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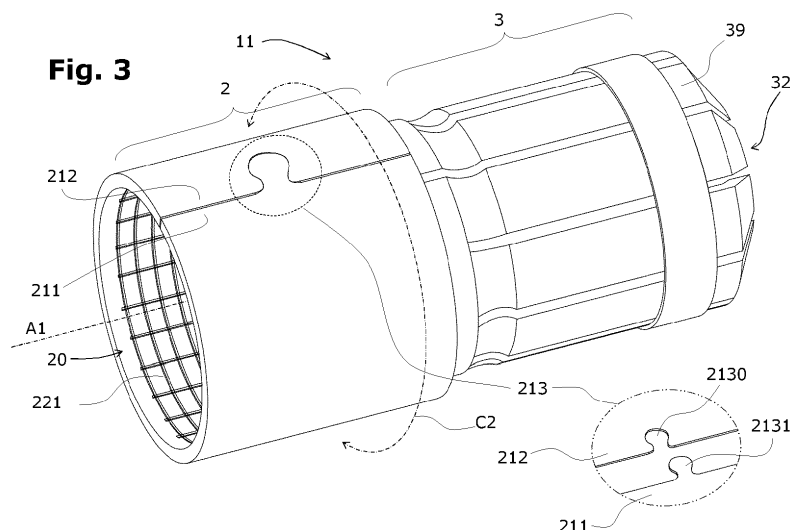
CONTACT TERMINAL FOR A CONNECTOR AND METHOD OF PRODUCING THE SAME

(57) Disclosure relates to a terminal (11,12,13,14,15) for electric contact, possibly for incorporating within a connector, intended to be crimped by an electromagnetic pulse process, or EMPT. Terminal comprises a contact portion (3) and a crimping portion (2). In its crimping area, a conductive material surrounds a crimping cavity along an electrically closed perimeter (C2). According to the disclosure, said crimping area is made from a stamped metal sheet bent on itself, two opposite edges of which are assembled together in an electrically conductive

manner.

Conductive assembly may be done edge to edge, with its edges fixed together by a puzzle assembly (213), or welding line (214) or point (215), or both. Optionally, crimping and contact areas are integral together and made from a same metal sheet, for example by stamping and/or rolling.

Disclosure also relates to a method for manufacturing such a terminal.



Description

[0001] The present disclosure relates to a terminal for electric contact, possibly for incorporating within a connector, intended to be crimped by an EMPT process, for "electromagnetic pulse technology". The terminal comprises a contact portion and a crimping portion which includes a crimping area. In the crimping area, a conductive material surrounds a crimping cavity along an electrically closed perimeter. According to the disclosure, said crimping area is made from a stamped metal sheet bent on itself, two opposite edges of which are assembled together in an electrically conductive manner.

[0002] Conductive assembly may be done edge to edge, with its edges fixed together by a puzzle-type assembly, or welding line or point, or both. Optionally, crimping and contact areas are integral together and made from a same metal sheet, for example by stamping and/or rolling.

[0003] Disclosure also relates to a method for manufacturing such a terminal.

State of the art

[0004] The disclosure relates to the field of connectors, and in particular to the field of automotive connectors.

[0005] Connectors are used to assemble several previously manufactured devices, usually two, in order to make a connection between them that allows electrical energy and/or signals to be transmitted between these devices. These devices can each be a cable or a motor, or another type of device such as a computer or a sensor or a lighting device.

[0006] A connector has one or more contact terminals, each of which is intended to make electrical contact with a counter terminal within a counter connector when the latter is mated with the connector. Such a connector can be a multi-contact connector, comprising several different contact terminals insulated from each other. A single terminal can also be used alone, insulated or not from the outside, and seen as a mono-contact conductor.

[0007] Such a contact terminal generally has a contact portion, intended to come into electrical contact with the contact portion of the counter-terminal; and a connection portion intended to be permanently connected with one or more electrical conductors such as wires within a cable. This connection is usually made either by soldering or brazing or by crimping.

[0008] Crimping is a widely used method, and has the advantage of being quick and simple, and to be done at ambient temperature. Such crimping is obtained by plastic deformation of the crimping portion so as for it to be tightly clamped and pressed around the conductors. The conductors are inserted into a cavity formed within the crimping portion, which is placed in a press, usually between a die and a tool. Electrical contact is then most often made by simply pressing the crimping portion against the exposed surface of the conductor(s).

[0009] In order to obtain a good quality of electrical contact between the contact terminal and the electrical conductors, it is necessary that the crimping be done with a high effort. The more conductors there are in a cable, the higher the force required, so that the force is transmitted deep inside the cable toward the center conductors of the cable and their contact with their immediate neighbors become sufficiently conductive.

[0010] In the case of cables with a large cross-section, for example for the transmission of high currents such as for a battery cable or for powering an electric traction motor, in order to obtain a high crimping force it is known to use an electromagnetic pulse crimping process, or "EMPT" for Electro Magnetic Pulse Technology. This comprises subjecting the crimping portion and the conductors to a very short pulse of a very strong magnetic field, typically longitudinally to the conductors, so as to generate a circular current in the crimping portion all around the conductors. This circular current, associated with the magnetic field that is transverse to it, produces a force in a third direction perpendicular to the other two, in accordance with Lorentz's law. This force is directed towards the interior of the cable, all around it, and crushes the crimping portion on the conductors within the cable.

[0011] EMPT technology is very efficient and relatively fast to operate, but it creates particular constraints for the design of the crimping portion. Inter alia, for the process to work, the crimping portion must be electrically conductive all the way around the conductors.

[0012] For this purpose, the contact terminals currently in use have a crimping portion in the form of a circular skirt, usually machined by material removal. As an example, EP4099519A1 discloses a sleeve-like crimping portion which could be compatible with EMPT crimping, though using such technology is not disclosed nor suggested within its teaching. In order to obtain a good contact quality with the conductors, it is also useful to provide a raised pattern on the internal surface of the crimping portion, which is most often made in the form of a thread obtained by tapping.

[0013] However, it would be useful to be able to produce a contact terminal compatible with EMPT crimping that is faster, simpler and less expensive to manufacture, and that can be designed with greater freedom of shape and material, including in the design of such raised pattern.

List of drawings

[0014] Other advantages and features will become apparent on examination of the detailed description of several examples of embodiments that are in no way limitative, and the attached drawings, in which:

- Fig.1 shows two perspective views of a terminal according to a prior art, including a longitudinal section thereof,
- Fig.2 is a schematic illustration of the principles of the

EMPT crimping technology,

- Fig.3 shows a perspective view of a first example of embodiment of the disclosure, including a detail of the puzzle assembly,
- Fig.4 shows a perspective view of a second example of embodiment of the disclosure,
- Fig.5 shows a perspective view of a third example of embodiment of the disclosure,
- Fig.6 shows a perspective view of a fourth example of embodiment of the disclosure,
- Fig.7 shows a perspective view of a fifth example of embodiment of the disclosure.

Description in reference to the drawings

[0015] Fig.1 shows a perspective view of a longitudinal section of a female terminal 9 according to EP4099519A1. This terminal 9 has a connection portion 92, configured for electrically connecting, by crimping and/or soldering, the terminal to an electrical cable. This connection portion 92 is in shape of a circular skirt longitudinal to the terminal, in the opening 920 of which the cable is to be longitudinally inserted. Integral with the connection portion, and longitudinal with it, the terminal has a contact portion 93 intended to be mated, by an insertion movement along an axial direction D9, with the contact portion of a counter terminal not represented here. In this example, the contact portion 93 has several flexible blades 931, the internal surface 9310 of it is intended to make electrical contact with an external surface of the counter connector. In its center, contact portion 93 has a finger 932 the external surface 9320 of which is to make electrical contact of an internal surface of the counter connector.

[0016] As the skirt appears to be made of a single piece, with an electrical continuity around the perimeter of the skirt 92, the terminal 9 should be usable in an EMPT crimping machine. Regardless of the contact portion 93, it is clear that such connection portion 92 may possibly be manufactured by machining and/or casting, but not by stamping nor rolling a metal sheet.

[0017] Fig.2 illustrates the basic principle of EMPT crimping of a terminal, such as terminal 9 from Fig.1, around wires 929 of an electrical cable. The skirt 92 of the connection portion is provided with its wires 929 and is inserted within an electrical loop L. A current I_s passes in the conductors of the loop L, thus generating a magnetic field B which is longitudinal to the skirt 92. Because the skirt has electrical continuity all around its internal opening 920, it forms a conductive closed loop where the magnetic field B produces an electrical current I_r .

[0018] According to the Lorentz law, represented by the three-digits rule illustrated on the right of the figure, skirt current I_r interacts with the magnetic field B perpendicular to it, for producing a force F which is perpendicular to both current I_r and field B and is center-oriented. In the EMPT crimping machine, this centripetal force F is sufficient to crush the skirt 92 on and around the wires 929 and

thus produce the crimping.

[0019] In Fig.3 to Fig.6 are illustrated various examples of embodiments of a terminal according to the present disclosure. While these examples have the same kinds of contact portion, it must be understood that the disclosure mainly pertains to the connection portion. Different kinds of contact portions may be configured with such connection portion, in particular many contact portions of a known type.

[0020] As it will be described more in details thereafter, the crimping portion includes a crimping area 2 where an electrically conductive material surrounds, along an electrically closed perimeter C2, a crimping cavity 20 arranged for receiving one or several electrical conductors the terminal 11 to 15 is to be crimped on.

[0021] According to the disclosure, manufacturing this crimping area comprises the following steps :

- preparing, by stamping from a metallic sheet, a blank of the terminal that comprises the crimping area, where the latter shows two opposite edges arranged to be assembled together, called crimping area edges,
- shaping the crimping area 2, by plastic deformation such as mono or multi-pass die-stamping and/or rolling, for bringing together said crimping area edges 211, 212,
- joining said crimping area edges together, in a manner 213, 214, 215, providing electrical continuity there between.

[0022] In Fig.3 is illustrated a first example of embodiment of the disclosure, with a terminal 11. Its contact portion 3 has the same kind of central finger 32 (not visible here) and blades 39 as the terminal 9 of Fig.1. The terminal 11 of the disclosure has a connection portion, here called the crimping portion 2, intended to be EMPT-crimped on a cable.

[0023] This crimping portion 2 is in shape of a circular cylindrical skirt of axis A1, with a blind back opening 20 for inserting the cable to be connected with the terminal. This skirt, also called barrel, is made from a metal sheet. The sheet is stamped for making its external shape, and bent by stamping or rolling so as to have a shape of a cylinder. Its crimping area edges 211, 212 are joined together in an edge to edge manner, by assembly 213 of two complementary shapes 2131, 2130 of respective said edges in a way similar to assembling two pieces of a puzzle, in a manner which is known per se.

[0024] Furthermore, in their common bi-dimensional surface, the first edge 211 has a protrusion 2131 the width of which increases in the direction of the second edge 212, and which is arranged to be inserted in an edge-to-edge contact cooperation within a cavity 2130 formed in the second edge, which cavity has a width which decreases in the direction of the first edge, thus producing an assembling 213 here called "puzzle" assembly. With the right dimensional fit, it has been determined that such

assembly may provide an electrical contact between the edges 211, 212 which is sufficiently conductive for the inducted current I_r to pass from one to another in the EMPT technology.

[0025] As the internal surface of the crimping skirt 2 previously was an apparent face of the metal sheet used to produce the blank, one understands that it is easy to produce on it any kind of embossed pattern 221, before bending the edges together, which pattern 221 may be very useful for enhancing electrical contact between the skirt 2 and the cable it is crimped on.

[0026] In this example, the contact portion 3 may be produced out of the same sheet blank, or produced separately and assembled for example in a known manner.

[0027] Fig.4 shows a second example of embodiment, which will be described only in its differences. In this example, the terminal 12 has a crimping portion 2 similar to terminal 11 of Fig.3. However, the contact portion 3 is here also made of a metal sheet blank which is bent into a barrel, the edges 311, 312 of which are here also joined by an edge to edge puzzle assembly 313.

[0028] In this example, contact portion 3 is a barrel 391 which is made from the same blank as crimping portion 2, though its diameter may be different thanks to stamping or other plastic deformation operations that are known per se. Center finger 321 may be produced as a separate part, which is here inserted into one 33 or another 32 barrel, and fixed therein by a hook that clips in a see-through opening 303 of such barrel.

[0029] Fig.5 shows a third example of embodiment, which will be described only in its differences with Fig.4. As illustrated, in this terminal 13, crimping area 2 has its first 211 and second 212 edges assembled by one or several soldering or welding lines, in particular one line 214, making them connected in an electrically conductive manner.

[0030] Fig.6 shows a fourth example of embodiment, which will be described only in its differences with Fig.4. As illustrated, in this terminal 14, crimping area 2 has its first 211 and second 212 edges are assembled with one or several soldering or welding points, in particular two points 215.

[0031] Fig.7 shows a fifth example of embodiment, which will be described only in its differences with Fig.4. As illustrated, in this terminal 15, crimping area 2 has its first 211 and second 212 edges assembled both by a combination of puzzle assemblies and soldering or welding lines or points, in particular one puzzle assembly 213 and two points 215.

[0032] Of course, the disclosure is not limited to the examples just described, and many adjustments can be made to these examples without departing from the scope of the disclosure.

Claims

1. Terminal (11, 12, 13, 14, 15) for electric contact, intended to be incorporated within a connector or to form itself an electric connector, said terminal being intended to be crimped by an electromagnetic pulse process, or EMPT, on one or several electrical conductors so as to make with them a permanent electrical connection, said terminal comprising

a contact portion (3) designed to enable an electrical connection through contact with a counter-terminal, particularly incorporated within a counter-connector;

a crimping portion including a crimping area (2), such as a sleeve or barrel, where an electrically conductive material surrounds, along an electrically closed perimeter (C2), a crimping cavity (20) able to receive the conductors so as to allow the crimping of said crimping area on them, said terminal being **characterized in that** said crimping area (2) is made from a stamped metal sheet bent on itself, two opposite edges (211, 212) of which are assembled together in an electrically conductive manner (213, 214, 215) so as to form the electrically closed periphery.

2. Device according to the preceding claim, **characterized in that** the crimping area edges (211, 212) are arranged in an edge to edge manner.

3. Device according to any one of claims 1 to 2, **characterized in that** the crimping area edges comprise a first edge and a second edge, wherein the first edge (211) has a protrusion (2131) the width of which increases in the direction of the second edge (212), and which is arranged to be inserted in contact cooperation within a cavity (2130) formed in the second edge, which cavity has a width which decreases in the direction of the first edge, thus producing an assembling (213) called "puzzle".

4. Device according to any one of claims 1 to 3, **characterized in that** the crimping area edges (211, 212) are joined by a welding or soldering line (214) or with one or several soldering points (215).

5. Method for manufacturing a contact terminal (11, 12, 13, 14, 15), to be crimped on one or several electric conductors by a process using electromagnetic pulse technology, or "EMPT", particularly to be incorporated within a multicontact connector, said terminal comprising

a contact portion (3), including a contact area intended for enabling an electrical connection with a counter-terminal, particularly incorpo-

rated within a counter-connector, and a crimping portion, including a crimping area (2) where an electrically conductive material surrounds, along an electrically closed perimeter (C2), a crimping cavity (20) arranged for receiving one or several electrical conductors the terminal is to be crimped on, said method comprising the following steps :

- preparing, by stamping from a metallic sheet, a blank of the terminal that comprises the crimping area (2), where the latter shows two opposite edges arranged to be assembled together, called crimping area edges (211, 212),
- shaping the crimping area (2), by plastic deformation, for bringing together said crimping area edges (211, 212),
- joining said crimping area edges (211, 212) together, in a manner (213, 214, 215) providing electrical continuity there between.

(3), simultaneously or separately from the crimping area (2), for producing a contact area adapted to make an electrical connection with a contact area of the counter terminal, particularly through joining together the contact area edges, such as through a "puzzle" form assembling (313).

6. Method according to the preceding claim, **characterized in that** it comprises a step of coining on the crimping area of the blank a grip pattern (221) arranged to be in contact with the conductors during the crimping process, particularly in the same operation as the making of the blank.
7. Method according to any one of claims 5 to 6, **characterized in that** the crimping area edges (211, 212) are arranged in an edge to edge manner.
8. Method according to any one of claims 5 to 7, **characterized in that** the crimping area edges comprise a first edge and a second edge, wherein the first edge (211) has a protrusion (2131) the width of which increases in the direction of the second edge (212), and which is arranged to be inserted in contact cooperation within a cavity (2130) formed in the second edge (212), which cavity has a width which decreases in the direction of the first edge, thus producing an assembling (213) called "puzzle".
9. Method according to any one of claims 5 to 8, **characterized in that** the crimping area edges (211, 212) are assembled by a welding or soldering process, particularly with a soldering line (214) and/or with one or several soldering points (215).
10. Method according any one of claims 7 to 9, **characterized in that** the blank of terminal further comprises, within its contact area (3), two opposed edged call contact area edges (311, 312), and **in that** the method further comprises a step of shaping by plastic deformation of said contact area

Fig. 1 - prior art

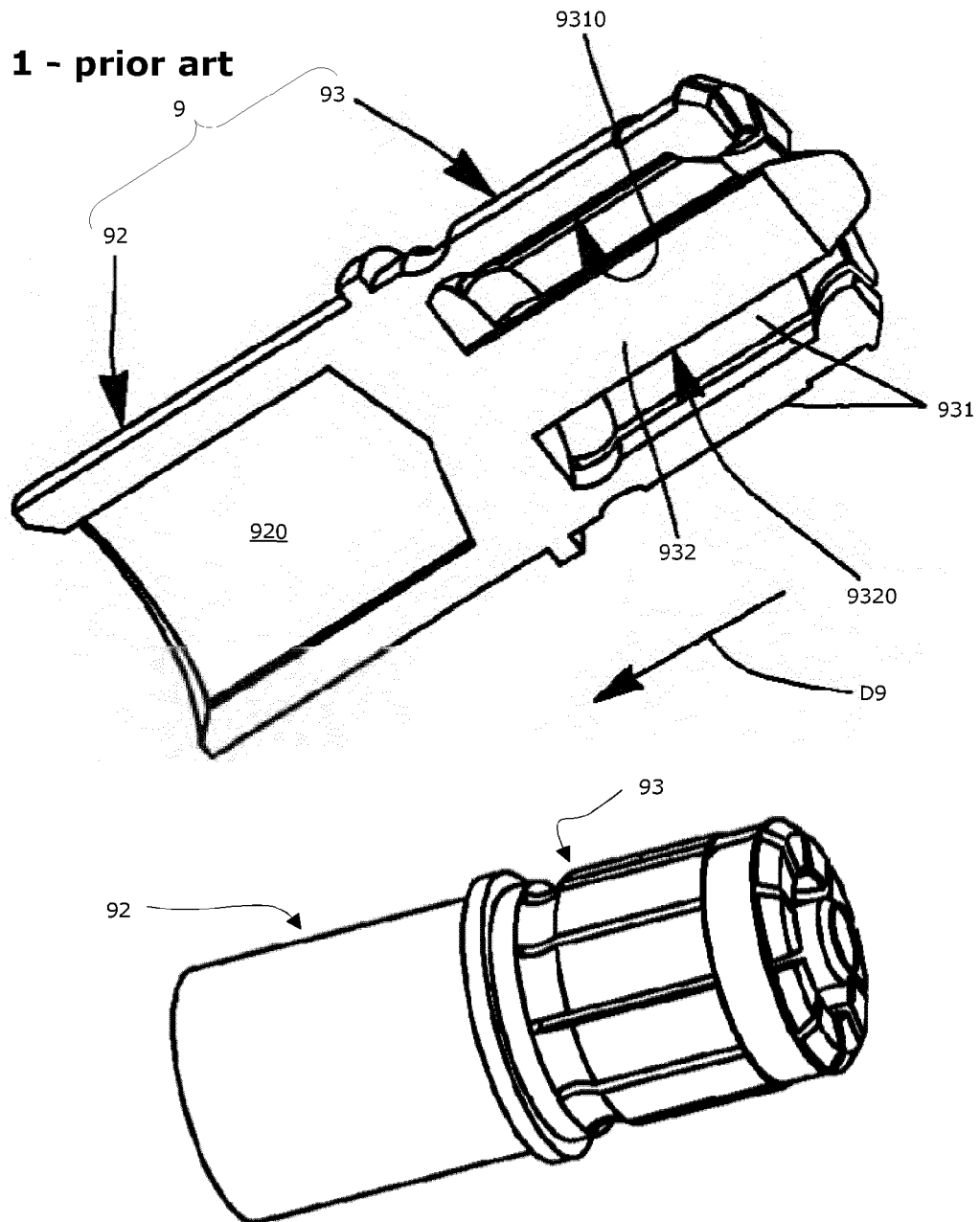


Fig. 2 - prior art

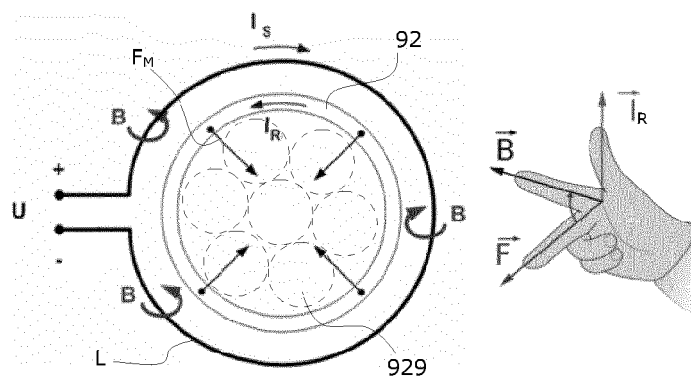


Fig. 3

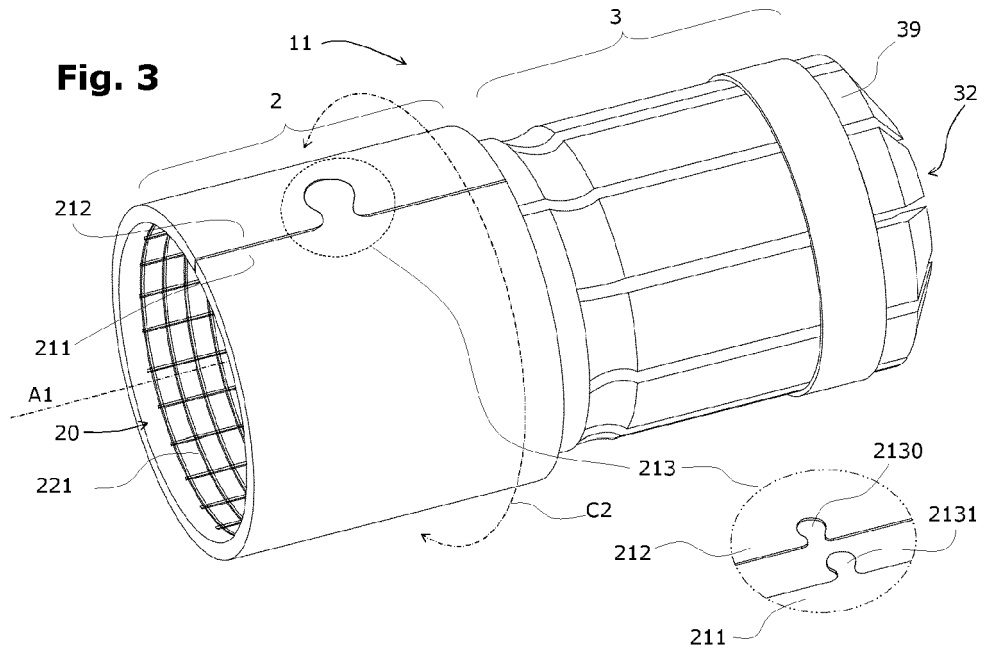


Fig. 4

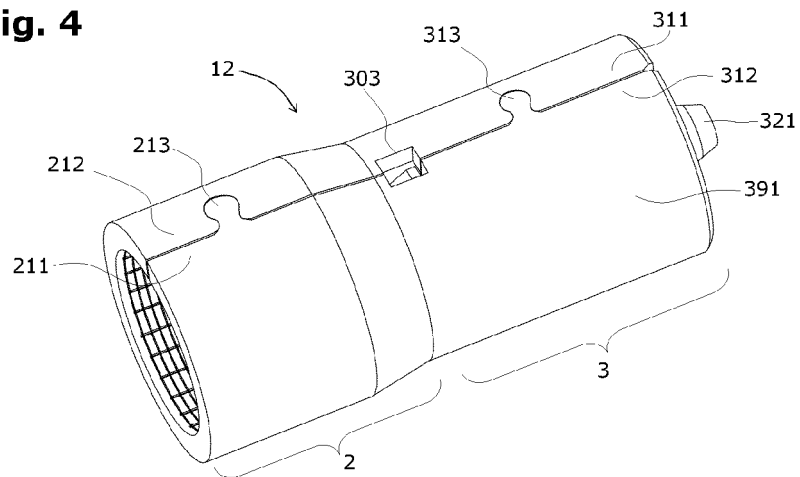


Fig. 5

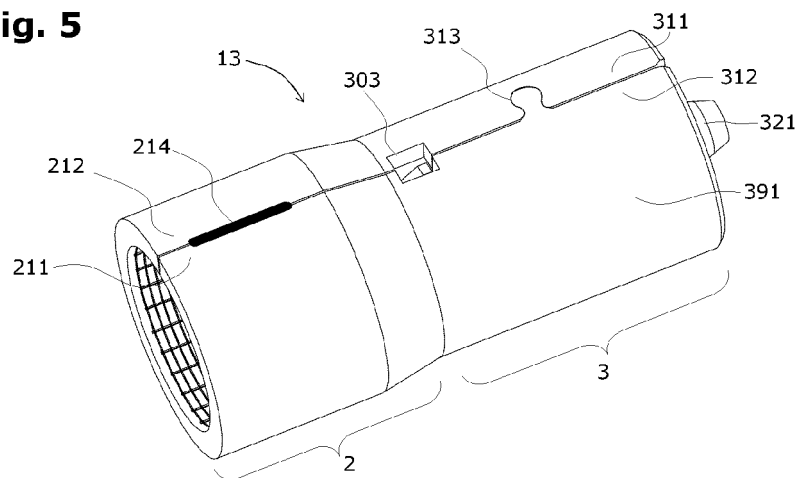


Fig. 6

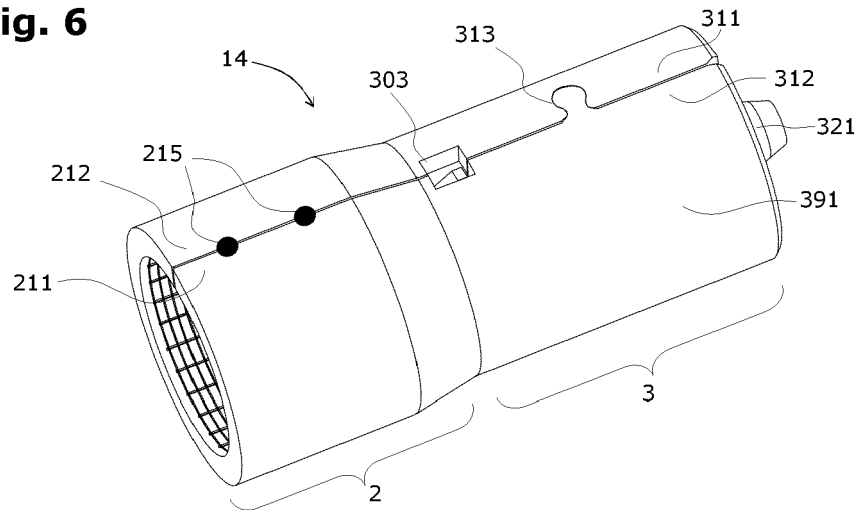
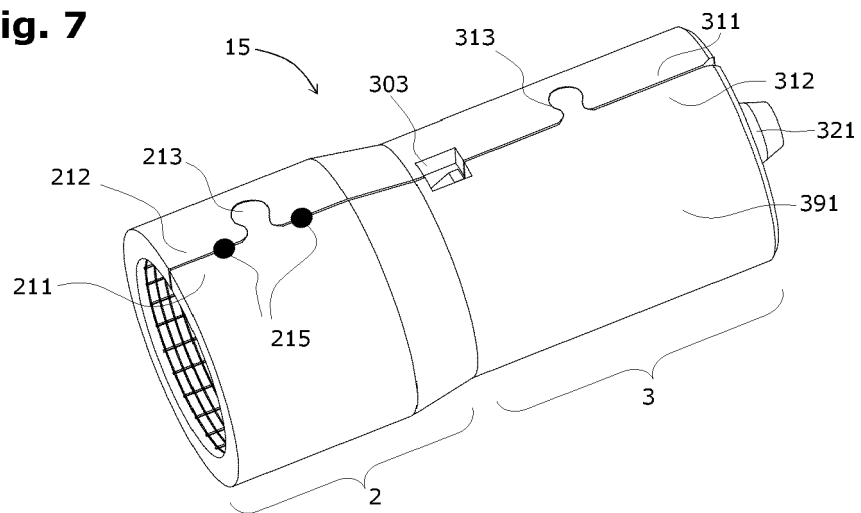


Fig. 7





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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		20 November 2023	Bouhana, Emmanuel
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