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- (73) Patenthaver: **Bals Elektrotechnik GmbH & Co. Kg, Burgweg 22, 57399 Kirchhundem-Albaum, Tyskland**
- (72) Opfinder: **Ramm, Andreas, Heinsberger Str. 56, 57399 Kirchhunden, Tyskland**
- (74) Fuldmægtig i Danmark: **CHAS. HUDE A/S, Langebrogade 1, 2. B2, 1411 København K, Danmark**
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FEMALE TERMINAL FOR AN ELECTRICAL CONNECTOR

The invention relates to a female terminal for an electrical connector.

5 The invention is based on a prior art according to which electrical connectors usually have a contact insert block in which one or more elongated female terminals are arranged, each one as an individual contact. Such electrical connectors can be mechanically and electrically connected with complementary electrical connectors in which one or more elongated pin terminals are arranged as individual contacts in a contact insert block.

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Accordingly, the employed female terminals are adapted for mechanically and electrically coupling with a respective complementary pin terminal. That is, an elongated pin terminal is mechanically and electrically coupled to an elongated female terminal, i.e. the female terminal receives the pin terminal in its interior or the pin terminal accommodates the female terminal over its outer circumference.

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Such electrical female terminals, which are also referred to as individual contacts, have been described in particular in standards DIN EN 62196 and DIN EN 60309.

US 2,743,428 A discloses a female terminal according to the preamble of claim 1.

20

Thus, such female terminals for an electrical connector are substantially made of an electrically conductive material, conventionally of a metal.

The portion of a female terminal which is adapted for coupling with or for receiving a pin terminal will also be referred to as the receptacle portion below and in the claims.

25

Such a receptacle portion extends from a first end portion, which is usually used for mechanical and electrical coupling, or for receiving an electrical connection conductor such as a stranded wire or a wire or a cable. Furthermore, the receptacle portion usually has a substantially cylindrical shape and defines a longitudinal axis of the female terminal.

30

The receptacle portion of such a female terminal furthermore has a cylindrical interior along its longitudinal axis, which is enclosed by the electrically conductive material and has an open end opposite the first end portion, adapted for inserting or plugging into it the electrical contact end of a

pin terminal for electrically and mechanically contacting the surfaces of the pin terminal with the surfaces inside the receptacle portion.

5 For improving the mechanical and electrical connection between a female terminal and a pin terminal, it has been known to arrange, in the cylindrical interior of the female terminals, individual wires or lamellar strips or the like, made of electrically conductive material, preferably in a resilient manner. Often, separate inserts are provided for this purpose, on which such wires or lamellas are attached, that is to say fixed thereto or arranged thereon. A complementary cylindrical pin terminal can thus be reliably inserted or plugged in between the wires or lamellas, that is to say it can be
10 received and retained there. Consequently, the surfaces of the wires or lamellas are caused to make mechanical and electrical contact with the surface of the pin terminal.

The wires or lamellas thus serve to improve both the mechanical and the electrical contact between a female terminal and a pin terminal and offer a large number of contact surfaces due to the large
15 number of individual wires or lamellas engaging on the inserted pin terminal, which consequently also provides for a low electrical contact resistance to a pin terminal and to the interior of the female terminal.

However, it has been found that a low contact resistance cannot always be guaranteed permanently,
20 because oxidation layers and layers of dirt might form on the surfaces of the wires or lamellas as well as on the pin terminals, which will significantly increase the electrical contact resistance over time.

It is therefore an object of the invention to further develop and to provide a cost-effective female terminal of the generic type as described above such that it provides for the transfer of electric
25 current with permanent strong performance, in particular continuously, even over a very large number of mating cycles, preferably with permanently low electrical contact resistances and preferably with a permanently high cleaning effect, however with the smallest possible insertion and withdrawal forces.

30 This object is achieved by the subject-matter of independent claim 1. Advantageous embodiments are specified by the subject-matter of the dependent claims.

Accordingly, the object is achieved by a female terminal designed according to the invention for an electrical connector, comprising an elongated receptacle portion which is essentially cylindrical in

shape, made of an electrically conductive material and defines a longitudinal axis, and which extends from a first end portion to an open end. Consequently, the receptacle portion is adapted for receiving as well as mechanically and electrically coupling an electrical contact end of a pin terminal of a connector to be mated with the electrical connector, which pin terminal is designed complementary to the female terminal and is intended to be introduced via the open end. The receptacle portion provides an interior including contacting webs along the inner circumference towards the open end. Furthermore, the receptacle portion is manufactured in a stamping/bending process and is kept in shape movably by a material interengagement such that the interior provided with the contacting webs along the inner circumference can be resiliently expanded, in particular when the pin terminal is urged or plugged into the open end of the female terminal. On a side substantially facing away from the material interengagement, the receptacle portion is partially formed with an axially extending slot that starts at the open end.

This results in the advantage that insertion and pulling forces are kept extremely low and contamination and/or oxidation layers can still be effectively removed by the contacting webs and through the interspaces that are consequently provided between the contacting webs, in particular already by slightly turning a pin terminal to be introduced, while the contacting webs provide defined contact surfaces for a good electrical connection. Furthermore, the defined contact surfaces of the stamp and bent sleeve may already be influenced particularly well during the stamping process and interspaces can be formed with an axial, oblique or else thread-like orientation, in view of the final bent state. Consequently, in practical use, dirt as removed by the contacting webs, both from the pin terminal and from the webs themselves, can easily collect in the interspaces, and can also easily fall out or be removed from the open end.

Overall, the durability of a female terminal according to the invention is thus improved compared to the prior art, and neither complex cleaning nor lubrication processes have to be carried out to maintain the female terminal, even in a harsh application environment.

The invention thus makes it possible to cost-efficiently produce a female terminal in which an undesirable oxide layer between the inner surfaces of the female terminal and the surface of a pin terminal is avoided, which ensures wear-free surfaces and a permanently low contact resistance of the female terminal of the invention, in particular even in the case of a multitude of mating cycles.

By providing at least one material peg on one side and a corresponding window opening on the other side, in which the material peg is movably caught between two positions, for material interengagement at the material edges that are bent towards one another, it is advantageously possible to adjust the resilient deflection, in particular near the inlet opening of the female terminal, such that low insertion and withdrawal forces can always be ensured based on the smallest and largest possible diameter.

In order to provide a further enhanced clamping effect by the contacting webs arranged in the receptacle portion, the receptacle portion can favourably define a concave inner surface when the pin terminal is not introduced, i.e. in the initial state, so that the receptacle portion can resiliently engage on the pin terminal during the entire insertion process, in particular through the contacting webs provided therein, and can optimally develop its clamping effect.

By using a special material for the receptacle portion and/or by refining the receptacle portion, in particular the inner surface thereof, for example by galvanic treatment and/or heat treatment, it is possible to further improve the electrical contact resistance and to achieve a high level of wear resistance even with a high number of mating cycles.

Appropriately, a special connection device for receiving a connection conductor is additionally provided on the first end portion, to which an electrical conductor can actually be fixed, and the electrical conductor can in particular either be screwed thereto, or can be fixed to the connection device by a spring technique, or by a crimping technique and/or by a soldering or welding technique.

The invention furthermore encompasses connectors which comprise at least one female terminal that is configured according to any one of the embodiments described above.

The invention will now be described in more detail by way of a few preferred exemplary embodiments with reference to the drawings, so that the aforementioned and further advantages and features of the invention will become obvious again. In the drawings show:

30

Fig. 1a a first partial view of a first embodiment of a female terminal according to the invention, with substantially axially extending contacting webs;

Fig. 1b a second partial view of the embodiment according to Fig. 1a, rotated by 180° with respect to Fig. 1a;

- Fig. 2a a first partial view of a second embodiment of a female terminal according to the invention, with substantially thread-like contacting webs;
- Fig. 2b a second partial view of the embodiment according to Fig. 2a, rotated by 180° with respect to Fig. 2a;
- 5 Fig. 3a a first partial view of a third embodiment of a female terminal according to the invention, with substantially oblique contacting webs;
- Fig. 3b a second partial view of the embodiment according to Fig. 3a, essentially rotated by 180° with respect to Fig. 3a;
- Figs. 4a and 4b two partial views of a female terminal according to the invention to illustrate the
 10 mechanism of the invention for defining minimum and maximum dimensions of the diameter of the female terminal;
- Figs. 5a to 5e various partial views of the contact area provided by the female terminal according to the invention; and
- Fig. 6a to 6c three partial views of possible connection ends opposite to the contact area of the
 15 female terminal according to the invention.

Below, features of the invention and possible variations of preferred exemplary embodiments will be discussed in more detail with reference to the embodiments illustrated in the drawings.

20 A female terminal 100 according to the invention for an electrical connector, as schematically illustrated in Figs. 1a and 1b, for example, has an elongated receptacle portion 101 which is essentially cylindrical in shape, is made of an electrically conductive material and defines a longitudinal axis, and which extends from a first end portion 102 to an open end 103. The first end portion 102 serves to connect an electrical conductor (not shown for reasons of clarity). For fixing the
 25 conductor, a connection device 200 is favourably arranged on the first end portion 102, which may in particular be in the form of a clamping spring (Fig. 6a), a crimping clamp (Fig. 6b) or a screw clamp (Fig. 6c), as schematically illustrated in FIGS. 6a to 6c. Instead of fixing the electrical conductor by screwing or by a spring or crimping technique, it may also be fixable to the connection device by other means, such as by soldering or welding, for example, depending on the embodiment.

30

The receptacle portion 101 is adapted to receive as well as mechanically and electrically couple an electrical contact end of a pin terminal 108 (see Figs. 5d, 5e) of a connector to be mated with the electrical connector, which pin terminal is complementary to the female terminal and is to be introduced via the open end 103.

For this purpose, the receptacle portion 101 provides an interior 104 which, towards the open end 103, includes contacting webs 110, and into which the electrical contact end of the pin terminal is to be introduced via the open end 103 of the receptacle portion 101. As can be seen from the figures, the receptacle portion 101 is furthermore preferably provided with an insertion bevel 105 at the open end 103, so that when the pin terminal is introduced or plugged in, it will not abut "bluntly" so to speak, but can easily be inserted through the insertion bevel 105. As can also be seen from the figures, the contacting webs 110 provided along the inner circumference thus preferably extend as far as to the open end 103, although in the case of an insertion bevel 105 provided on the open end 103, the insertion bevel 105 may be free of these contacting webs 110 (Figs. 3a, 3b). Moreover, in a preferred embodiment, the contacting webs 110 extend axially (see Figs. 1a, 1b, 4a, 4b, 5a to 5e) or alternatively obliquely (see Figs. 3a, 3b) or in a thread-like fashion (see Figs. 2a, 2b) along the inner circumference. This has the advantage that dirt adhering to the pin and/or to the contacting webs, which is removed therefrom due to the pin contacting the contacting webs during the process of introducing the pin into the receptacle, can easily be accommodated in the interspaces that are consequently provided between the webs, and can also easily be removed when the pin is pulled out of the receptacle, or which might also fall out of the open end 103 by itself, in the "forward" direction, from the interspaces, depending on the specific design. Such dirt may, for example, be present on the pin and/or on the contacting webs and can be removed most easily by slightly turning the pin in the receptacle for cleaning purposes and, as a result, for improved contacting.

In practical implementation, such contacting webs 110 may be produced by stamping corresponding interspaces into the material. Furthermore, in this case, the contact surfaces to be formed with the stamp and bent sleeve can be optimally influenced, especially during stamping, and it is possible to selectively form interspaces in which dirt can accumulate but will also easily fall out or can be removed. Also, such contacting webs and the interspaces consequently provided between the contacting webs are useful for venting and draining of accumulated water, so that, overall, there will be less oxidation.

Therefore, the contacting webs 110 provide defined contact surfaces for good contact-making, as has only been known so far for lamellas as described in conjunction with the prior art. Moreover, the contacting webs 110 require low insertion and pulling force when introducing or removing a pin terminal, without the cleaning effect suffering as a result. This is in particular due to the reduced

contact surface area, since the pressure exerted on the remaining contact surface area increases accordingly and the cleaning effect thus remains preserved or even increases.

5 Furthermore, at least the receptacle portion 101 is manufactured in a stamping/bending process and is movably kept in shape by a material interengagement 109 such that the interior 104 provided with the contacting webs 110 along the inner circumference can be resiliently expand, in particular when the pin terminal is introduced or plugged into the open end of the female terminal.

10 Instead of a cylindrical receptacle portion conventionally manufactured by a stamping/bending process with an interior into which a pin terminal is to be inserted, the receptacle portion 101 according to the invention thus has no cut joint at which edges as produced by the stamping and bent towards each other of the stamped or cut-out material, i.e. cut edges, would permanently abut against one another.

15 Rather, resilient material properties of the rest shape of the receptacle portion as pre-adjusted by the stamping/bending process are intentionally exploited, and consequently such cut edges can move resiliently away from each other according to the invention under a respective radially outwardly directed force, so that the inner diameter of the interior 104 increases. Without a respective application of force, the receptacle portion will remain in its pre-adjusted rest shape or will return to
20 this rest shape due to the resilient material properties. Thus, although a rest shape (see Fig. 4a, for example) can basically define the smallest inner diameter of the interior 104 and hence the smallest diameter of a pin terminal that can be correctly accommodated in the receptacle, it is also possible for the female terminal to receive pin terminals that have a larger diameter, due to the widening of the inner diameter of the interior 104 (see Fig. 4b, for example).

25 More particularly, in order to ensure a limitation in terms of overstretching the material when the inner diameter of the interior 104 is widened, it is contemplated to at least partially interengage the edges of the stamped or cut-out material produced by the stamping and bent towards one another so as to form an over-expansion stop.

30 So, conveniently, it is suggested for the interengagement 109 to provide at least one material peg 109' on one side and a corresponding window opening 109" on the other side, as can be seen in Figs. 4a and 4b. As a result, a respective material peg 109' is movably caught between two positions in the corresponding window opening 109". As can be seen from FIGS. 4a and 4b, a respective

material peg 109' and the corresponding window opening furthermore also substantially entirely define part of the interior 104, due to the material edges with the cut areas of the receptacle portion 101 which are brought together by bending.

- 5 Furthermore, as is in particular apparent from Figs. 4a and 4b, abutments 112 and 111 are useful to advantageously limit both the resilient deflection and a possible collapse of the female terminal.

This practical implementation thus provides a limitation with regard to an overexpansion by the abutment 112 and with regard to a collapse of the female terminal by the abutment 111.

- 10 Consequently, according to a preferred embodiment (see Fig. 4a), abutment 111 furthermore defines a predetermined minimum diameter in order to minimize the insertion forces, and abutment 112 defines a predetermined maximum dimension for the diameter of a female terminal. As can furthermore be seen from the figures, the receptacle portion 101 and in particular the contacting webs 110 formed in the interior 104 may define a concave surface towards the open end 103.

- 15 Consequently, the contacting webs 110 are formed into the cylindrical interior 104 and therefore ensure permanent good engagement on an inserted pin terminal for a reliable connection between the pin terminal and the female terminal even after a multitude of mating and disconnecting cycles.

- To further increase the elasticity of the resilient deflection and for a defined adjustment of the forces
20 to be applied when plugging and pulling or of the pressures acting on an inserted pin terminal, an axially extending slot 107 is formed in the receptacle portion 101 according to the invention. As can be seen from the figures, such a slot 107 is substantially provided on a side facing away from the material interengagement 109 and starts at the open end 103, extending axially over part of the receptacle portion 101. The greatest pressure and consequently the greatest cleaning effect is
25 therefore provided in an intermediate area between the edges bent towards one another of the stamped or cut-out material and the slot 107. On the other hand, the additional provision of such a slot allows to adjust the resilient deflection so as to always ensure low insertion and withdrawal forces with regard to the smallest and largest possible diameter, without negatively affecting the engagement of the contacting webs.

30

The female terminal of the invention may be arranged as a part of a connector, in particular in the form of an individual contact, in a contact insert block of a connector. Since such connectors and contact insert blocks are known per se to a person skilled in the art, a corresponding illustration by figures has been dispensed with.

Reference signs:

	100	Female terminal
	101	Elongated receptacle portion
5	102	First end portion
	103	Open end
	104	Cylindrical interior
	105	Insertion bevel
	107	Slot
10	108	Pin terminal
	109	Interengagement
	109'	Material peg
	109"	Window opening
	110	Contacting webs
15	111, 112	Abutments
	200	Connection device
	L	Longitudinal axis

Patentkrav

1. Hunterterminal (100) til en elektrisk konektor der omfatter en langstrakt optagelsessektion (101), som i det væsentlige er cylindrisk udformet af et elektrisk ledende materiale og defineret af en længdeakse, og som strækker sig fra en første endesektion (102) til en åben ende (103), og som er udformet til optagelse og til mekanisk og elektrisk kobling af en elektrisk kontaktende af en kontaktstift af en elektrisk konektor, der skal parres med den elektriske konektor, hvilken kontaktstift er komplementært udformet til hunterterminalen og skal indføres via den åbne ende (103);
- 10 hvor optagelsessektionen (101) tilvejebringer et indre (104), som mod den åbne ende (103) omfatter kontaktbroer (110), der strækker sig aksialt eller skråt eller på en gevindlignende måde langs den indre omkreds; og
- 15 hvor kontaktbroerne (110) der er tilvejebragt langs den indre omkreds, strækker sig så langt som til den åbne ende (103); og
- hvor optagelsessektionen (101) er fremstillet i en stanse-/bukkefremgangsmåde;
- kendetegnet ved, at** optagelsessektionen (101) holdes i en form der er bevægelig af en fortanding af materialet (109), således at det indre (104)
- 20 der er forsynet med kontaktbroerne (110) langs den indre omkreds, kan spredes elastisk ud i begrænset omfang, især når kontaktstiften presses eller sættes ind i den åbne ende af hunterterminalen, og hvor optagelsessektionen (101) på en side der i det væsentlige vender væk fra fortandingen af materialet (109), er delvist udformet med en aksialt forløbende
- 25 slids (107), som starter i den åbne ende.
2. Elektrisk hunterterminal (100) ifølge krav 1, hvor den åbne ende (103) af optagelsessektionen (101) er udformet med en indføringsaffasning (105), som også kan være fri for kontaktbroerne (110).
- 30
3. Elektrisk hunterterminal (100) ifølge et hvilket som helst af kravene 1 eller 2 der omfatter mindst en materialetap (109'), som er dannet på den ene side, og en tilsvarende vinduesåbning (109'') der er dannet på den anden side på materia-

lekanterne, som er bøjet mod hinanden, hvilken materialetap er fanget i vinduesåbningen for at være bevægelig mellem to positioner.

4. Elektrisk hunterminal (100) ifølge et hvilket som helst af de foregående krav,
 - 5 hvor en forbindelsesindretning (200) er anbragt på den første endedel (102), hvortil en elektrisk leder kan fastgøres, hvilken elektriske leder især kan fastgøres til forbindelsesindretningen (200) enten ved skruring eller ved en fjederteknik eller ved en krympeteknik og/eller ved en lodde- eller svejseteknik.
- 10 5. Konnektor der omfatter en hunterminal (100) ifølge et hvilket som helst af kravene 1 til 4.

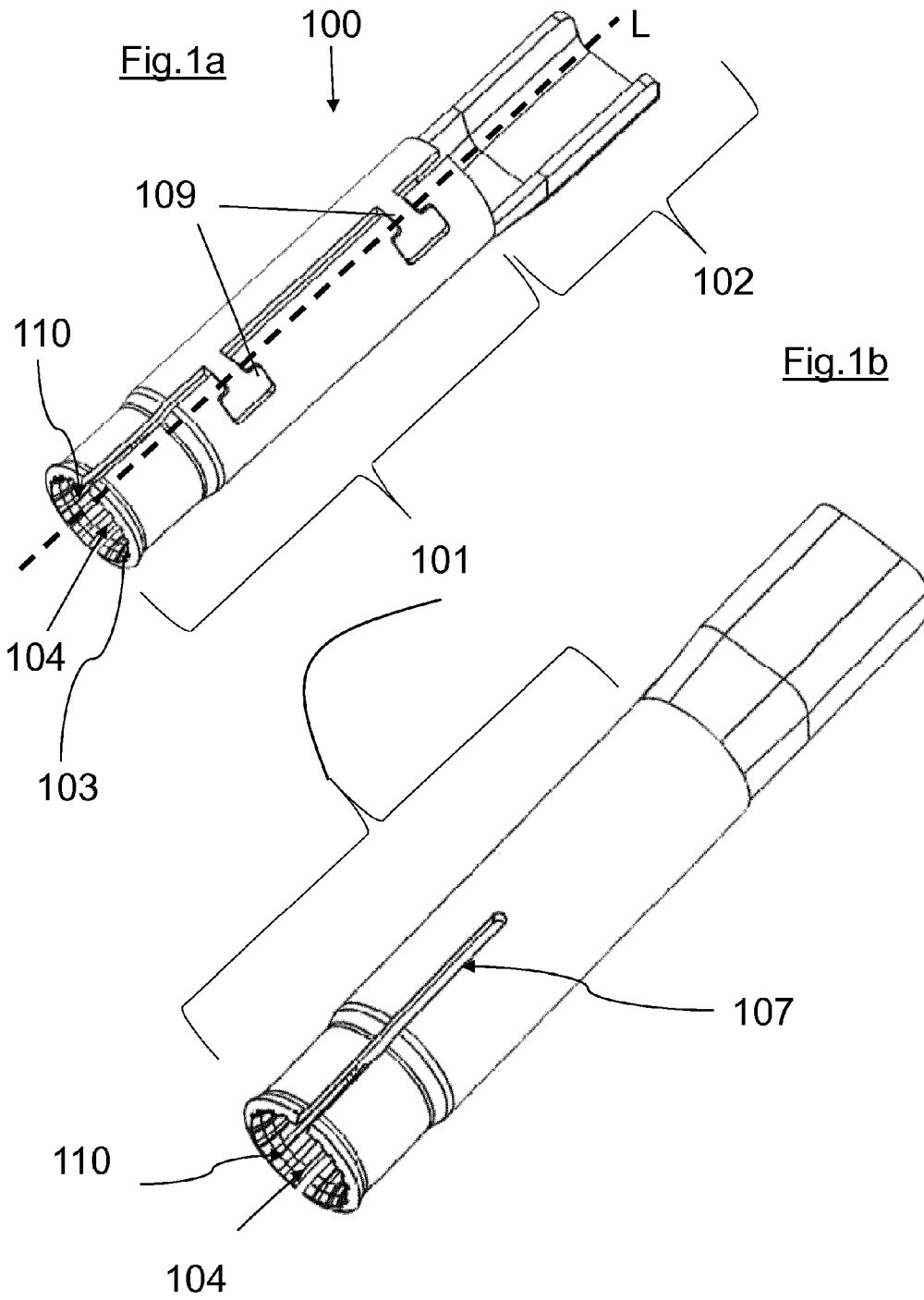


Fig.2a

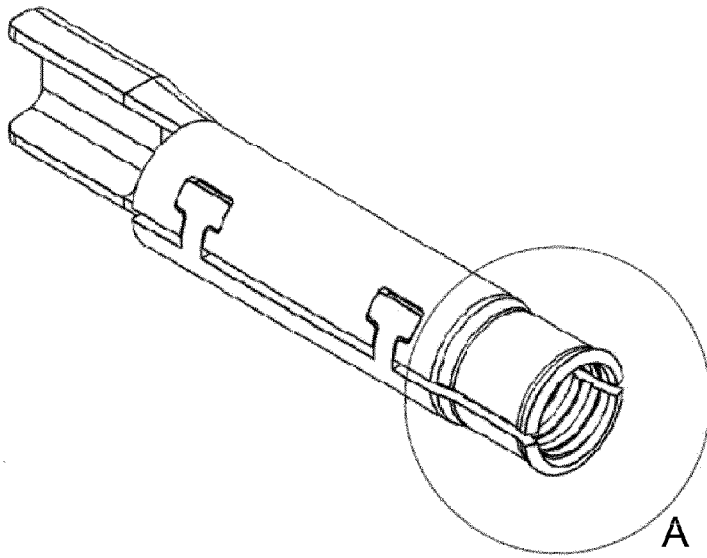


Fig.2b

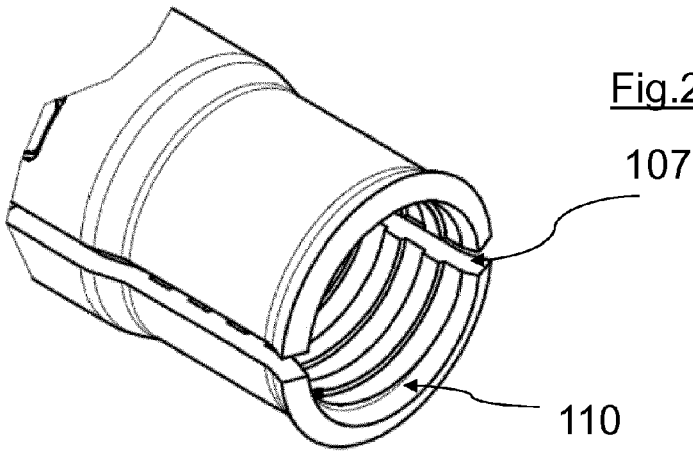


Fig.3a

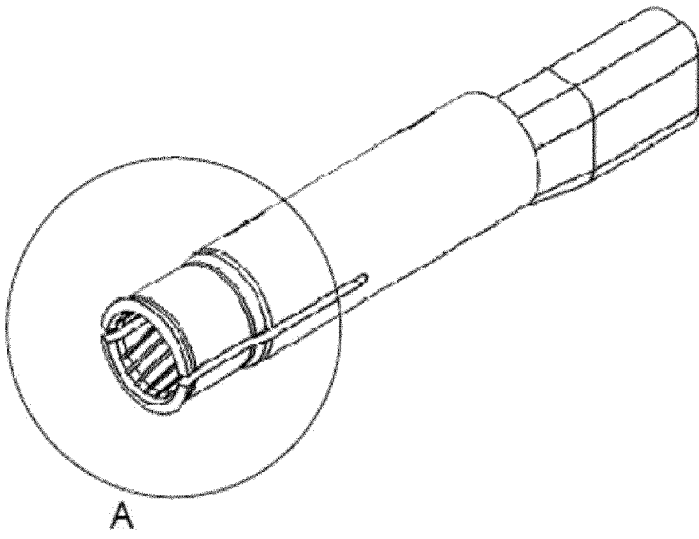


Fig.3b

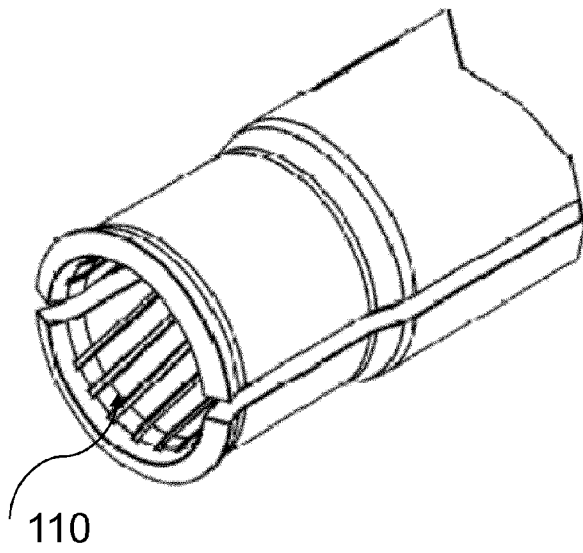


Fig.4a

Fig.4b

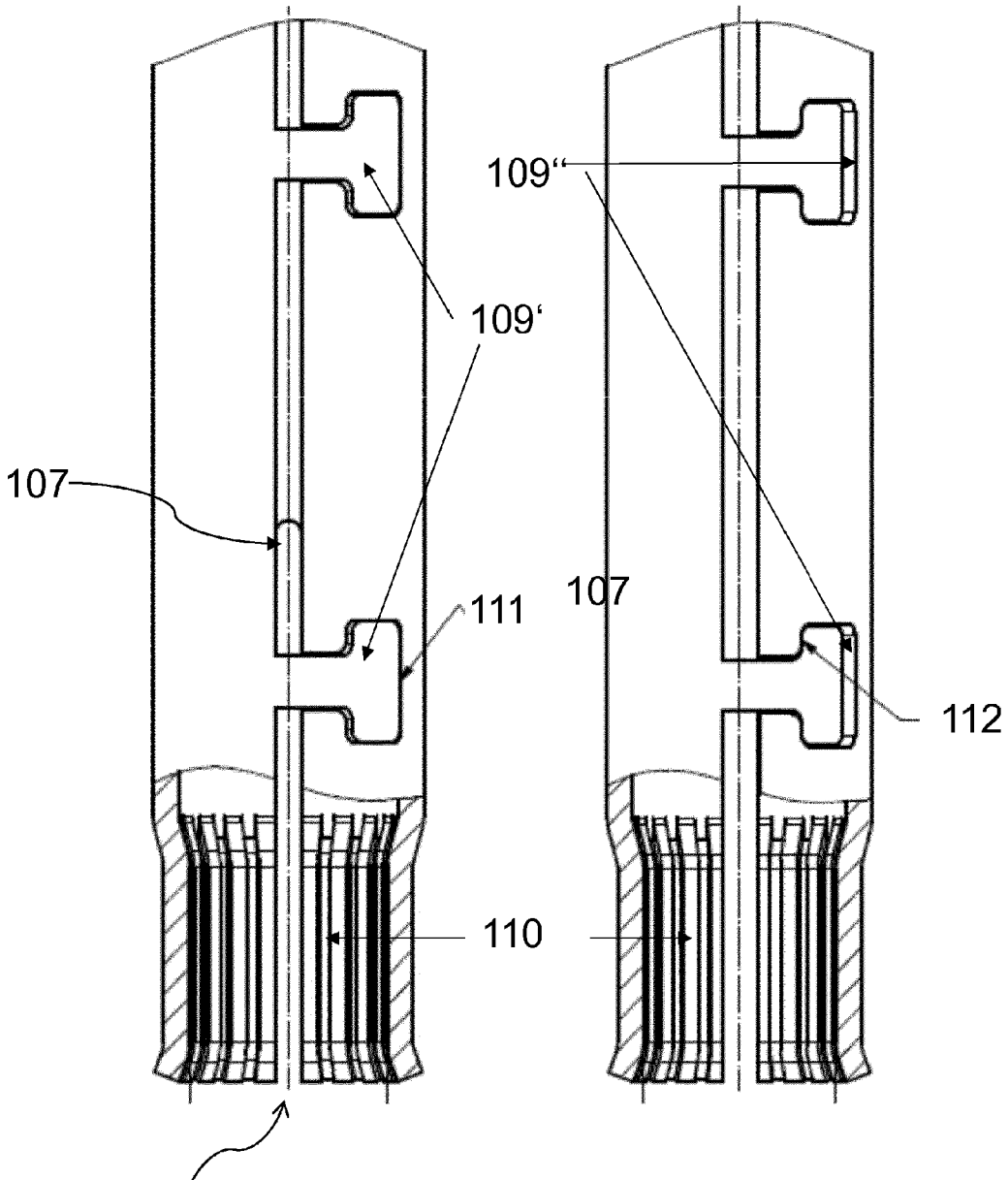


Fig.5a

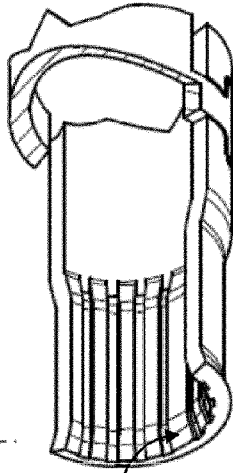


Fig.5b

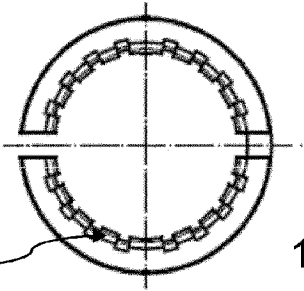


Fig.5d

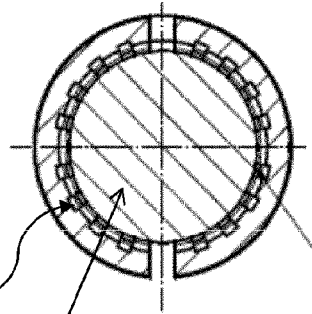


Fig.5e

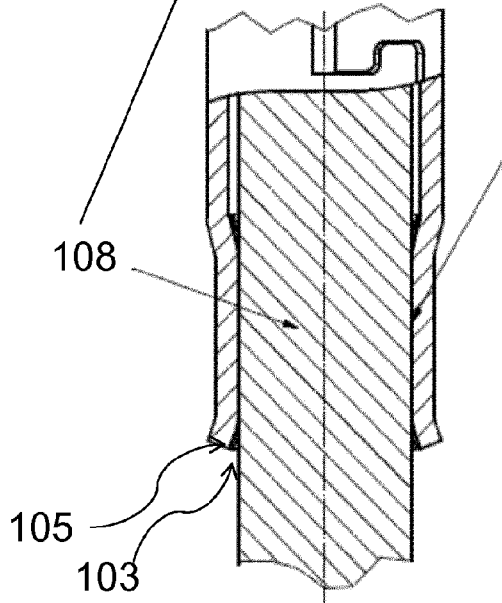


Fig.5c

