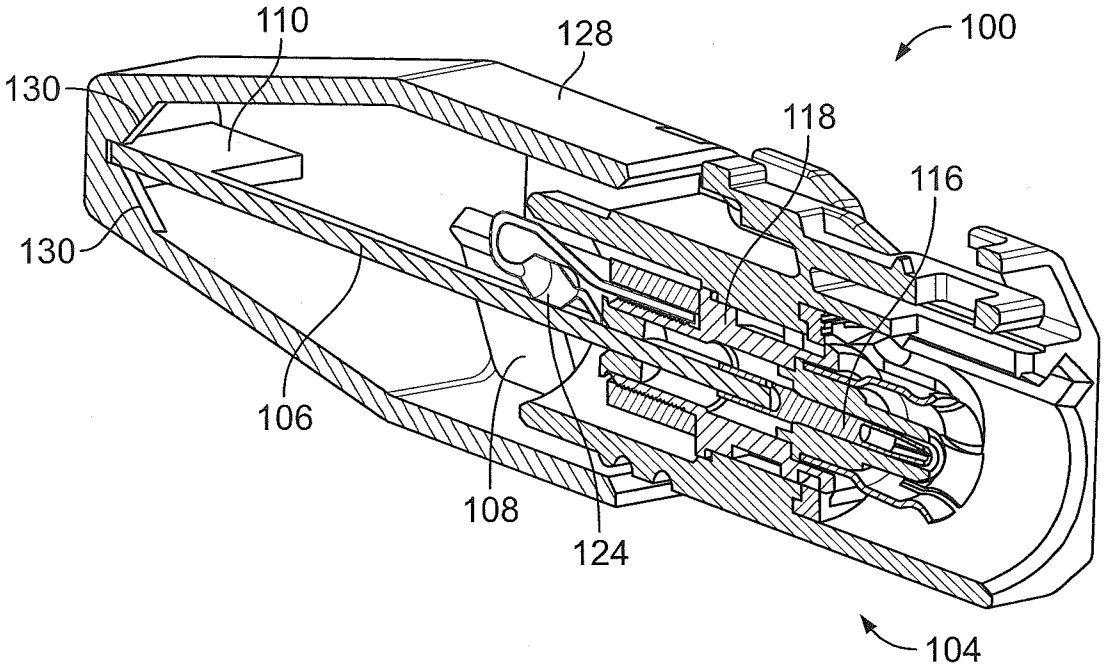


Fig. 7



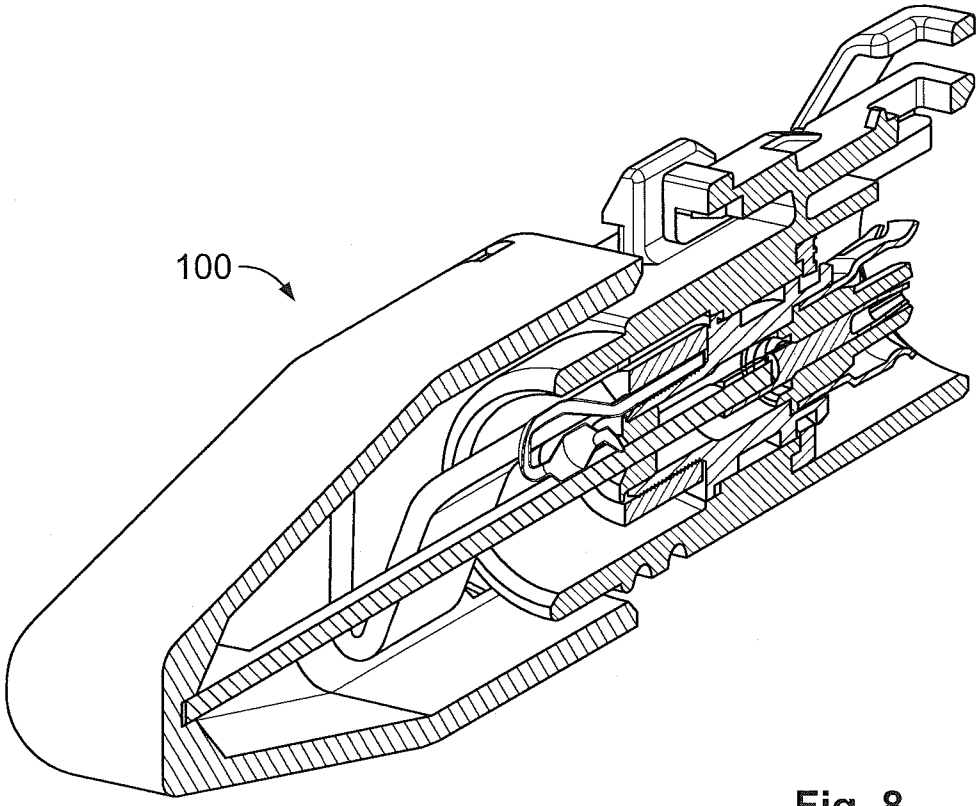


Fig. 8

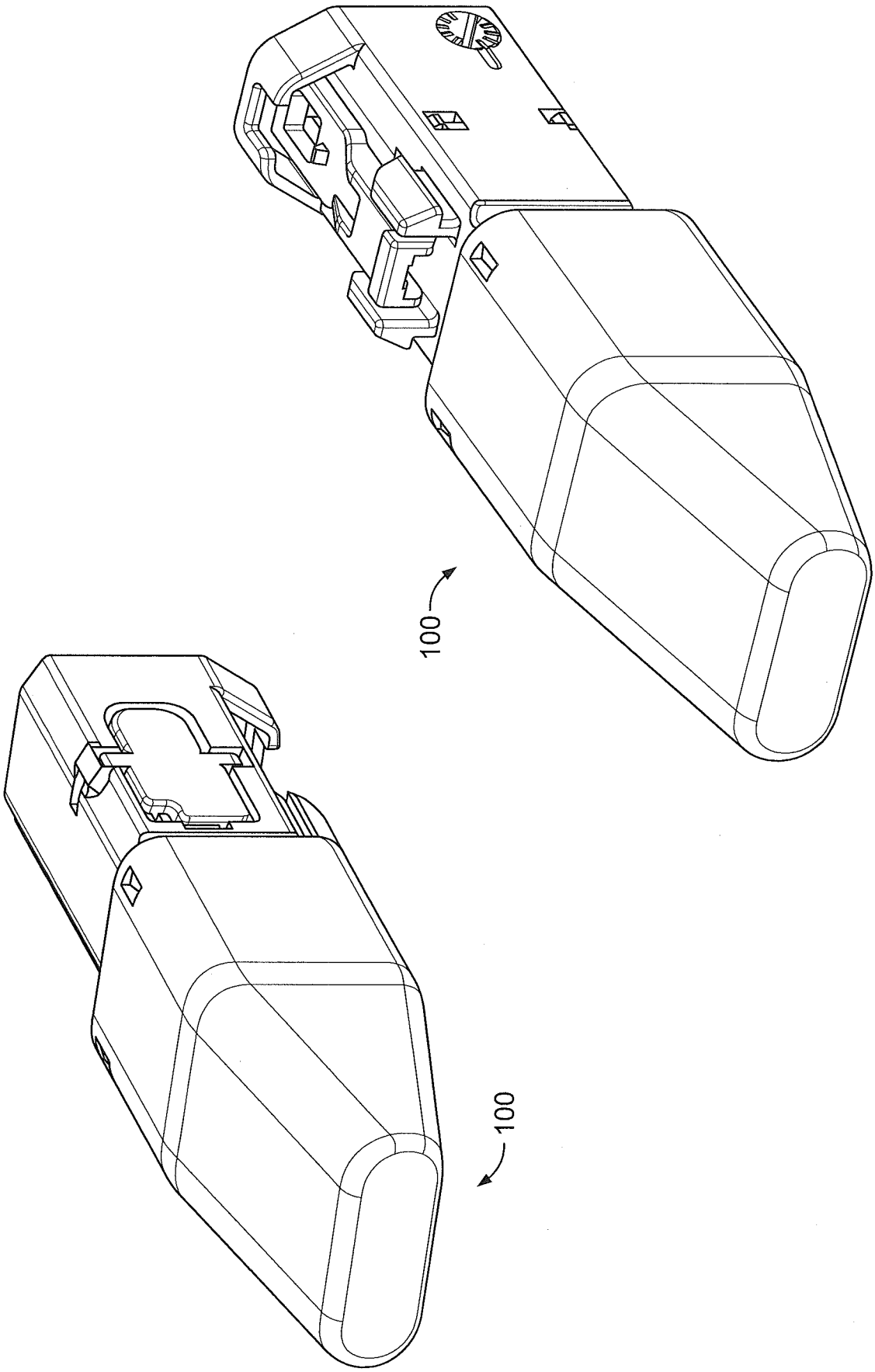


Fig. 9

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2015/058829

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01Q1/44 H01Q9/36 H01Q9/38 H01Q9/40
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2010/019979 A1 (BUXTON CAREY GWYNNE [US] ET AL) 28 January 2010 (2010-01-28) figure 1 paragraphs [0035] - [0037] -----	1-3,5, 12-16
X	US 5 267 297 A (KAWANO MINORI [JP] ET AL) 30 November 1993 (1993-11-30) figure 1 column 7, lines 1-47 -----	1-3,5, 12-16
X	EP 1 717 902 A1 (WISTRON NEWEB CORP [TW]) 2 November 2006 (2006-11-02) abstract; figure 4 paragraphs [0014] - [0015] -----	1-9, 12-16

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
6 July 2015	14/07/2015

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Unterberger, Michael

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2015/058829

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 542 315 A1 (SAMSUNG ELECTRONICS CO LTD [KR]) 15 June 2005 (2005-06-15) figure 4 paragraphs [0025] - [0028]	1-5, 12-16
A	EP 2 355 240 A1 (LAIRD TECHNOLOGIES AB [SE]) 10 August 2011 (2011-08-10) abstract; figure 4 paragraph [0041]	1-17

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2015/058829

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2010019979 A1	28-01-2010	NONE	
US 5267297 A	30-11-1993	CA 2049615 A1	23-02-1992
		JP H04103228 A	06-04-1992
		US 5267297 A	30-11-1993
		US 5349694 A	20-09-1994
		US 5369782 A	29-11-1994
EP 1717902 A1	02-11-2006	CN 1855625 A	01-11-2006
		EP 1717902 A1	02-11-2006
EP 1542315 A1	15-06-2005	CN 1652401 A	10-08-2005
		EP 1542315 A1	15-06-2005
		KR 20050055551 A	13-06-2005
		US 2005146471 A1	07-07-2005
EP 2355240 A1	10-08-2011	NONE	