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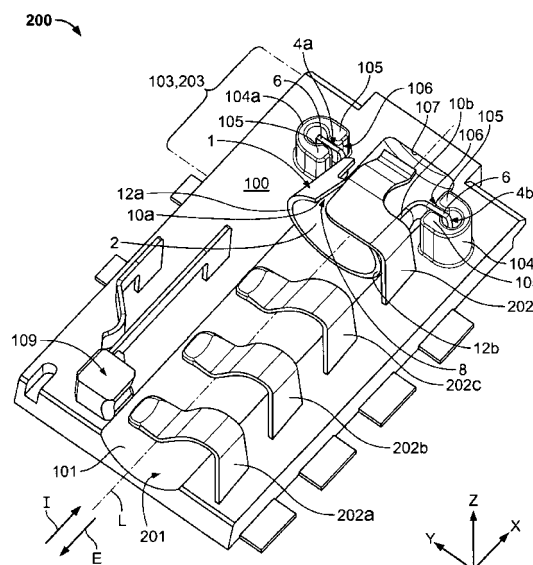
BA ME• **Zwartkruis, Sjoerd****5361 CB Grave (NL)**• **Tuin, Jacobus Nicolaas****5684 HC Best (NL)**(74) Representative: **Grünecker, Kinkeldey,****Stockmair & Schwanhäusser****Leopoldstrasse 4****80802 München (DE)**(71) Applicant: **Tyco Electronics Nederland B.V.****5222 AR 's-Hertogenbosch (NL)**

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• **Jansen, Wim****5035 JN Tilburg (NL)****(54) Retention spring and substrate therefor**

(57) The present invention relates to a spring member (1) for retaining an electrical plug and a substrate (100) for a receptacle (201) for an electrical plug. In order to provide a receptacle for electrical plugs, especially 3.5 mm AV-plugs with circular cross-sections, which provides stable and sufficiently high retention forces, a spring member (1) according to the present invention is designed such that it comprises at least two spring sections (12a, 12b) resiliently deflectable with respect to

each other and defining between them a volume (3) for receiving at least a section of the electrical plug in an insertion direction (I) of the spring member (1), wherein at least one of the spring sections (12a, 12b) provides a guiding surface (3a, 3b) slanted with respect to the insertion direction (I) for guiding the plug into an end position (F) of the plug within the volume (3) and a latching organ (31) adapted to interact with the plug in the end position (F) in order to prevent withdrawing the plug from the end position (F) against the insertion direction.

**Fig. 1**

Description

[0001] The present invention relates to a spring member for retaining an electrical plug, especially a 3.5 mm AV-plug.

[0002] Further, the invention relates to a substrate for a receptacle for an electrical plug.

[0003] Spring members and substrates mentioned above are known from the prior art. Especially, for the mentioned 3.5 mm AV-plugs, also called TRS-plugs or TRRS-plugs or in German "*Klinkenstecker*", it is provided that the plug is held in its receptacle by the spring forces exerted onto the plug by one of the electrical contacts within the receptacle, which may be an AV-jack. The contact generally meshes with a neck of the plug. In other words, the plug is provided with a circular groove behind its tip. One of the electrical contacts within the receptacle snaps into this groove in order to prevent that the plug is pulled out of the receptacle.

[0004] Disadvantages arising from the known ways of retaining the electrical plugs within circular cross-sections described above are that the retention forces vary greatly with the conditions of the spring contact retaining the plug. The spring contact may wear, become loose or may simply bend during its lifetime so that sufficient retaining forces cannot be assured. Further, tolerances in manufacturing and assembling the spring contact may lead to undesired deviations of retention forces of different receptacles manufactured in the same production line.

[0005] In view of these disadvantages, it is an object of the present invention to provide a receptacle for the mentioned electrical plugs, e.g. 3.5 mm AV-plugs with circular cross-sections, which provides stable and sufficiently high retention forces.

[0006] This object is achieved according to the invention for the initially mentioned spring member in that it comprises at least two spring sections resiliently deflectable with respect to each other and defining between them a volume for receiving at least a section of the electrical plug in an insertion direction of the spring member, wherein at least one of the spring sections provides a guiding surface slanted with respect to the insertion direction for guiding the plug into an end position within the volume and a latching organ adapted to interact with the plug in the end position in order to prevent withdrawing the plug from the end position against the insertion direction.

[0007] A spring member according to the invention does not necessarily have to have an electrical function but can be designed merely to exert a preferably high retention force onto the plug. The spring member may interact with the plug in that the latching organ can mesh with the plug, e.g. in that it snaps into the neck, i.e. circular groove. By guiding the plug into the end position, the spring member can assure a precise placement of the plug within the receptacle. Thereby, the spring contacts within the receptacle can be protected in that uncon-

trolled movements of the plug within the receptacle are prevented. Further, the spring contacts may be designed to only fulfil electrical specifications and may therefore be optimized as the mechanical requirements for retaining the plug are shifted to the spring member.

[0008] For the substrate in the beginning of the description, the object of the invention is solved in that the substrate comprises at least one counter fixing element for fixing a spring member according to the invention by positive fit and/or friction fit. Thereby, the receptacle may be easily assembled in that the spring member is pressed onto the substrate such that the spring member meshes with the at least one counter fixing element, whereby no additional means such as adhesives or fixing elements like pins or screws are needed.

[0009] The above-mentioned solutions according to the present invention may be combined in any way with any one of the following advantageous embodiments of the present invention respectively and thus further improved.

[0010] According to a first improvement, the spring member may circumferentially encompass the volume by at least 180° essentially perpendicularly to the insertion direction. Thereby, the spring member may encompass the plug, e.g. the neck of an AV-plug with a circular cross-section. This helps to improve the interaction between the plug and the spring member, whereby the retention forces and the precision of the retention of the plug may be increased. In other words, the spring member may tightly grab the plug in that it encompasses the plug by preferably more than 180°.

[0011] Encompassing the plug may be realised in that in a projection along the insertion direction, the spring member is shaped essentially as a ring portion with two free ends defining a gap between each other allowing for an extension of the spring member. Thereby, the volume defined by the spring member may be circular in a projection along the insertion direction, such that it provides a snug fit of the plug between the spring sections. The spring sections may simply be segments of the ring, i.e. the cross-sections of the spring sections may be segments of a circle. The gap between the free ends may then be necessary in order to provide the elasticity and flexibility of the spring member.

[0012] The above-mentioned embodiments may be easily realised in that the spring member may at least partially have a frusticonical shape. Hence, in a projection in a radial direction running essentially perpendicularly to the insertion direction, the spring member may have a trapezoidal shape. Due to the frusticonical shape, both spring sections may have slanted surfaces as the volume defined by the spring member may taper along the insertion direction. The gap between the free ends may be easily realised in that the frusticonical shape is provided with a lateral cut-out.

[0013] According to another advantageous embodiment of a spring member according to the present invention, the at least one latching organ may be located at a

rear end of the spring member, the rear end may be pointing into the insertion direction. This may be achieved for example in that the spring member having a frusticonical shape can be designed such that the edge on the tapered side can be formed as a latching organ. Thereby, e.g. a head of an AV-plug with a circular cross-section may be pushed through the spring member along the insertion direction until the rear end of the spring member snaps into the neck. Hence, the head may be first guided and centred within the frusticonically shaped volume for then expanding the spring member at its most narrow portion in the region of the rear, which will then interact with the neck by meshing with the neck when the plug has reached the end position. In other words, the end position may be defined by the rear end when it interacts with the plug, e.g. by snapping into the neck.

[0014] According to another advantageous embodiment of the present invention, it may be provided that the latching organ comprises at least two latching elements arranged essentially at the same level in the insertion direction and distanced from each other along a circumferential line of the spring member. Thereby, it may be assured that the spring member interacts with the plug at a precisely defined position in the insertion direction. An equally distanced distribution of the latching elements enables a balanced exertion of retention forces onto the plug. For example, the at least two latching elements may be formed as teeth protruding from the spring member in the insertion direction. These teeth may have a trapezoidal shape with a flat outer edge. Thereby, the teeth can be designed for having a desired resiliency. It can be prevented that the teeth cut into the plug and damage it or its coating in a way that electrical specifications of the plug are impaired.

[0015] According to a further embodiment of the present invention, it may be provided that at least one fixing element for fixing the spring member to a substrate is formed at the spring member. The fixing element may be formed as a lug protruding from the spring member in the insertion direction and/or transversely to the insertion direction. The lug can be easily inserted into the counter fixing elements formed at the substrate. By protruding from the spring member, it may be prevented that the lug interferes with the volume for accommodating the plug. The lug may be shaped as desired in order to affix the spring member at the substrate.

[0016] Further, at least two fixing elements may protrude from the spring member at opposing sides of the spring member. Thereby, any forces acting on the spring member during insertion or extraction of the plug may be evenly distributed between the fixing elements in order to provide a balanced bearing of these forces at the substrate. This effect may further be improved in that at least two fixing elements can be arranged within a common plane. The plane may extend in a height- and a cross-direction of the spring member.

[0017] The manufacturing and lifetime of the spring member may be enhanced in that the first and the second

spring sections are integrally formed by a body section of the spring member. This body section may have the frusticonical shape mentioned above. Thereby, the spring member can be formed as one piece, e.g. from sheet metal material.

[0018] For the substrate mentioned in the beginning of the description, the solution according to the present invention may be further improved in that the at least one counter-fixing element can be arranged at a rear section of the receptacle. This is especially useful when using the substrate for assembling a receptacle for AV-plugs with rounded cross-sections which have the mentioned head on their ends which is separated from their shafts by a neck. The head may then interact with the spring member located at the rear section of the receptacle and may be held by the at least one counter-fixing element.

[0019] According to another embodiment of a substrate according to the present invention, at least two counter-fixing elements may be arranged at opposite sides of a receptacle area of the substrate in a common plane running essentially perpendicularly to the insertion direction. Thereby, the forces exerted by the spring member onto the substrate may be evenly distributed at both sides of the receptacle area. This enables a balanced bearing of the forces and a precise positioning of the spring member.

[0020] The invention will be described in more detail by way of example hereinafter with reference to the accompanying drawings which illustrate advantageous embodiments. The described embodiments are only possible configurations in which the individual features may, however, as described above, be implemented independently of each other or be omitted. Corresponding elements illustrated in the drawings are provided with the same reference signs. Parts of the description relating to the same elements in different drawings are omitted.

[0021] In the drawings:

Fig. 1 is a schematic perspective view of an arrangement comprising a spring member and a substrate according to an embodiment of the present invention;

Fig. 2 is a schematic perspective view of a spring member according to an embodiment of the present invention;

Fig. 3 is a schematic side view of the spring member shown in Fig 2;

Fig. 4 is another schematic side view of the spring member shown in Figs. 2 and 3; and

Fig. 5 is an example of a diagram showing insertion and extraction forces acting on a plug along its displacement in parallel with an insertion direction, exerted onto the plug by a receptacle comprising a spring member according to an em-

bodiment of the present invention.

[0022] In the following, an arrangement 200 for a receptacle 201 for an electrical plug (not shown), especially for AV-plugs with circular cross-sections, comprising a spring member 1 and a substrate 100 are explained with reference to the respective embodiments thereof shown in the figures.

[0023] Fig. 1 is a schematic perspective view of the spring member 1 and the substrate 100 assembled as parts of the arrangement 200. The substrate 100 may be a printed circuit board (PCB) or any kind of mechanically stable mounting plate serving as a base of the arrangement 200.

[0024] A receptacle area 101 may be formed on the substrate 100. The receptacle area 101 may have the form of a groove the shape of which is adapted to the shape of an outer circumference of the plug. In the present embodiment, the receptacle area 101 is formed as a groove with a rounded shape for snugly accommodating an AV-plug having a rounded cross-section. The form of the receptacle area at least partially defines the shape of the receptacle 201 and thereby a longitudinal axis L of the receptacle 201.

[0025] The longitudinal axis L runs in parallel to a length direction X of the arrangement 200. The length direction X runs perpendicularly to a cross direction Y of the arrangement 200. The length direction X and the cross direction Y both run perpendicularly to a height direction Z of the arrangement 200. For easy reference, the above-mentioned length, cross and height directions, X, Y, Z, respectively, are commonly used for the arrangement 200, the substrate 100 and the spring member 1.

[0026] The longitudinal axis L runs in parallel to an insertion direction I in which the plug is inserted into the receptacle 201, and in parallel to an extraction direction E, in which the plug is extracted from the receptacle 201. The insertion direction I and the extraction direction E are running in opposite directions. For easy reference, the insertion and extraction direction, I, E, respectively, apply to the arrangement 200, as well as to the substrate 100 and the spring member 1.

[0027] The receptacle 201 is further defined by a number of electrical spring contacts 202a, 202b, 202c, 202d, arranged along the receptacle 201 and distanced from each other in the length direction X. The spring contacts 202a to 202d delimit the receptacle 201 on the side of the receptacle 201 opposing the receptacle area 101 in the height direction Z. The spring contacts 202a to 202d may be over-moulded by the substrate as shown herein. The spring contact 202a may serve as a ground connection. The spring contact 202b may serve for transmitting video signals. The spring contacts 202c and 202d may serve for transmitting left and right audio signals, respectively, of a stereo audio signal.

[0028] The spring member 1 is arranged at an end section 203 of the receptacle 201, which at the same time represents an end section 103 of the receptacle area

101. A body portion 2 of the spring member 1 is snugly seated within the receptacle area 101. An outer circumference of the body portion 2 and the rounded circumference of the receptacle area 101 are in mesh and aligned with each other. Fixing elements 4a, 4b of the spring member 1 protrude from the body portion 2 in the length direction X and the cross-direction Y. The fixing elements 4a, 4b are seated within counter-fixing elements 104a, 104b, respectively, formed on the substrate 100.

[0029] The counter-fixing elements 104a, 104b have a horse shoe-like shape in a projection along the height direction. The free ends of the horse shoe-like shapes constitute clamping limbs 105 which define between each others clamping zones 106. Fixing zones 6 in the form of sections of the fixing elements 4a, 4b running in the cross-direction Y and being arranged at the same level in the length direction X, i.e. in a common cross-sectional plane, are seated within the respective clamping zones 106. Thereby, the spring member 1 is retained on the substrate 100 and secured against movements in the height direction Z by a friction fit of the clamping section 6 within the clamping zones 106. Against the height direction Z, the spring member 1 is held by the receptacle area 101. In parallel to the length direction X, i.e. in the insertion direction I and extraction direction E, the spring member 1 is supported at the respective clamping limbs 105.

[0030] Further, the spring contact 102d reaches into the receptacle 201 in the vicinity of a gap 8 formed between two free ends 10a, 10b of spring sections 12a, 12b, respectively, of the spring member 1. Thereby, the plug may be contacted in an electrically conductive manner in the end section 203, although it is encompassed by the spring member 1 therein, in that the spring contact 102d reaches through the gap 8 towards the plug.

[0031] Moreover, the receptacle area 101 is formed such that it provides a bottom 107 for the receptacle 201. The substrate 100 may be further adapted to hold auxiliary parts 109 such as switches and side contacts.

[0032] Fig. 2 is a schematic perspective view of the spring member 1. A volume 3 for the plug is defined between the two spring sections 12a, 12b which are virtually separated from each other in this view by the longitudinal axis L. Each spring section 12a, 12b provides a guiding surface 3a, 3b, respectively, delimiting the volume 3. The plug may be centred and guided during the insertion and extraction between the guiding surfaces 3a, 3b. The gap 8 between the free ends 10a, 10b extends over approximately 90° to 120° of the circumference of the body portion 2.

[0033] Further, a latching organ 31 is formed at the rear end 30. The latching organ 31 comprises several latching elements 32a, 32b and 32c, which are formed as teeth protruding from the body portion 2 in the insertion direction I.

[0034] Fig. 3 is a schematic perspective side view of the spring member 1. Here it becomes evident that the body portion has a frusticonical shape such that its pro-

jection along the cross direction Y and/or the height direction Z is trapezoidal.

[0035] Between the latching element 32a and the fixing element 4a, between the fixing element 4a and the latching element 32b, and between the latching element 32b and the latching element 32c, cut-outs 33a, 33b and 33c, respectively, are provided. The cut-outs 33a to 33c contribute to the resiliency of the latching elements 32a to 32c. Measured in the length direction, the cut-out 33a is deeper than the cut-out 33b, which again is deeper than the cut-out 33c. Thereby, the clamping forces exerted by 32a to 32c onto the plug are homogenised.

[0036] Fig. 4 is another schematic perspective side view of the spring member 1. Here, a latching element 32d is visible. A cut-out 33d is provided between the latching element 32c and the latching element 32d. A further cut-out 33e is provided between the latching element 32d and the fixing element 4b. The clamping sections 6 of the fixing elements 4a, 4b are connected to the body portion 2 via root sections 7. The root sections 7 are bent essentially by 90° and thereby provide a resilient, yet stable support for the clamping sections 6 at the body portion 2.

[0037] Fig. 5 illustrates the insertion and extraction forces to be applied onto a plug or pin inserted or extracted, respectively, into and from the spring member 1 over the displacement measured in parallel to the longitudinal axis L as dimensionless values just representing relations between displacement and forces. Starting at a displacement of approximately 1.6 slightly behind the front end 20, insertion forces increase linearly to slightly declining just before the main diameter of the plug tip passes the rear end 30 at a displacement of approximately 3.8. At their peak, the insertion forces amount to approximately 2.9. After the plug tip has passed the rear end 30, the insertion forces rapidly decrease between 3.8 and a displacement of approximately 4 until reaching approximately 0.7 at a displacement of 4. Afterwards, the insertion forces linearly decrease until the end point of the plug insertion, at which the rear end 30 is on the smaller diameter of the plug at a displacement of 6, where the insertion forces are approximately 0.4.

[0038] Hence, insertion forces are relatively rapidly increasing between the starting point slightly behind the front end 20 and the point at which the main diameter of the plug passes the rear end 30, where they peak, thus giving a user a defined response and feeling for the state of the insertion procedure. By decreasing between the point at which the main diameter of the plug passes the rear end 30 and the end point of pin insertion where the rear end 30 is on the smaller diameter of the plug, the pin is easily brought into the end point or end position F, where it is latched by the latching organ 31, which may snap into a groove or neck of the plug or pin.

[0039] For extraction, the pin or plug has to be pulled out of its end position F, which is illustrated by negative extraction forces. The absolute value of the extraction forces increases on a diminishing scale between the end

point F and the point at which the main diameter of the plug passes the rear end 30, where the absolute value has its peak of approximately 2.3 at a displacement of 4. Between the point at which the main diameter of the plug passes the rear end 30 and a point just behind the front end 20, the extraction forces decrease such that they become positive up to a peak value of approximately 0.8 at a displacement of 2.7 until diminishing at the front end 20 at a displacement of 1.6. In other words, the user has to first pull rather strongly at the plug between a displacement of 6 and 4, meaning that the plug is held firmly by the spring member 1. Afterwards, between a displacement of 4 and 1.6, the plug is pushed out of the spring member 1 facilitating it for a user to withdraw the plug from a receptacle.

[0040] The maximum absolute value of the insertion forces exceeds the maximum absolute value of the extraction forces, both at approximately the same displacements. There, both values peak. Thus, a well-defined pressure point is provided to the user.

[0041] Deviations from the above-described embodiments are possible within the inventive idea. The body portion 2 of the spring member 1 does not necessarily need to have an at least partially circular cross-section in a projection along the longitudinal axis L. The shape of the body portion 2 may be adapted to the shape of a pin or plug to be retained by the spring member 1. However, the circular shape of the body portion 2 is especially advantageous with plugs having a circular cross-section, such as AV-plugs. The number of fixing elements 4a, 4b and latching elements 32a to 32d may be varied according to the respective requirements. Hence, also the number and shape of the cut-outs 33a to 33e may be adapted to the desired requirements. Also the shape of the substrate 100, especially the shape of the receptacle area 101 and the counter fixing elements 104a, 104b may be adapted to the desired shape of the plug and the shape of the spring member 1.

[0042] Having two spring sections 12a, 12b resiliently connected or attached to each other is of advantage, especially when the spring sections 12a, 12b are rounded such that they encompass the volume 3. Alternatively, more than two spring sections 3a, 3b may be provided, e.g. three sections forming a triangle, such that they define the volume 3 between them.

[0043] The arrangement 200 may be provided as a kit characterised in that it comprises at least one spring member 1 and/or at least one substrate 100 according to an embodiment of the present invention.

Claims

1. Spring member (1) for retaining an electrical plug, said spring member (1) comprising at least two spring sections (12a, 12b) deflectable with respect to each other and defining between them a volume (3) for receiving at least a section of the electrical

- plug in an insertion direction (I) of the spring member (1), wherein at least one of the spring sections (12a, 12b) provides a guiding surface (3a, 3b) slanted with respect to the insertion direction (I) for guiding the plug into an end position (F) of the plug within the volume (3) and a latching organ (31) adapted to interact with the plug in the end position (F) in order to prevent withdrawing the plug from the end position (F) against the insertion direction.
2. Spring member (1) according to claim 1 **characterised in that** it circumferentially encompasses the volume (3) by at least 180° essentially perpendicularly to the insertion direction (I).
 3. Spring member (1) according to claim 1 or 2 **characterised in that** in a projection along the insertion direction (I), the spring member (1) is shaped essentially as a ring portion with two free ends (10a, 10b) defining a gap (8) between each other allowing for an expansion of the spring member (1).
 4. Spring member (1) according to one of claims 1 to 3 **characterised by** an at least partially frustoconical shape.
 5. Spring member (1) according to one of claims 1 to 4 **characterised in that** the at least one latching organ (31) is located at a rear end (30) of the spring member (1), the rear end (30) pointing into the insertion direction (I).
 6. Spring member (1) according to claim 5 **characterised in that** the latching organ (31) comprises at least two latching elements (32a, 32b, 33c, 33d) arranged essentially at the same level in the insertion direction (I) and distanced from each other along a circumferential line of the spring member (1).
 7. Spring member (1) according to claim 6 **characterised in that** the at least two latching elements (32a, 32b, 32c, 32d) are formed as teeth protruding from the spring member (1) in the insertion direction (I).
 8. Spring member (1) according to one of claims 1 to 7 **characterised by** at least one fixing element (4a, 4b) for fixing the spring member (1) to a substrate (100), the fixing element (4a, 4b) is formed as a lug protruding from the spring member (1) in the insertion direction (I) and/or transversely to the insertion direction (I).
 9. Spring member (1) according to claim 8 **characterised in that** at least two fixing elements (4a, 4b) protrude from the spring member (1) at opposing sides of the spring member (1).
 10. Spring member (1) according to claim 8 or 9 **characterised in that** at least two fixing elements (4a, 4b) are arranged within a common plane.
 11. Spring member (1) according to one of claims 1 to 10 **characterised in that** a first and a second spring section (12a, 12b) are integrally formed by a body portion (2) of the spring member (1).
 12. Substrate (100) for a receptacle (201) for an electrical plug **characterised in that** the substrate (100) comprises at least one counter fixing element (104a, 104b) for fixing a spring member (1) according to one of claims 1 to 11 by positive fit and/or friction fit.
 13. Substrate (100) according to claim 12 **characterised in that** the at least one counter fixing element (104a, 104b) is arranged at a rear section (103) of the receptacle (201).
 14. Substrate (100) according to claim 12 or 13 **characterised in that** the at least two counter fixing elements (104a, 104b) are arranged at opposite sides of a receptacle area (101) of the substrate (100) in a common plane running essentially perpendicularly to the insertion direction (I).

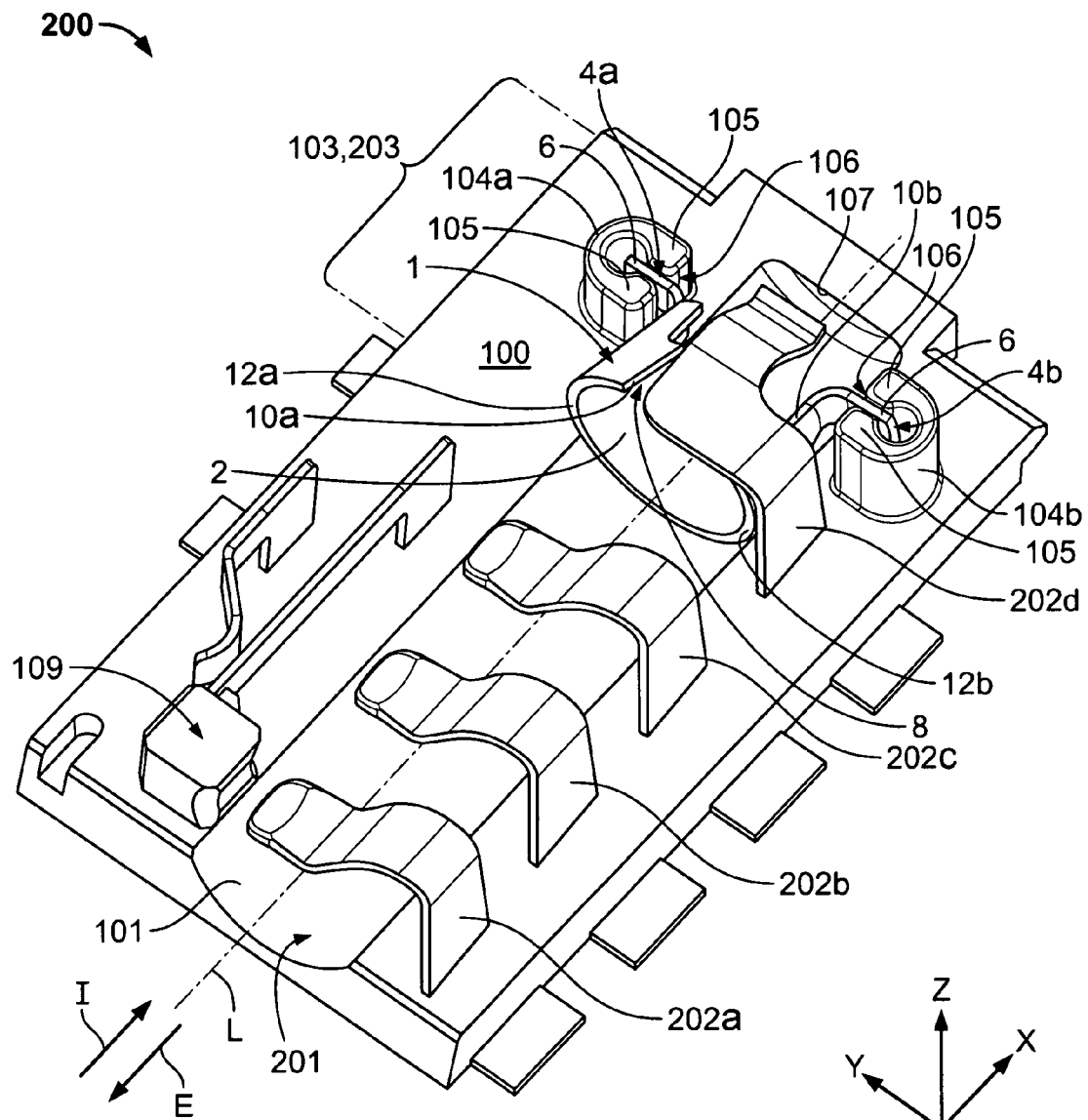


Fig. 1

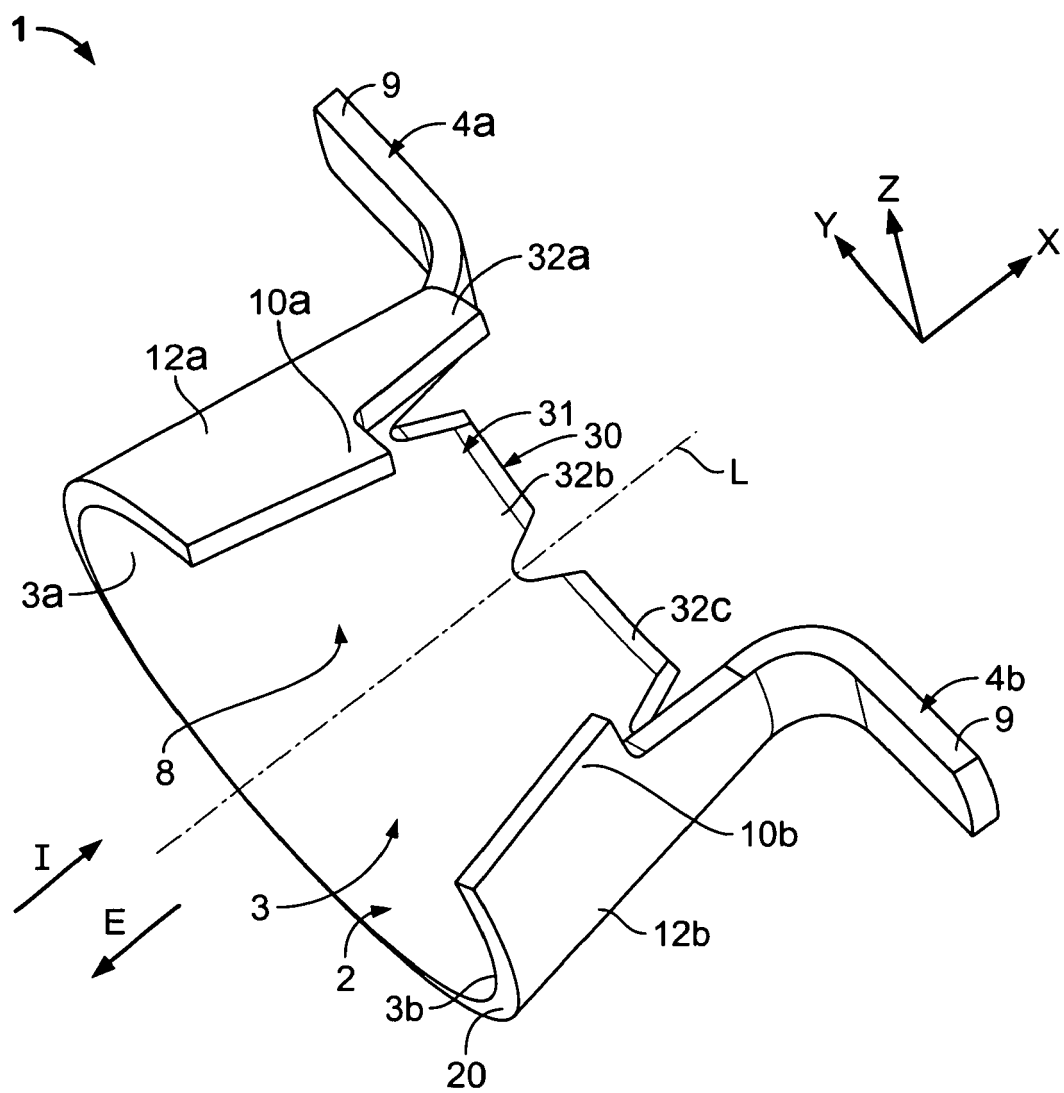
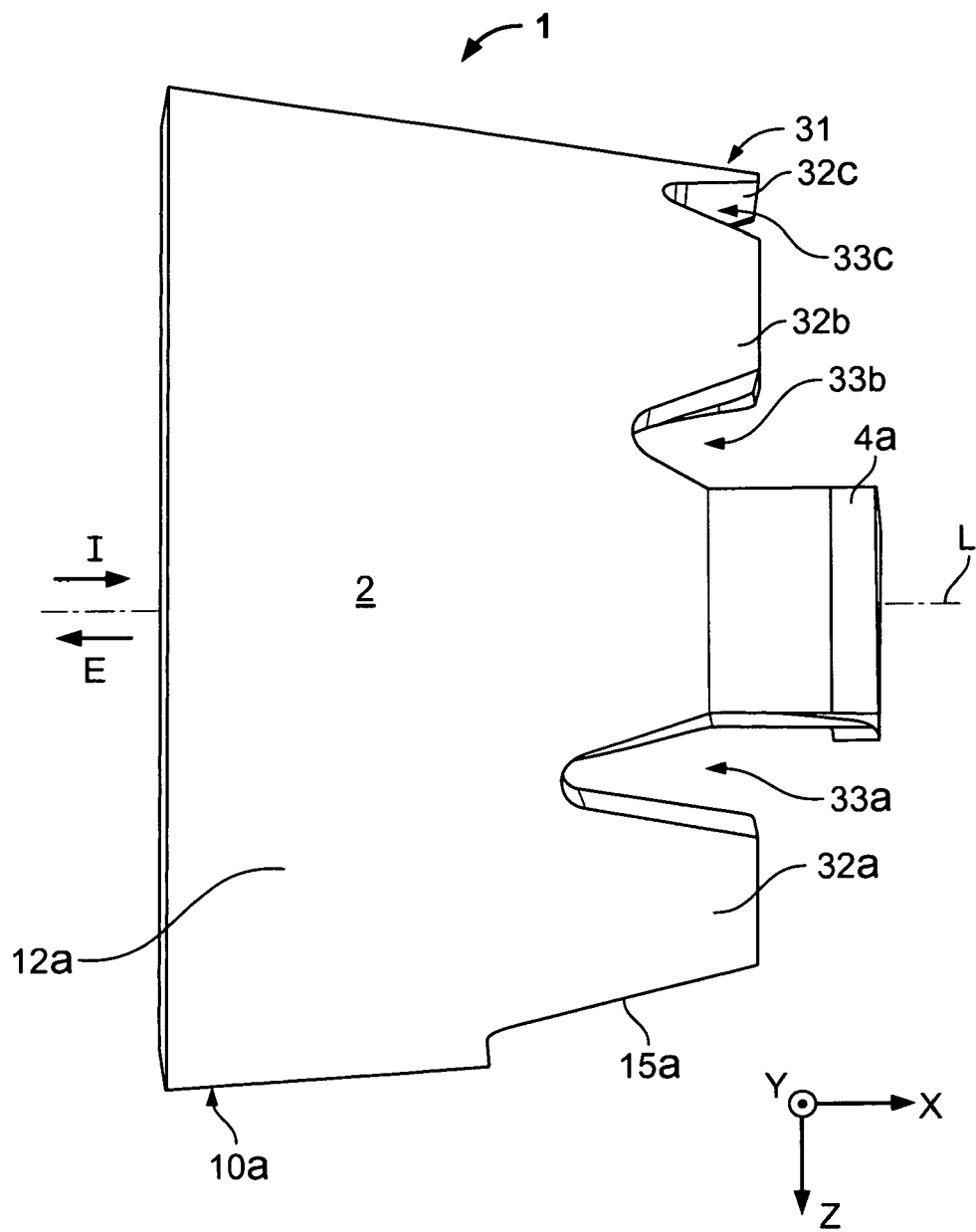


Fig. 2



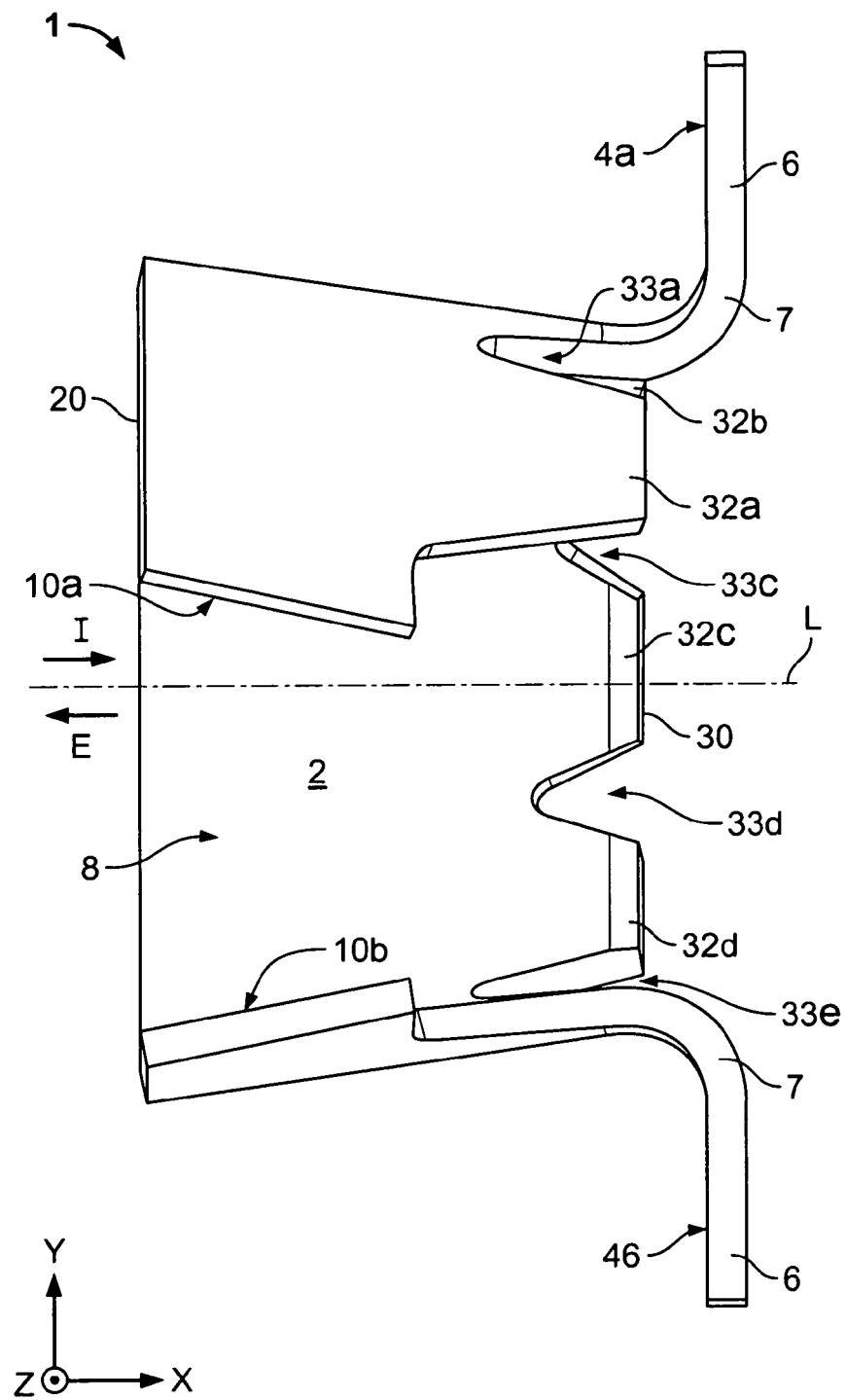


Fig. 4

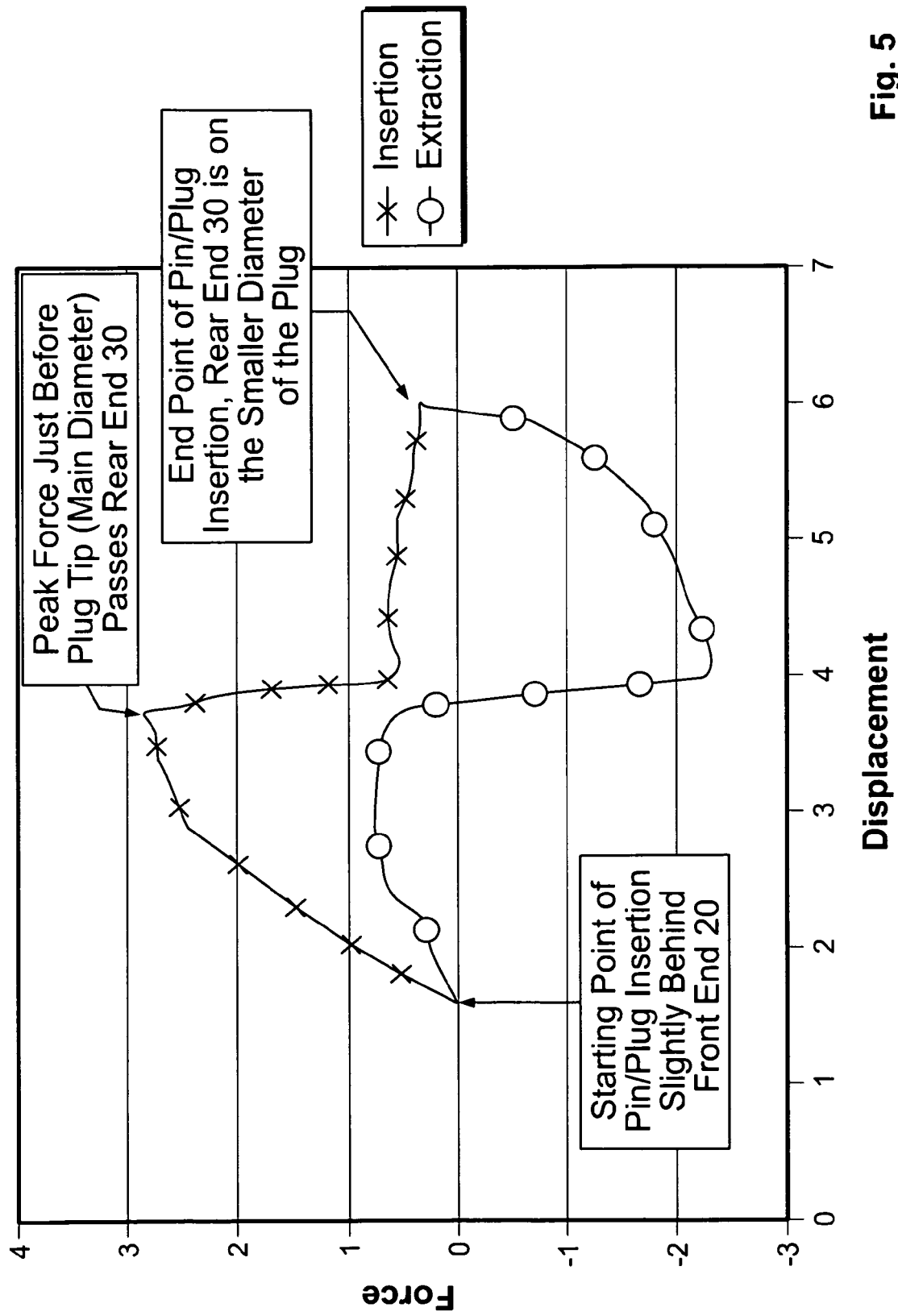


Fig. 5



EUROPEAN SEARCH REPORT

Application Number
EP 11 17 7275

DOCUMENTS CONSIDERED TO BE RELEVANT			
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 3 January 2012	Examiner Chelbosu, Liviu
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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EP 11 17 7275

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