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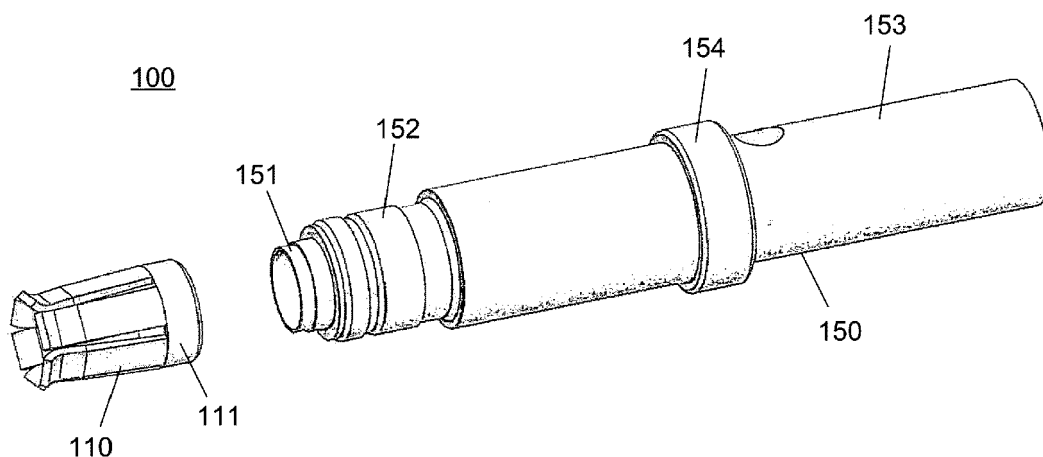
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(54) **TERMINAL PLUG**

(57) A terminal plug (100) for an electric connector, comprising a conductive base body (150), a conductive clip (110), attached to the conductive base body (150) and arranged for coupling with another terminal of the

electric connector, characterized in that the conductive clip (110) is attached to the conductive base body (150) by an ultrasonic weld to form a welded area.

Fig. 1



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Description

[0001] The present invention relates to a circular contact assembly which comprises a barrel and a clip attached thereto.

[0002] In such a connector, two parts must be electrically connected to each other. In the connecting technology, several methods such as a press-fitting, a crimping, a latching, a brazing, a soldering or conductive adhesives can be used. However, there is need for low resistance, low cost and compact connecting structure without damaging to plating. In particular, a press fit assembly typically requires thick walls, which leads to large pitch between connectors when several connectors are grouped in a plug. Also, a welding step generate high temperatures, thus affecting a plating applied to the parts prior to welding step. Thus, a step of plating might be required after assembly, which leads to complicate process of manufacturing.

[0003] An object of the invention is to provide a compact terminal plug with high quality which can be manufactured in a cost-efficient way.

[0004] In the above aim, a first aspect of the invention is a terminal plug for an electric connector, comprising:

- a conductive base body,
- a conductive clip, attached to the conductive base body and arranged for coupling with another terminal of the electric connector,

characterized in that the conductive clip is attached to the conductive base body by an ultrasonic weld to form a welded area.

[0005] Ultrasonic welding permits at least one of the following advantages: a better gold plating aspect or resistance, a better behaviour in respect to radiofrequencies, a better resistance to heat and aging due to the fact that the connector is integral or monobloc, and the assembly does not require press-fitting while still providing high resistance of assembly.

[0006] Advantageously, the conductive clip comprises;

- an annular base part and
- a clipping part extending from the annular base part,

wherein an inner surface of the annular base part is attached to an outer surface of the base body such as an outer surface of a tip part of the base body, or wherein an outer surface of the annular base part is attached to an inner surface of the base body.

[0007] In this configuration, the annular base part of the conductive clip (easy to manufacture) can be ultrasonically welded to the tip part of the base body.

[0008] Advantageously, the inner surface of the annular base part is ultrasonically welded to the outer surface of the tip part.

[0009] Advantageously, the outer surface of the annular base part is ultrasonically welded to the inside of the base body.

5 **[0010]** Advantageously, the clipping part includes a plurality of holding plates that forms an inner space for receiving a pin of said another terminal.

[0011] Advantageously, the welded area is free of Heat Affected Zone, or wherein the welded area is comprising a Heat Affected Zone having a thickness lower than 0.01 mm. Ultrasonic welding does not require/provoke high temperature onto the parts to be welded. Thus, the aspect of parts is not affected by the weld, and in particular, if a plating is applied to the parts prior to the ultrasonic welding, such plating will not be damaged.

10 **[0012]** Advantageously, the welded area is extending along an axial direction of the conductive clip, and preferably, the welded area presents a length in axial direction greater than 0.3 mm, preferably greater than 0.5 mm. In this configuration, as the welded area is extending along an axial direction of the conductive clip, the conductive clip can be fixed to the conductive base body with sufficient strength.

15 **[0013]** Advantageously, the welded area is free of added metal. In this configuration, compact design can be achieved.

[0014] Advantageously, the annular base part has a seam so that a diameter of the annular base part can be increased/decreased during assembly to the other part, before the annular base part is welded to the conductive base body. This configuration does not damage the tip part of the base body when the annular base part is attached thereto. Also, this provides elastic deformation which keeps the parts attached before welding, even during manipulation - transport from one machine to another.

20 **[0015]** Advantageously, the conductive base body is plated, the plating being applied preferably before a step of welding the conductive clip to the conductive base body. Ultrasonic welding can be used for that kind of pre-plated parts.

25 **[0016]** Advantageously, the conductive clip is plated, the plating being applied preferably before a step of welding the conductive clip to the conductive base body.

[0017] Advantageously, the conductive clip comprises a tubular wall, wherein said tubular wall is ultrasonic welded to the conductive base body, and wherein the tubular wall presents a thickness of less than 0.25 mm, preferably less than 0.20 mm, and more preferably less than 0.15 mm. Ultrasonic welding can achieve that kind of thin connection.

30 **[0018]** One embodiment of the invention is directed to an electric connector comprising:

- the terminal plug as mentioned above, and
- 35 - a protective hood surrounding a part of the conductive clip.

[0019] Advantageously, the protective hood presents

a cylindrical shape, and a diameter of the protective hood is identical to a diameter of base body.

[0020] Other features and advantages of the present invention will appear more clearly from the following detailed description of particular non-limitative examples of the invention, illustrated by the appended drawings where:

- figure 1 represents a perspective view of a terminal plug before a clip is attached to a barrel.
- figure 2 represents a perspective view of the terminal plug of figure 1.
- figure 3 represents a perspective view of the clip of the terminal plug of figure 1.
- figure 4 represents a cross-sectional perspective view of the terminal plug of figure 1.
- figure 5 represents an enlarged perspective view of figure 4.
- figure 6 represents a perspective view of an electronic connector comprising the terminal plug of figure 1 and hood.
- figure 7 represents a perspective view of the electronic connector of figure 6 wherein the hood is attached to the terminal plug.
- figure 8 represents a cross-sectional perspective view of the electronic connector of figure 6.
- figure 9 represents a cross-sectional perspective view of the electronic connector of figure 6 wherein the hood is attached to the terminal plug.

[0021] It is of course understood that obvious improvements and/or modifications for one skilled in the art may be implemented, still being under the scope of the invention as it is defined by the appended claims.

[0022] Figures 1 to 5 depict one of the embodiments of a terminal plug according to the invention.

[0023] A terminal plug 100 shown in Fig. 1 is a substantially circular or cylindrical contact assembly, which has a barrel 150 and a clip 110.

[0024] The barrel 150 is in the shape of a rod including a tip end 151, a hood receiving part 152, a rod body 153 and a flange portion 154. The flange portion 154 is positioned on the rod body 153 and has a greater diameter than the rod body 153. As can be seen in Fig. 4, within the barrel 150 inner cavities 161, 163 are formed at each end of the barrel 150. The inner cavity 161, 163 may be a circular cross-sectional shape so that each can receive a mating pin contact (not shown). In this embodiment, the barrel 150 can have a through hole 153h on a wall of the rod body 153 which connects the inner cavity 163

and the radially outside of the barrel 150.

[0025] The barrel 150 is made of metal material. The barrel 150 can be typically machined from brass, phosphour-bronze, beryllium-copper or other copper alloy or other conductive metals/alloys, including nickel-silver alloys. The parts may be typically post-plated with any one of a variety of coatings (such as gold) for the purpose of enhancing electrical contact and improving wear and corrosion resistance.

[0026] The clip 110 can be in the form of sleeve-like shape as shown in Figs. 1 to 3. The clip 110 has a tubular wall 111 positioned rearward and a mating or clipping part 115 positioned frontward and extending from the tubular wall. The clipping part 115 consists of a plurality of holding plates 117 for supporting a mating pin contact in its inner space S_{117} . In this embodiment, six holding plates 117 are provided. Front ends of each holding plates 117 are angled radially outwardly so that the mating pin contact can be inserted smoothly into the inner space S_{117} of the clip 110. The clip 110 is designed to align concentrically with the cylindrical barrel 150.

[0027] For a person skilled in the art it is understood that a different number or shapes or lengths of holding plates 117 can be used so long as the plates 117 can hold a mating pin contact.

[0028] The clip 110 can be manufactured from a copper alloy, typically beryllium-copper or other high strength conductive copper alloy. The clip 110 can be made of a metal sheet. The sheet is bent to form a circular clip 110 as shown in Fig. 3. The tubular wall 111 may comprise a slit or seam 111s extending in a longitudinal axial direction of the barrel 150. This means that the tubular wall 111 has a C-shape before it attached to the barrel 150. This ensures that a diameter of the tubular wall 111 can expand easily when the clip 110 is mounted to the barrel 150 and providing a small coupling force to stay attached to the barrel 150. The tubular wall 111 may present a thickness of less than 0.25 mm, preferably less than 0.20 mm, and more preferably less than 0.15 mm.

[0029] As can be seen in Fig. 5, the tubular wall 111 is secured to an outer surface of the tip end 151. Particularly, the tubular wall 111 is ultrasonic welded onto the surface to form a circumferential welded area W. The welded area W is extending along the axial direction and preferably presents a length in axial direction greater than 0.3 mm, preferably greater than 0.5 mm.

[0030] Consequently to the low temperature welding step, the ultrasonic welded area W is free or almost free of Heat Affected Zone, or comprises a Heat Affected Zone having a thickness lower than 0.01 mm. The welded area W can also be free of added metal. Therefore a plating applied to the parts before the welding is not damaged.

[0031] Ultrasonic welding permits at least one of the followings: a better gold plating (especially at the bottom of holes), a better behaviour in respect to the Radiofrequencies, a better resistance to heat and aging due to the fact that the connector is integral or monobloc, the

assembly does not require press-fitting. Further, ultrasonic welding permits that thin parts can be welded (i.e. the tubular wall 111 with thickness of less than 0.25 mm), as dismantling (pulling) resistance is provided by the welded area, and not a press fit force.

[0032] Thermal cycling or other conditions can lead to low force or separation of parts (i.e. clip 110 and barrel 150 in this embodiment) at the junction, but the welded configuration in the present embodiment can improve electrical connection to prevent high electrical resistance during these or other conditions.

[0033] Preferably, the welding area W is formed in a circumferential area. With this configuration, the clip 110 will not open up (expand radially) in the welded area W when a mating pin is inserted.

[0034] The terminal plug 100 in this embodiment is free of weld seam or added metal, therefore thickness of the welded portion can be reduced in comparison for example to a press-fit assembly or added metal welding operation.

[0035] Method for assembling a terminal plug 100 is not limited to a particular one, but the following method can be used. The clip 110 is first aligned with and inserted over the front end of the barrel 150 which has a slightly smaller diameter to accept/guide the clip 110 into position, using automatic, semiautomatic or manual assembly processes. The clip 110 is next welded to the barrel 150 using an ultrasonic welding process.

[0036] Ultrasonic welding relies on vibration plus force (lower than a press-fit force) to join two parts. The process can create a nearly zero resistance junction between the clip 110 and barrel 150. Consequently, it is avoiding an electrical resistance increase.

[0037] Other technologies to join two parts which must be electrically connected includes the followings; press-fitting, crimping, latching, brazing, soldering, conductive adhesives and other welding processes. However, in press-fitting, the problem can be high force required, thick walls and no area on clip to push or damage onto the clipping plates or beams. In crimping, the problem can be mechanical deformation, cracks appearance and potential plating damage. In latching, the problem can be relative movement of parts (high resistance and fretting corrosion). In brazing, the problem can be expensive, complicated, slow process and potential plating damage. In soldering, the problem can be part geometry and size a problem. In conductive adhesives, the problem can be low mechanical strength and electric resistance increase. In the other welding processes, the problem can be damage to plating.

[0038] Figures 6 to 7 depict an electric connector which has the terminal plug as described above and a protective hood 200. The protective hood 200 is in the form of a tube. The protective hood 200 can be made of metal material.

[0039] The protective hood 200 is attached to the front end of the barrel 150 in order to cover the clip 110 and a part of barrel 150. In other words, the front end of the

barrel 200 is inserted into the inside of protective hood 200 in an insertion direction. The insertion direction is oriented parallel to a longitudinal axis of the barrel 150. As can be seen in Fig. 9, in a fully covered condition by the protective hood 200, the clip 110 is accommodated within the protective hood 200.

[0040] In this embodiment, diameter of the protective cover 200 is identical to the body 153 of barrel 150 in order ensure that no radially gap is formed between the two parts.

[0041] In the present invention, both a plane shaft barrel and a hollow tube barrel can be used. In the above embodiment the barrel 150 is a male member and the clip 110 is female member, however, the barrel 150 might be external and the clip might be internal.

[0042] The inventions are applicable for one of a combination of the following attributes:

- applications that require a two-piece contact design for various reasons,
- applications that require a clip to be a stamped part with an open seam,
- applications that may require the two individual parts to be plated before joining the two parts together,
- applications that require a contact interface to accept a circular pin contact,
- applications that require a relatively "early mate" contact position,
- applications that require a protective metal hood part or plastic (insulator) part surrounding the clip,
- applications that do not have space for other means (mechanical or otherwise e.g., other welding processes, press-fitting, crimping, latching, brazing, soldering, conductive adhesives, etc.) of connecting a clip and barrel together,
- applications that cannot accept exterior deformation on parts for visual and/or mechanical and/or environmental reasons (e.g. where plating could be disrupted which would lead to environmental corrosion).

[0043] Figure 9 depicts another embodiment of the electric connector. In this embodiment, a clip 110-1 is displaced inside a barrel 150-1. The barrel 150-1 is mono part or integral part, and the clip 110-1 (in particular, annular base part of the clip) can be ultrasonically welded to inner wall of the barrel 150-1.

[0044] External hood 200-1 is attached to the barrel 150-1 so that the hood 200-1 covers both the clip 110-1 and a part of outer surface of the barrel 150-1. The hood 200-1 can be made of stainless steel. Function of the

hood 200-1 may be mechanical protection and/or guiding of the male contact. Preferably, the external hood 200-1 is configured to cover and protect part of the clip 110-1 that protrudes from the annular edge (left end shown in Fig. 10) of the barrel 150-1.

[0045] The electric connector of Fig. 10 can have an optimal mechanical retention compared to the external mounting as shown in Fig. 6.

Claims

1. A terminal plug (100) for an electric connector, comprising:

- a conductive base body (150),
- a conductive clip (110), attached to the conductive base body (150) and arranged for coupling with another terminal of the electric connector, **characterized in that** the conductive clip (110) is attached to the conductive base body (150) by an ultrasonic weld to form a welded area.

2. The terminal plug (100) according to claim 1, wherein the conductive clip (110) comprises;

- an annular base part (111) and
- a clipping part (115) extending from the annular base part (111),

wherein an inner surface of the annular base part (111) is attached to an outer surface of the base body (150) such as an outer surface of a tip part (151) of the base body (150), or

wherein an outer surface of the annular base part (111) is attached to an inner surface of the base body (150).

3. The terminal plug (100) according to claim 2, wherein the inner surface of the annular base part (111) is ultrasonically welded to the outer surface of the tip part (151).

4. The terminal plug (100) according to claim 2, wherein the outer surface of the annular base part (111) is ultrasonically welded to the inside of the base body (151).

5. The terminal plug (100) according to any one of the claims 2 to 4, wherein the clipping part (115) includes a plurality of holding plates (117) that forms an inner space (S115) for receiving a pin of said another terminal.

6. The terminal plug (100) according to any one of the claims 1 to 5, wherein the welded area is free of Heat Affected Zone, or wherein the welded area is com-

prising a Heat Affected Zone having a thickness lower than 0.01 mm.

7. The terminal plug (100) according to any one of the claims 1 to 6, wherein the welded area is extending along an axial direction of the conductive clip (110), and preferably, the welded area presents a length in axial direction greater than 0.3 mm, preferably greater than 0.5 mm.

8. The terminal plug (100) according to any one of the claims 1 to 7, wherein the welded area is free of added metal.

9. The terminal plug (100) according to claim 2, wherein the annular base part (111) has a seam (111s) so that a diameter of the annular base part (111) can be increased or decreased before the annular base part is welded to the conductive base body (150).

10. The terminal plug (100) according to any one of claims 1 to 9, wherein the conductive base body (150) is plated, the plating being applied preferably before a step of welding the conductive clip (110) to the conductive base body (150).

11. The terminal plug (100) according to any one of claims 1 to 10, wherein the conductive clip (110) is plated, the plating being applied preferably before a step of welding the conductive clip (110) to the conductive base body (150).

12. The terminal plug (100) according to any one of claims 1 to 11, wherein the conductive clip (110) comprises a tubular wall, wherein said tubular wall is ultrasonic welded to the conductive base body (150), and wherein the tubular wall presents a thickness of less than 0.25 mm, preferably less than 0.20 mm, and more preferably less than 0.15 mm.

13. An electric connector (1) comprising:

- the terminal plug (100) according to any one of claims 1 to 12, and
- a protective hood surrounding at least a part of the conductive clip (110).

14. The electric connector (1) according to claim 13, wherein the protective hood (200) presents a cylindrical shape, and a diameter of the protective hood is identical to a diameter of base body (150).

Fig. 1

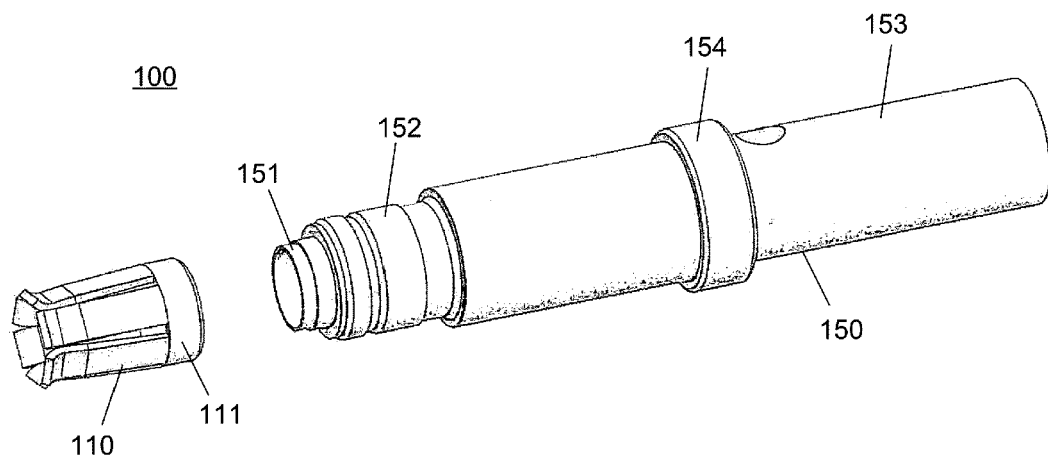


Fig. 2

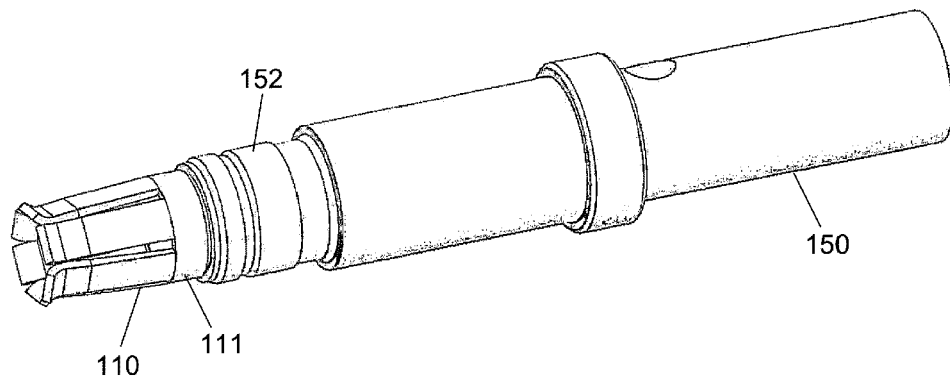


Fig. 3

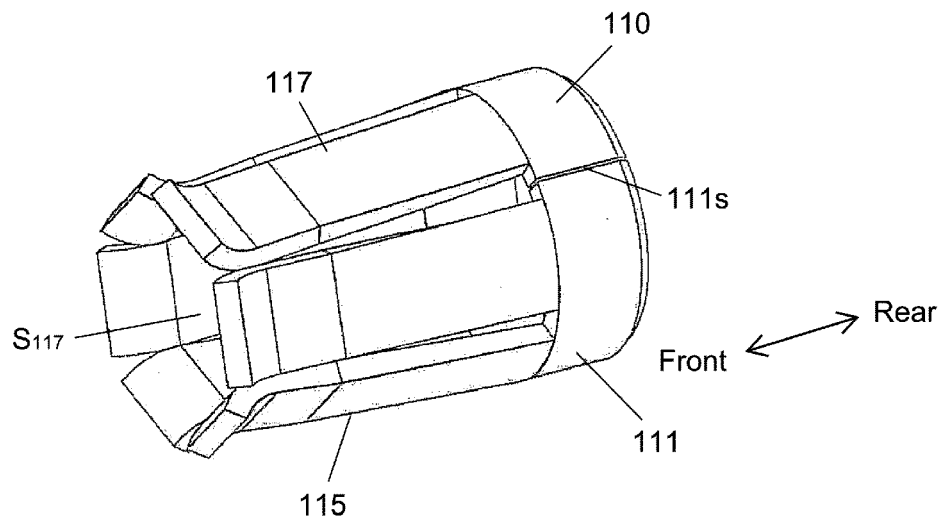


Fig. 4

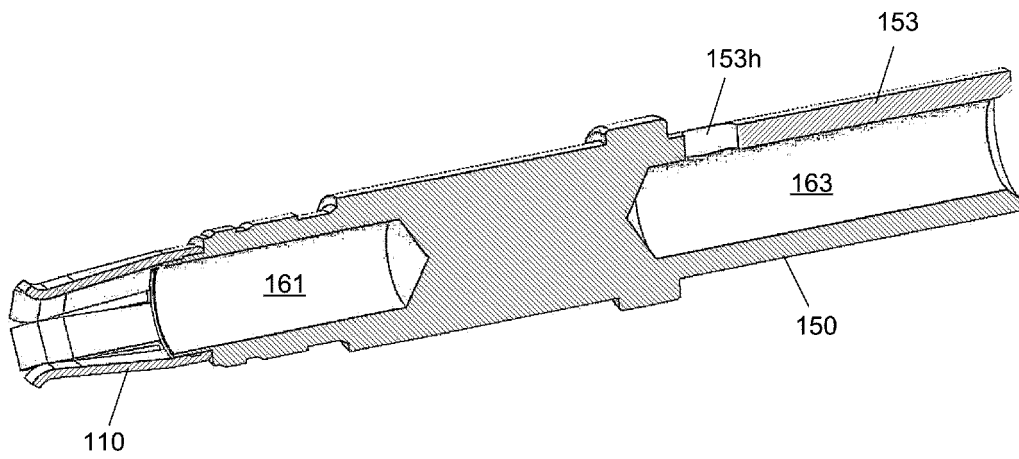


Fig. 5

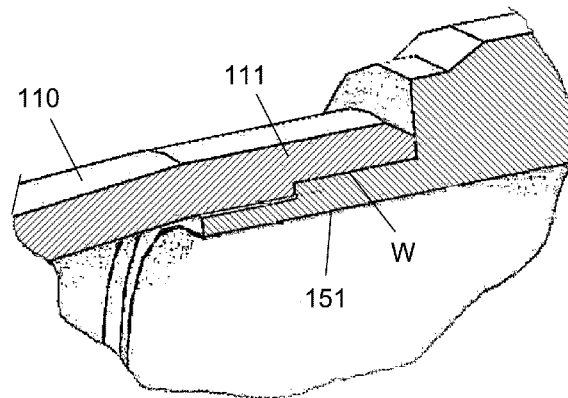
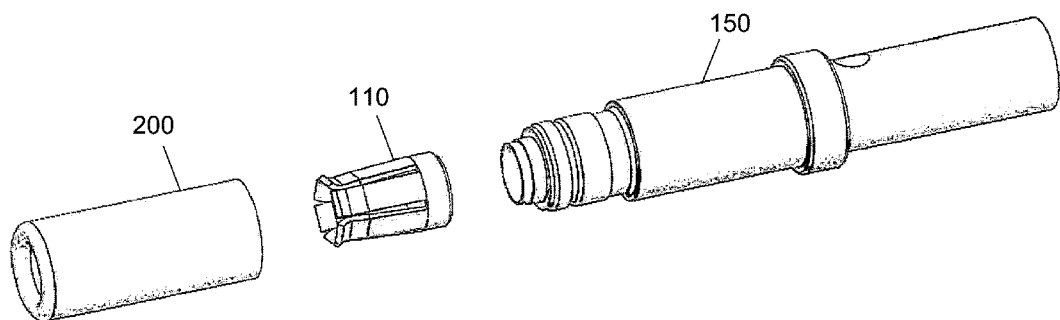


Fig. 6



5 Fig. 7

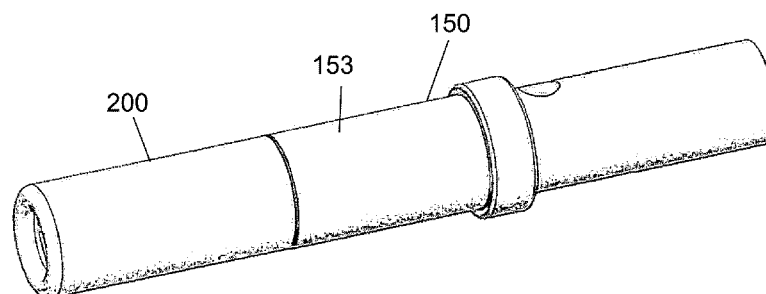


Fig. 8

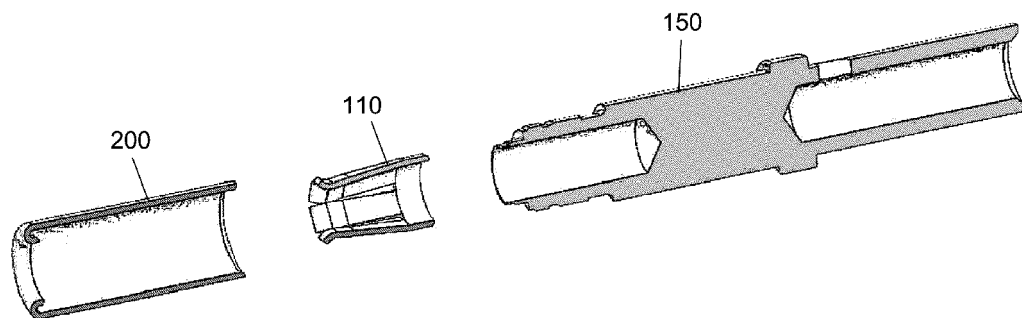


Fig. 9

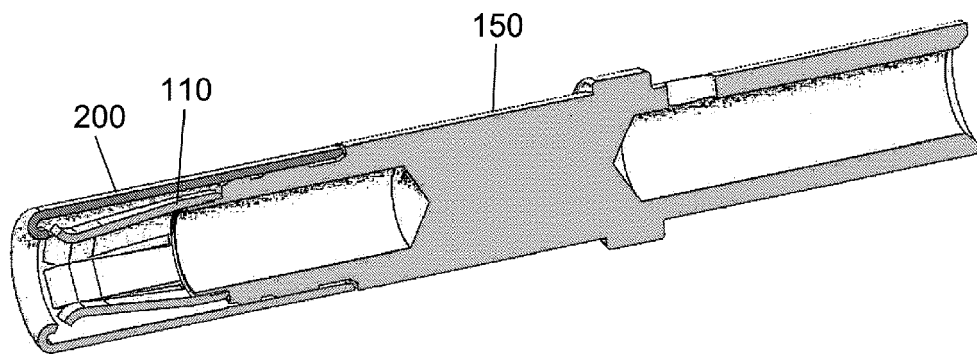
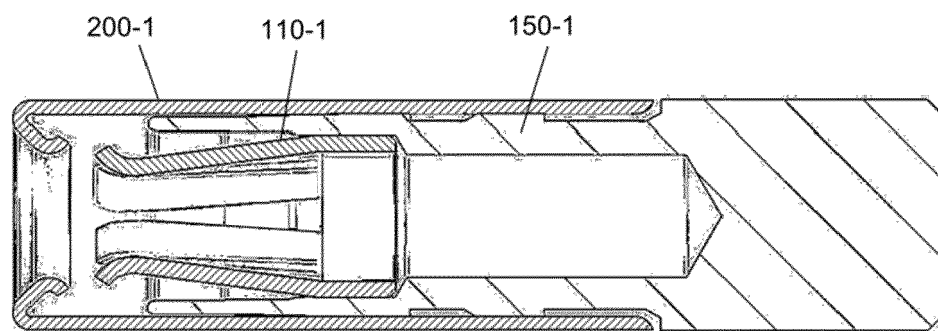


Fig. 10





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Application Number
EP 21 16 9348

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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			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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