

Electrical terminal and method of manufacture

The present invention relates to an electrical terminal and a process of manufacture thereof.

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In particular, the present invention is related to electrical terminals which are used in a vibratory environment.

10 Female terminals usually consist of a connection section attached to a wire and a contact section to which the male terminal is inserted therein.

The male terminal is placed in electrical contact inside
15 the female terminal by an elastic tongue provided on the connection section of the female terminal which also applies mechanical retention force through friction.

In a vibratory environment, for example in an automotive
20 vehicle, wires to be connected are positioned on parts that move relatively to each other. Therefore, the male terminal and the female terminal also move relatively to each other, even when the male terminal is inserted into the female terminal.

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This results in a phenomenon known as fretting corrosion: the mechanical means that hold the male terminal rub against the male terminal, the male terminal becomes abraded and the electrical conductivity of the connection
30 is compromised.

To overcome this problem, the female terminal might be provided with a spring section positioned between the connection section, or crimping section, and the contact
35 section.

For example, the document EP-A-0678936 already describes such a female terminal with a spring section. The spring sections provided on the female terminal usually comprises a plurality of spaced beams, which act as a spring, yet
5 preserving at least a narrow passage for the electrical current.

However, as the electrical current passes through a narrowed passage formed by the spring, it generates heat.
10 This effect causes losses and, therefore, may compromise efficiency and reliability of the connector.

However, terminals that do not use a spring show the above-mentioned effect of fretting corrosion.

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Therefore, a female terminal is needed that mitigates the above-mentioned drawbacks.

To this aim, according to the invention, an electrical
20 terminal is provided, the terminal comprising a bottom wall, a first lateral wall and a second lateral wall, a wire connection section, a contact section, and a spring section positioned between the connection section and the contact section. The spring section comprises two springs
25 which are arranged in the first lateral wall and the second lateral wall, respectively. Moreover, each of the springs comprises not more than three resilient beams, two adjacent resilient beams being interconnected by an arch portion.

30 With these features, relative movements of the contact section of the female terminal and the male terminal are reduced and thus the fretting corrosion is also reduced. Moreover, the springs may bring linear deformation, while reducing torsional deformation of the female terminal, thus
35 preventing the female terminal from being destroyed.

In some embodiments, one might also use one or more of the features defined in the claims.

These features may bring the following advantages:

- 5 - the heat loss is further reduced,
- retention of the male terminal inside the female terminal is improved, and the male terminal is guided inward, when the male terminal is inserted, and
- 10 - the fretting between the external cage and the female terminal is reduced, the external cage preventing the movements of the front portion of the female terminal to a lesser extent and the spring provided on the female terminal being not
- 15 prevented from acting.

This may help to further reduce the fretting corrosion, while the female terminal is still provided with a protection of the external cage.

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Of course, different features, alternatives and/or embodiments of the present invention can be combined with each other in various arrangement to the extent that they are not incompatible or mutually exclusive of others.

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The present invention will be better understood and other features and advantages will become apparent upon reading the following detailed description including embodiments for illustrative purposes with reference to the figures, presented as non-limitative examples, which can be used to complete the understanding of the present invention and the description and, where appropriate, contribute to its definition, in which:

- 30 - Figure 1 shows a female terminal according to the present invention with a spring section, seen from the top,
- 35 the top,

- Figure 2 shows the female terminal according to the present invention with a spring section, seen from the bottom,
- 5 - Figure 3 shows a cross-section of the female terminal according to the present invention with a spring section top wall,
- Figure 4 shows an external cage in which the female terminal according to the present invention may be inserted, seen from top,
- 10 - Figure 5 shows the external cage in which the female terminal according to the present invention may be inserted, seen from bottom,
- Figure 6 shows a cross-section of the external cage,
- 15 - Figure 7 shows a cross-section of an assembly of the female terminal and the external cage according to the present invention,
- Figure 8 shows a planar section view of the assembly of the female terminal and the external cage according to the present invention,
- 20 - Figure 9a to 9d shows various steps of a process of manufacturing of the female terminal according to the present invention,
- Figure 10 shows an alternative embodiment of the female terminal according to the present invention,
- 25 and
- Figure 11 shows an example of a male terminal.

It should be noted that, on figures, structural and/or
30 functional elements which are common to different embodiments may have the same reference sign. Thus, unless otherwise stated, these elements have structural, dimensional and material properties which are identical.

35 An example of a female terminal 1 according to the present invention can be seen on Figures 1 to 3.

The female terminal 1 generally consists of a box-shaped body having a top wall 11, a bottom wall 12, a first lateral wall 13 and a second lateral wall 14.

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The female terminal 1 comprises a connection section 2, preferably a stiff wire connection section 2, a spring section 3 and a contact section 4, preferably a stiff contact section 4, arranged one after the other along a longitudinal direction of the female terminal 1.

The connection section 2 further comprises a crimping tab, not currently shown, which extend from each side of a crimping base 201, abutments 203, a seam 204, opposed openings 205 and 206, and opposed openings 207 and 208. The opposed openings 205-208 are shaped to receive a plastic lance of a housing to lock the female terminal 1 in the housing.

When the female terminal 1 is attached to a wire, not currently shown, the crimping tabs are bent, so as to surround the wire, and a crimped connection between the female terminal 1 and the wire is established.

As can be seen from an example shown on Figures 1 to 3, the spring section 3 comprises two springs 301, each accommodated in a respective lateral wall, respectively the first lateral wall 13 and the second lateral wall 14. A transversal slit 303 spans from the first lateral wall 13 across the top wall 11 to the second lateral wall 14.

The springs 301 are attached to both the connection section 2 and the contact section 4 via transition portions 305. The transition portions 305 are, for example, located at the bottom wall 12. It is also possible to attach the springs 301 to the connection section 2 and the contact

section 4 directly.

The spring 301 consists of two generally parallel beams 307, 308. The beams 307, 308 are connected via an arch portion 302. The arch portion 302 is located near the top wall 11 of the female terminal 1. The beams 307 and 308 together with the arch portion 302 form, in the first lateral wall 13, a U-shaped meander. Similarly, another U-shaped meander is formed in the second lateral wall 14.

10

There is a gap 306 separating the beams 307, 308, which is parallel to the transversal slit 303.

As can be seen on Figure 2, the bottom part of the springs 301 also comprises a bump 304. The bumps 304 are positioned opposing the transition portions 305, protruding into the gap 306. The bumps 304 may help to avoid an unlimited deformation of the springs 301 during use and resulting damages to the springs 301.

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In the top wall 11, on each side of the transversal slit 303, two tabs 309 may be provided. The tabs 309 may also help to avoid an unlimited deformation of the springs 301 during use and resulting damages to the springs 301. Both the bumps 304 and the tabs 309 may also help to avoid plastic deformation of the springs 301 during manufacture.

The springs 301, as described in an example from Figures 1 to 3, form in each of the first lateral wall 13 and the second lateral wall 14 two resilient beams 307, 308 connected by the arch portion 302.

Alternatively, the springs 301 may be formed of three resilient beams, where each of the resilient beams is connected to the neighbouring resilient beam by an arch portion. Example of such embodiment can be found on Figure

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The spring section 3 from the example shown on Figure 10 comprises two springs, located in the first lateral wall 13 and the second lateral wall 14. The springs are each formed in three generally parallel beams 607, 608 and 610. The beams 607 and 608 are connected via an arch portion 602A, located near the bottom wall 12 of the female terminal 1. The beams 608 and 610 are connected via an arch portion 602B, located near the top wall 11 of the female terminal 1.

The beams 607, 608 and 610, together with the arch portions 602A, 602B form an S-shaped meander. The S-shaped meander is connected to the connection section 2 and the contact section 4 via transitional portions 605.

The remaining features of the female terminal 1 are analogous to the features of the embodiment shown on Figures 1 to 3.

In both above described embodiments, the spring section 3 is formed so as to bring a linear deformation rather than torsional deformation of the female terminal 1. Therefore, the female terminal 1 is prevented from being easily destroyed.

Referring back to the first embodiment, the springs 301, consisting of beams 307 and 308, advantageously resilient beams 307 and 308, with the arch portion 302, form a narrow passage that is kept as short as possible without losing the spring action. Therefore, the design of the spring section 3 allows the springs 301 for both performing spring action with the required stiffness, while keeping compact.

At the end of the female terminal 1, opposite to the

connection section 2, there is the contact section 4. The contact section 4 forms a front opening 401 on the top wall 11, the bottom wall 12, and the first lateral wall 13 and the second lateral wall 14.

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A male terminal 600, which is shown on Figure 11, is inserted through the front opening 401. The male terminal 600 has a constant cross-section beyond the tapered insertion end.

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On the top wall 11, there is a seam, with an optional welding point.

Preferably, both the top wall 11 and the bottom wall 12 comprise at the contact section 4 a U- or V-shaped cut 409, which divides the contact section 4 into two lateral sections, thus forming two elongated branches 407 and 408, advantageously two elongated resilient branches 407 and 408.

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The two branches 407 and 408 may bring more flexibility to the female terminal 1, and the contact force provided by the retention means, which are here below described below, may be adjusted.

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The contact section 4 further comprises retention means for providing a retention force and, therefore, holding the male terminal 600 inside.

The retention means can, for example, consist of one or more arms 402, preferably resilient arms 402, cut out of the first lateral wall 13 and the second lateral wall 14. The resilient arms 402 also establish an electrical contact. The resilient arms 402 either may have a free end or may be attached at both ends.

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The resilient arms 402 may employ one or more contact protrusions such as points or ribs, which contact the male terminal 600.

- 5 The retention means of the male terminal 600 may be further enhanced by a pair of tabs 403, advantageously a pair of resilient tabs 403.

10 An example shown on Figures 1 to 3 employs an inwardly protruding front portion of the female terminal 1 to form the pair of tabs 403.

The pair of tabs 403 is formed adjacent to the front opening 401, at the opposing ends of the elongated branches 15 407 and 408. Each tab 403 may be one-piece or may be further divided into two or more resilient fingers 405, 406 as shown on Figure 3. Each of the fingers 405 and 406 may have one or more contact protrusions such as points or ribs.

20

The pair of tabs 403 may improve the control resiliency of the contact section 4.

25 Upon inserting the male terminal 600, it will not only deflect the tabs 403, but the whole branches 407 and 408. The stiffness of the branches 407 and 408 is more easily controlled within tight tolerances than that of the fingers 405 and 406.

30 It may also improve holding the male terminal 600, once it is inserted into the female terminal 1.

The inwardly protruding front portion which constitutes the tabs 43 may also work as a guiding portion, which 35 facilitates the correct insertion of the male terminal 600.

Moreover, once the pair of tabs 403 is provided divided into two or more fingers 405 and 406, the contact with the male terminal 600 is more flexible.

- 5 The arms 402 establish an electrical contact between the female terminal 1 and the male terminal 600. The arms 402 may apply relatively small retention force, compared to the force applied by the tabs 403 in cooperation with the branches 407 and 408.

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In this way, the point of electrical contact is separated from the point where the male terminal 600 is held. If the male terminal 600 is then moved, the fretting corrosion at the point of electrical contact is further reduced.

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The function of the spring section 3, as shown in the example of Figures 1 to 3 will now be described.

- 20 The female terminal 1, when in use, may be positioned in a vibratory environment. When the male terminal 600 is inserted into the female terminal 1 and the assembly is placed in the vibratory environment, the springs 301 deform, so as to prevent the contact portion 3 of the female terminal 1 with the male terminal 600 from moving
25 with respect to each other.

- Only in cases of extreme stress applied, the contact portion 4 of the female terminal 1 with the male terminal 600 move with respect to each other. Therefore, the
30 fretting corrosion is reduced and the electrical conductivity of the assembly is improved.

- Preferably, the spring 301 acts on about tens of micrometres (10 μm to 50 μm).

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Further, the female terminal 1 may be inserted into an

external cage 5, which is shown on Figures 4 to 6.

The external cage 5 protects the female terminal 1 and may provide additional retention means to hold the male terminal 600 inside the female terminal 1. Moreover, the external cage 5 may hold any additional features necessary for inserting the female terminal 1 to any complementary device, such as an electrical connector, external housing or the like, not currently shown.

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The external cage 5 generally consists of a top wall 502, a bottom wall 503, a first lateral wall 504 and a second lateral wall 505, respectively. The top wall 502, the bottom wall 503, the first lateral wall 504 and the second lateral wall 505 form together a box-shaped body adapted to receive the female terminal 1.

The box-shaped body of the external cage 5 has a wire opening 501 and an insertion opening 509.

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The wire opening 501 is positioned so as to be adjacent the connection section 2 of the female terminal 1, once the female terminal 1 is inserted into the external cage 5, while the insertion opening 509 is positioned opposite the wire opening 501.

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The insertion opening 509 is positioned adjacent to the front opening 401 of the female terminal 1, so that the male terminal 600, when inserted, passes through the insertion opening 509.

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The first lateral wall 504 and the second lateral wall 505 may comprise opposed rear openings 514 and 515, in order to receive the locking lance of the housing.

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Further, the first lateral wall 504 and the second lateral

wall 505 may comprise opposed front openings 516 and 517 which are superposed with the openings 207 and 208 of the female terminal 1, shaped to receive an additional locking lance of the housing for extra retention.

5

A front part of the insertion opening 509 may be folded towards the inside of the external cage 5. The front portion may be further divided into two elastic fingers 510 and 511, as can be seen on Figures 6 and 7.

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These features together may provide additional retention force for holding the male terminal 600 in the assembly of the female terminal 1 and the external cage 5. Thus, these features may help to reduce the fretting corrosion.

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On the top wall 502 of the external cage 5, there is a pair of retention tabs 507. Similarly, on the bottom wall 503 of the external cage 5, there is a pair of retention tabs 506. Alternatively, more pairs of retention tabs 506 or 507 could be provided.

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The top wall 11 of the female terminal 1 comprises the opening 206, while the bottom wall 12 of the female terminal 1 comprises the opening 205. The opening 206 of the top wall 11 of the female terminal 1 and the opening 205 of the bottom wall 12 of the female terminal 1 are respectively positioned so as to be able to cooperate with the pair of retention tabs 506 of the bottom wall 503 of the external cage 5 and the pair of retention tabs 507 of the top wall 502 of the external cage 5.

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Once the female terminal 1 is inserted into the external cage 5, the retention tabs 506 and 507 are folded towards the insides of the external cage 5, enter the openings 205 and 206 of the female terminal 1 and cooperate with the openings 205 and 206, so as to hold the female terminal 1

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in place inside the external cage 5.

The female terminal 1 is also provided with one or more pairs of abutments 203. The abutments 203 are preferably positioned symmetrically on both the first lateral side 13 and the second lateral side 14. In the example shown on Figures 1 to 3, 7 and 8, there are two pairs of abutments 203, positioned adjacent the top wall 11 and the bottom wall 12 of the female terminal 1.

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Once the female terminal 1 is inserted into the external cage 5, the abutments 203 contact the lateral walls 504 and 505 of the external cage 5. As the abutments 203 are positioned symmetrically, they help to centre the female terminal 1 inside the external cage 5. The abutments 203 also help to hold the female terminal 1 in place, thus to prevent the female terminal 1 from being shifted in both longitudinal and transversal directions. In addition, it further prevents the relative movements of the female terminal 1 and the male terminal 600.

On the top wall 502 of the external cage 5, a pre-opener 508 may be provided. The pre-opener 508 is cut out of the top wall 502 of the external cage 5 and is bent so as to project towards the inside of the external cage 5.

Once the female terminal 1 is inserted into the external cage 5, the pre-opener 508 enters the cut 409 of the female terminal 1 and holds the two resilient branches 407 and 408 in a pre-tensioned state. This setting may help to centre the female terminal 1 inside the external cage 1.

When the female terminal 1 is inserted into the external cage 5, as seen on Figures 7 and 8, the contact section 4 of the female terminal 1 closely encounters the external cage 5.

In the example shown on Figures 7 and 8, the direct contact between contact section 4 and the external cage 5 is avoided.

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Between the contact section 4 and the external cage 5, there is a gap 512. The gap 512 is preferably so wide that the branches 407 and 408 do not touch the external cage 5, even when the male terminal 600 is inserted into the female terminal 1.

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The above described features of abutments 203 and pre-opener 508 help to maintain this condition.

15 In this way, the external cage 5 does not cause additional stress, e.g. friction, on the contact section 4. The contact section 4 of the female terminal 1 has a certain freedom of movement inside the external cage 5. Thus, the external cage 5 does not interfere with the action of the spring 301 provided on the female terminal 1.

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The female terminal 1 may be manufactured from a band of metal in a reel-to-reel continuous process. Figure 9a shows the output of a stamping step of the band, where a metal sheet is formed flat with a geometry which can be folded to form the female terminal 1. To a next step of operation, as shown on Figure 9b, the tabs 403 are separated from the arm 402, in another cutting operation. Then, as shown on Figure 9c and 9d, the sheet is folded to form the female terminal 1.

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Even though the embodiment above is provided for a female terminal, a similar spring section could be provided for a male terminal. The female terminal and the male terminal according to the present invention are designated as electrical terminal.

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Obviously, the present invention is not limited to
embodiments which are here above described and provided
only as examples. It also includes different modifications,
5 and alternatives that may be considered by the person skill
in the art as part of the present invention, including all
combinations of different embodiments here above
described, taken alone or in combination.

CLAIMS

1. Electrical terminal (1) comprising:
- a bottom wall (12), a first lateral wall (13) and a
5 second lateral wall (14),
 - a connection section (2),
 - a contact section (4), and
 - a spring section (3) positioned between the connection
section (2) and the contact section (4) and comprising
10 two springs (301) arranged in the first lateral wall
(13) and the second lateral wall (14), respectively,
characterized in that each of the springs (301) comprises
not more than three beams (307, 308, 607, 608, 610), two
adjacent beams (307, 308, 607, 608, 610) being
15 interconnected by an arch portion (302, 602A, 602B).
2. Electrical terminal (1) as in claim 1, **wherein** the
spring section (3) further comprises one or more bumps
(304) and/or tabs (309), to limit deformation of the
20 springs (301).
3. Electrical terminal (1) as in claims 1 or 2, **wherein**
each of the springs (301) comprise two beams (307, 308)
interconnected by an arch portion (302), therefore forming
25 an U-shaped curve.
4. Electrical terminal (1) as in any of the preceding
claims, **wherein** the springs (301) extend from the first
lateral wall (13) and the second lateral wall (14) towards
30 the bottom wall (12), the springs (301) being partly
accommodated in the bottom wall (12).
5. Electrical terminal (1) as in any of the preceding
claims, **wherein** the electrical terminal (1) is a female
35 terminal further comprising a front opening (401) for the

male terminal (600) and retention means providing a retention force on the male terminal (600), the retention means being preferably positioned adjacent to the front opening (401).

5

6. Electrical terminal (1) as in claim 5, **wherein** the retention means comprise at least one arm (402).

7. Electrical terminal (1) as in claims 5 or 6, **wherein**
10 the retention means comprise a pair of tabs (403) formed from an inwardly protruding front portion of the electrical terminal (1).

8. Electrical terminal (1) as in any of the preceding
15 claims, **wherein** the electrical terminal (1) is a female terminal further comprising an external cage (5), having :

- a top wall (502), a bottom wall (503), a first lateral wall (504) and a second lateral wall (505), forming a box-shaped body,
- 20 - an opening (509), through which a male terminal (600) is to be inserted,
- at least one pair of retention tabs (506, 507), suitable to cooperate with the female terminal (1) to hold the female terminal (1) inside the external cage
25 (5),

wherein, when the female terminal (1) and the external cage (5) are assembled, a front portion of the external cage (5), defined as a portion adjacent the opening (509), does not touch an adjacent portion of the female terminal (1).

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9. A terminal as in claim 8, **wherein** the electrical terminal (1) further comprises one or more symmetrically positioned abutments (203), which are adapted to centre the female terminal (1), when the female terminal (1) is
35 inserted into an external cage (5).

10. A terminal as in claims 8 or 9, **wherein** the external cage (5) further comprises a pre-opener (508), suitable to hold branches (407, 408) of the electrical terminal (1) in a pre-tensioned state.

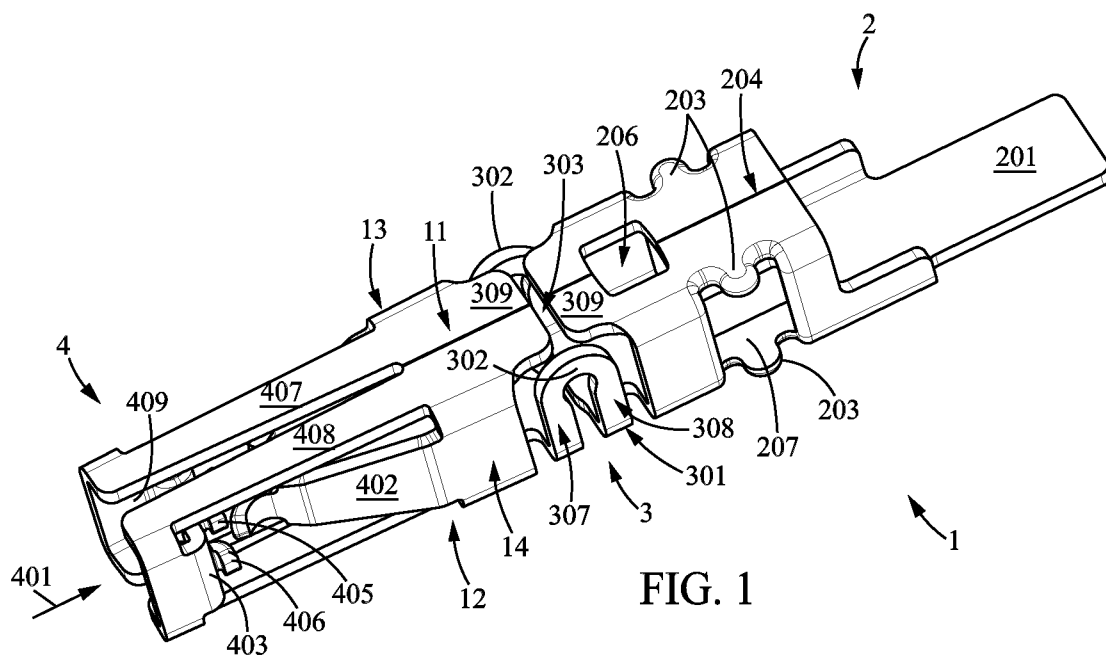
11. Process of manufacture of a electrical terminal (1) as in any of claims 1 to 9, the process comprising steps of:

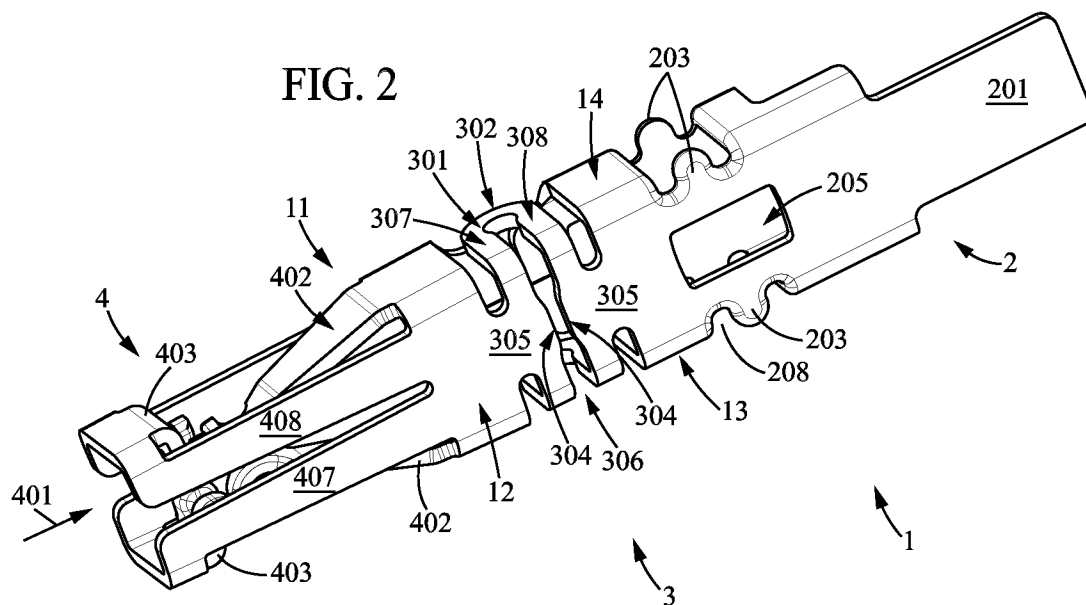
- providing a sheet metal,
- 10 - forming a connection section (2) out of the sheet metal,
- forming a contact section (4) out of the sheet metal,
- forming a spring section (3) out of the sheet metal, the resilient spring section (3) being positioned between
- 15 the connection section (2) and the contact section (4), and
- folding the sheet metal to a U-shaped or box-shaped body,

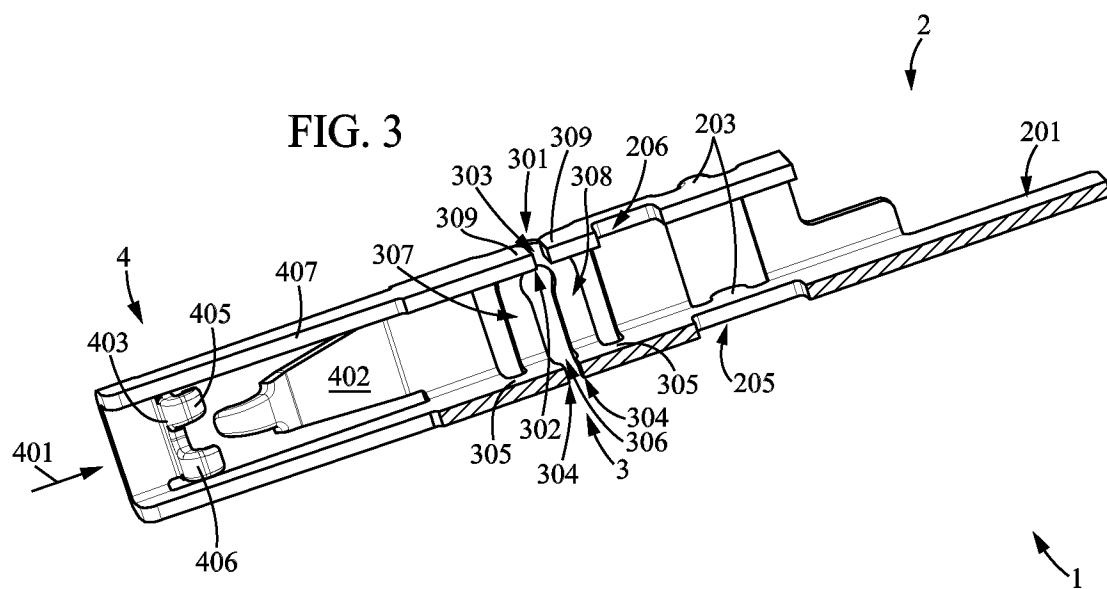
wherein forming the spring section (2) further comprises step of:

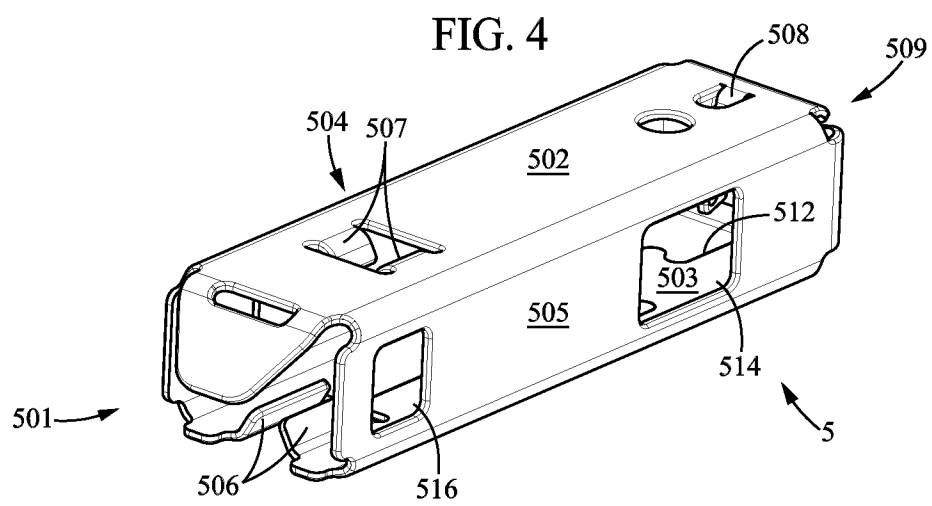
- 20 - forming two springs (301) to be arranged in a first lateral wall (13) and a second lateral wall (14) of the electrical terminal (1), the springs (301) comprising not more than three beams (307, 308, 607, 608, 610), two adjacent beams (307, 308, 607, 608,
- 25 610) being interconnected by an arch portion (302, 602A, 602B).

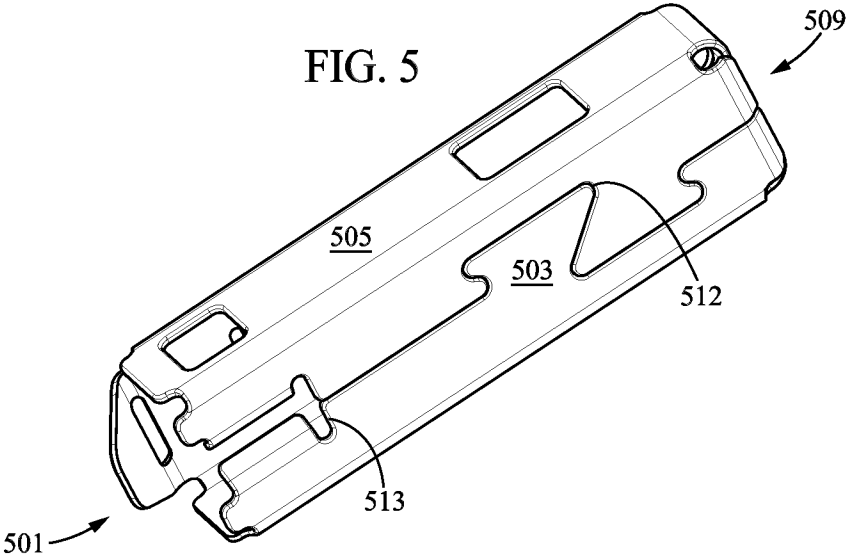
12. A sheet metal blank foldable into an electrical terminal according to claims 1 to 9.

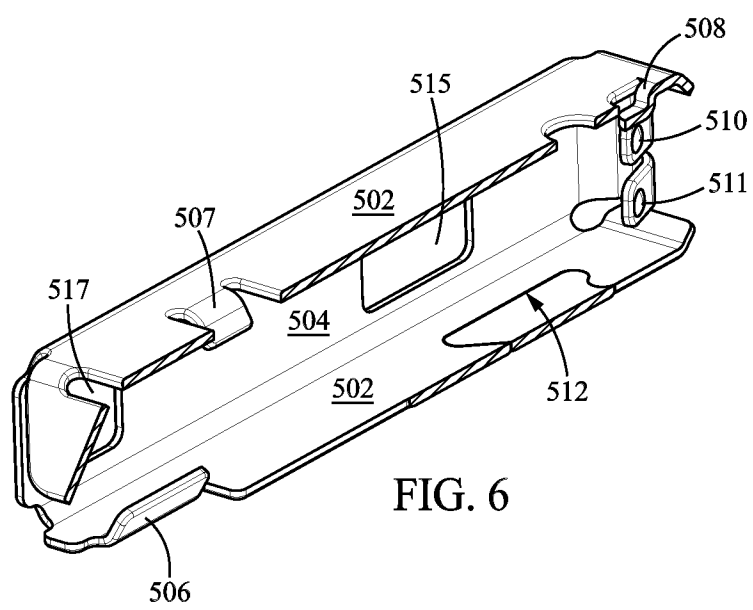


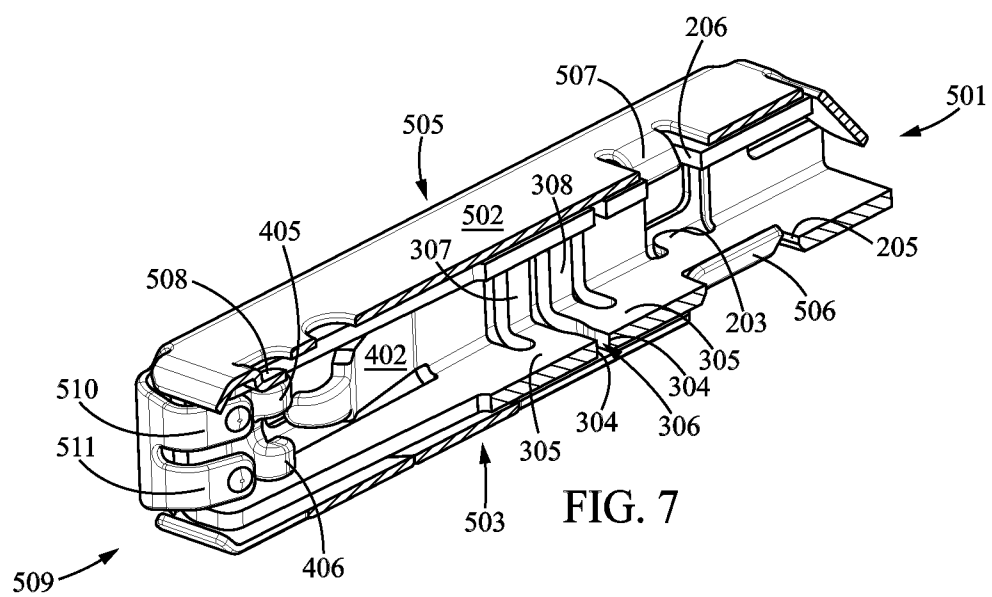












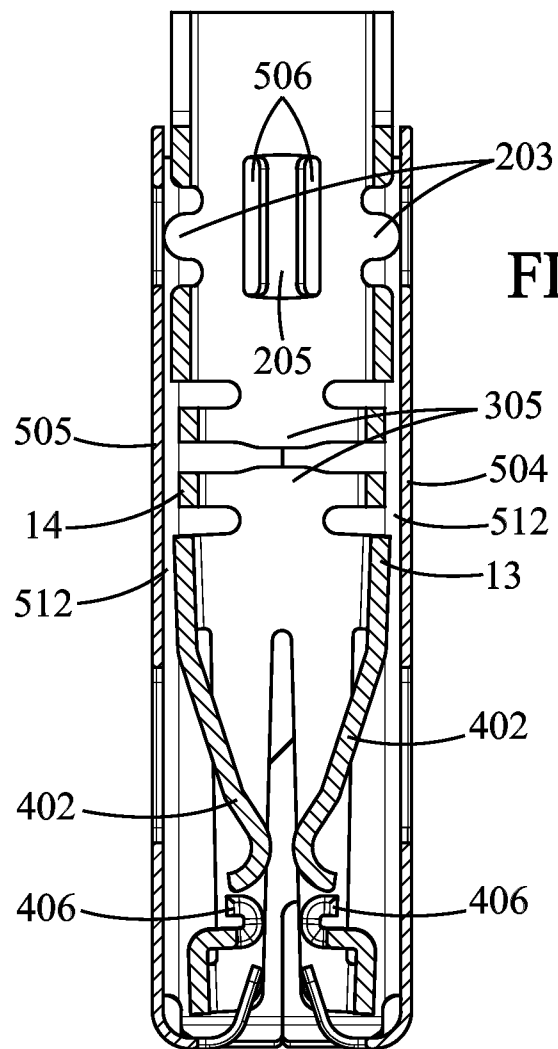


FIG. 8

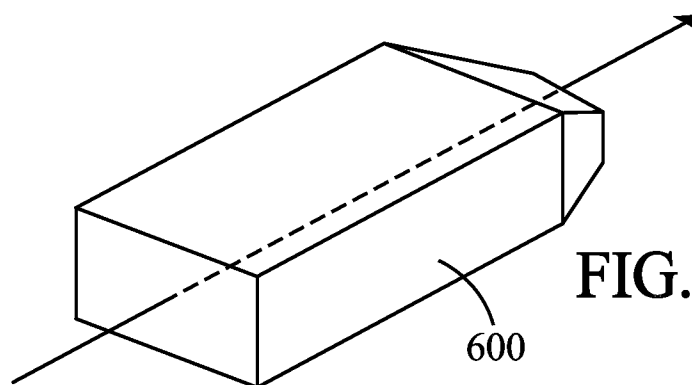


FIG. 11

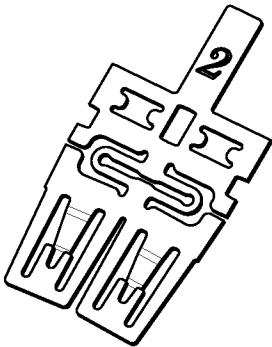


FIG. 9a

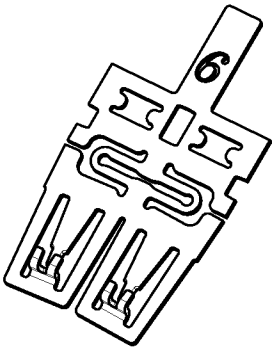


FIG. 9b

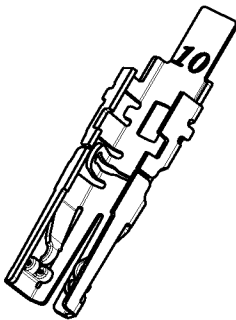


FIG. 9c

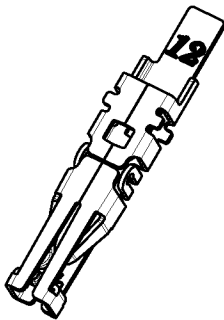
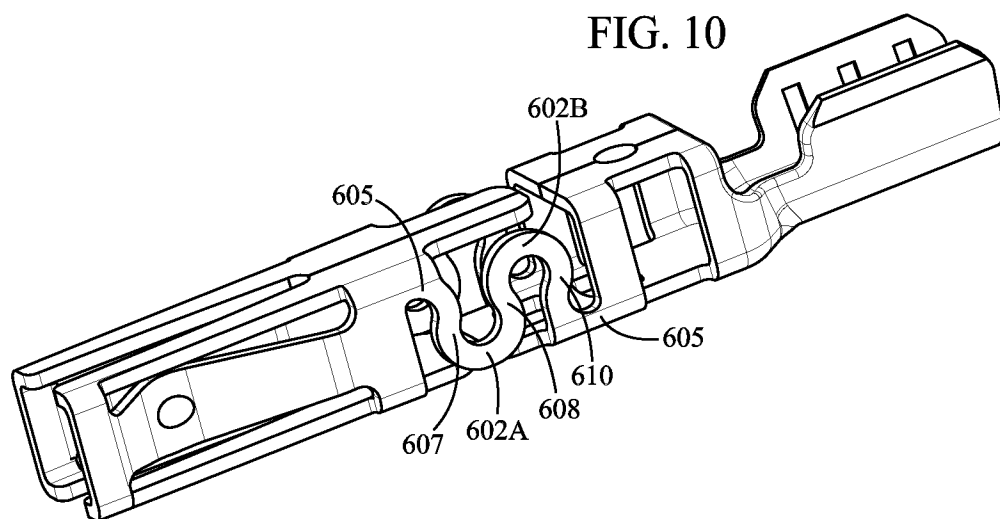


FIG. 9d



INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2012/002872

A. CLASSIFICATION OF SUBJECT MATTER

INV. H01R13/14 H01R13/187
ADD. H01R101/00 H01R13/11

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)

H01R

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)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 678 936 A1 (WHITAKER CORP [US]) 25 October 1995 (1995-10-25) cited in the application figures 1-6	1-9, 11, 12
X	----- US 2012/028507 A1 (KATANO TETSUYA [JP]) 2 February 2012 (2012-02-02) figures 1-4 -----	1-7, 11, 12

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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Date of the actual completion of the international search

9 September 2013

Date of mailing of the international search report

13/09/2013

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
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Authorized officer

Esmiol, Marc-Olivier

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2012/002872

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0678936	A1	25-10-1995	DE 69503171 D1 06-08-1998
			DE 69503171 T2 10-12-1998
			EP 0678936 A1 25-10-1995
			ES 2117998 T3 01-09-1998
			FR 2719163 A1 27-10-1995
			JP H07296886 A 10-11-1995
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