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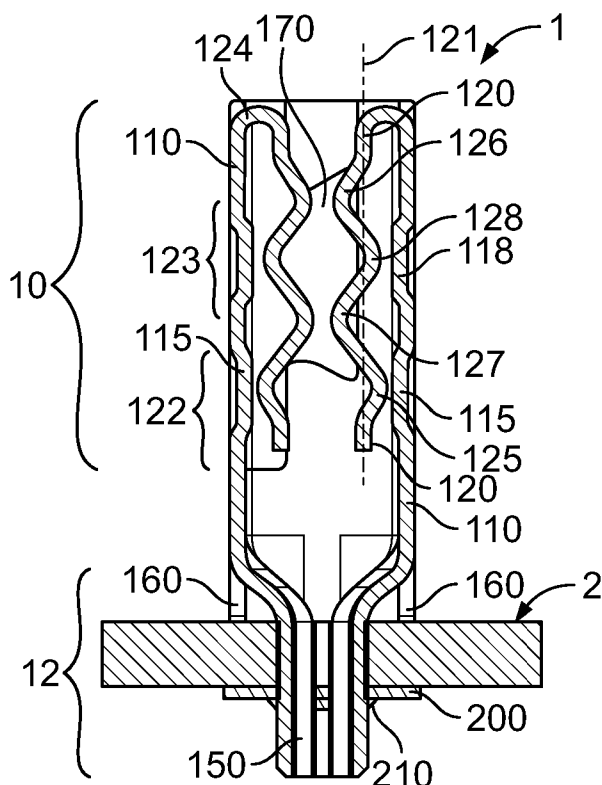
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(54) Title: ELECTRICAL CONTACT



(57) Abstract: The invention relates to an electrical con-
tact for a printed-circuit board or a pressed screen of an elec-
trical or electronic appliance, wherein the electrical contact
(1) comprises a first electrical contact region (10) for the
electrical connection to a mating connector, and a second
electrical contact region (12) for the electrical connection to
the printed- circuit board (2) or the pressed screen, wherein
the first electrical contact region (10) comprises an electri-
cal spring contact (120) that is bent round toward a side wall
(110) of the electrical contact (1), and a first projection (115)
of the side wall (110) is provided, which interacts with the
spring contact (120) and by means of which the adjustment
of the spring normal force of the spring contact (120) is ef-
fected.

Electrical Contact

The invention relates to an electrical contact and/or to an electrical plug-in connector for a printed-circuit board or a pressed screen of an electrical or electronic
5 appliance.

In power electronics, particularly in the automotive field, it is necessary to transfer high electric currents to a printed-circuit board or a pressed screen or away from a printed-circuit board or a pressed screen by means of electrical contacts. Contacts are used to reliably and optionally repetitively establish and safely interrupt a highly
10 conductive electrical connection without an additional tool. For this purpose, electrical contacts conventionally have rigid or spring contact elements in the form of pins or blades, which are connected remotely from their free end to an electric conductor of the printed-circuit board or to the pressed screen and together with suitable mating connectors, such as a tab connector, provide an electrically conductive connection.

15 US 6 210 240 B1 discloses an electrical contact for tab connectors having a plurality of parallel-lying electric terminals. In each case, an electric terminal comprises a punching metal sheet that has been bent together into a box shape, wherein in this box for the electrical contacting of the tab connector, two mutually opposing combs, each comprising a plurality of segments, have been bent inward. A plurality of press-in pins
20 project from an underside of the box and are pressable into a printed-circuit board.

Particularly in the automotive field, high standards are demanded of electrical plug-in connectors and hence also of the electrical contacts involved, wherein these have to be able to continue to function for a long time, over a wide temperature range, under dynamic and/or vibrating loads, and optionally also in the environment of noxious media,
25 and at the same time guarantee the exchangeability of a mating connector, such as, for example, a tab connector.

It is therefore desirable, in the case of electrical contacts, to be able to define a subsequent contact normal force of an electric tactile contact of the contact upon a mating connector already at the stage of manufacture of the contact, without at the same time
30 having to redesign the electrical contact itself or having to subject the electrical contact to a re-machining step, which would add unnecessarily to the cost thereof. Furthermore, an alteration of the contact normal force of a contact that is to be newly produced is to be

possible during standard production in order to be able to react flexibly to changes in the requirements of a customer.

It is therefore an object of the invention to provide an improved electrical contact. In particular, a contact normal force upon an insertable mating connector is to be adjustable in the course of manufacture of the electrical contact (punching out of a metal sheet and subsequent shaping by bending). Furthermore, the electrical contact is to have a good current carrying capacity while being of a low unit volume and a simple structural design.

The object of the invention is achieved with the aid of an electrical contact for a printed-circuit board or a pressed screen of an electrical or electronic appliance, wherein the electrical contact comprises at least one spring contact, which is formed integrally with a side wall of the electrical contact and is bent over against or toward the side wall and supported by a portion against a first projection, which is formed or provided on the side wall.

According to the invention, by virtue of a design of this projection, in particular its height relative to the side wall, it is possible to adjust a spring normal force of the electrical spring contact. In other words, according to the invention it is possible to adjust a spring force at right angles to the side wall and/or at right angles to the direction of insertion of a mating connector into the electrical contact, wherein the electrical spring contact is preferably of a strip-shaped design. According to the invention it is possible in the course of manufacture of the electrical contact, in particular, in the course of punching a blank of the electrical contact out of a metal sheet, for the projection to be suitably provided e.g. in the form of an embossed portion or bead in/on the side wall. Simply by means of altering a depth of the embossed portion/bead and/or a height of the first projection, different spring normal forces of the respective spring contact may be adjusted.

According to the invention an electrical contact may be realized by means of a single electrical spring contact, which interacts, for example, with a second side wall of the contact upon insertion of the mating connector. In a preferred manner, however, a plurality of electrical spring contacts are provided inside the electrical contact, wherein in a preferred manner in each case two spring contacts are provided opposite one another and form between them an intermediate space for the mating connector. When a plurality

of such electrical spring contact pairs are provided, they lie side by side in a row and are bent into a contact box of the electrical contact, wherein in a preferred manner, three, four or five spring contact pairs lying side by side are provided. An electrical contact comprising three spring contact pairs lying side by side is suitable, for example, for a 2.8 mm tab connector, an electrical contact comprising four spring contact pairs is suitable for a 6.3 mm tab connector, and an electrical contact comprising five spring contact pairs is suitable for a 9.5 mm tab connector. It is of course possible to provide one, two, or more than five spring contact pairs lying side by side inside an electrical contact. This depends in particular upon the space available, a miniaturization of the electrical contact itself, and the requirements regarding the current carrying capacity of the contact.

According to the invention it is now possible to provide a plurality of similar (depending on the number of spring contacts) electrical contacts, which are designed for a different current carrying capacity and at the same time offer the possibility of adjusting a spring normal force upon a mating connector. According to the invention, it is even possible to adjust a spring normal force individually for each individual electrical spring contact. In this case, it is particularly advantageous for the current flow when, besides the integral connection of each electrical contact spring to the side wall, there is, moreover, at least one additional second electrical contacting of each contact spring with the side wall by means of the first projection (embossed portion/bead).

In a preferred embodiment of the invention, each electrical spring contact on its end (the non-attached end) remote from the corresponding side wall (post-punching state) has a lug, which in the finished bent state, interacts with the relevant first projection of the side wall. In the finished bent state of the electrical contact, the lugs may or may not lie adjacent to the first projection. Advantageously, the point of contact between lug and first projection is situated remote from the integral connection (attached end) of the electrical spring contact to the side wall.

In a preferred embodiment of the invention, between the cohesively integral connection of the electrical spring contact to the side wall and the lug, two contact zones are preferably situated for an electrical contact of each spring contact with the mating connector. In this case, the two electrical contact zones preferably take the form of projections, which have an opposite orientation to the lug of the electrical spring contact.

In other words, the two electrical contact zones project from a spring contact plane in a direction that is remote from the relevant side wall.

A preferred embodiment of the invention further comprises an overstretch protection device, which is formed preferably between the two previously mentioned
5 electrical contact zones in the spring contact. In the present case, the overstretch protection device preferably takes the form of a projection that points in the same direction as the lug. In a preferred embodiment of the invention, this overstretch protection device interacts with a second projection, which is formed on the side wall and points in the same direction as the first projection.

10 According to the invention, by means of the overstretch protection a maximum spring excursion (at right angles to the spring contact plane) may be adjusted and damage to an electrical spring contact (except in the case of forcible insertion of a tab connector) may be reliably prevented. In a preferred manner, in an inoperative position of an electrical contact, the overstretch protection device does not rest against the second
15 projection. If, however, such contact is allowed in the inoperative position or if because of the structural design of a special electrical contact during insertion of a tab connector contact arises between the second projection and the overstretch protection device, then a height of the second projection may be selected in such a way that, by this means, the spring normal force of the respective spring contact may likewise be influenced.
20 Furthermore, such electrical contact is positive for the current carrying capacity of the electrical contact.

In a preferred embodiment of the invention, an electrical spring contact is of a strip-shaped design and the lug, the second electrical contact zone, the overstretch protection and the first electrical contact zone take the form of curvatures of the spring
25 contact that extend alternately in a different direction, wherein these curvatures are provided preferably over the entire width of the electrical spring contact. In the cross section of a spring contact, the result is, therefore, an undulating shape comprising two wave crests and two wave troughs. It is, however, naturally possible, instead of the curvatures in the electrical spring contact, to provide the spring contact with bumps or
30 similar projections and to design the spring contact itself such that it extends rectilinearly.

In embodiments having mutually opposite contact springs (contact spring pairs), in each case, the first electrical contact zones, the overstretch protection devices, the

second projections, the second electrical contact zones, the lugs and the first projections preferably lie, in each case, at a common height and/or, in each case, in a common plane lying, in each case, at right angles to the contact spring plane.

During a bending-together of the contact box of the electrical contact from a flat, elongate, punched metal sheet, the two longitudinal end portions of the metal sheet that meet one another preferably engage by means of a form-fit geometry, which preferably has at least one undercut, one into the other. This may be realized for example by means of a dovetailed projection on one longitudinal end of the metal sheet and a corresponding dovetailed recess in an opposite longitudinal end portion of the metal sheet. Alternatively, a plurality of such dovetailed profile intersections may be provided. In a preferred manner, the butt joint of the two longitudinal ends is spot-welded, particularly, in the region of the dovetailed profile. Other intersections of the two longitudinal portions are naturally possible.

The invention further relates to a printed-circuit board or a pressed screen having an electrical contact according to the invention.

There now follows a detailed description of embodiments of the invention with reference to the accompanying drawings. The drawings show:

- Fig. 1 a side view of a first embodiment of an electrical contact according to the invention;
- Fig. 2 a plan view of the electrical contact of Fig. 1;
- Fig. 3 a frontal, centrally cut side view of the electrical contact of Fig. 1;
- Fig. 4 a frontal side view of the electrical contact of Fig. 1; and
- Fig. 5 a frontal side view of a second embodiment of the electrical contact according to the invention.

There now follows a detailed description of an electrical contact for a printed-circuit board or an electrical or electronic appliance. However, the invention is not to be limited to such an embodiment for a printed-circuit board, but is to include all electrical contacts, including, for example, those for pressed screens. Furthermore, the following description relates to an electrical contact that is to be connected by soldering to the printed-circuit board. However, the invention is equally not to be limited to such an embodiment, but is to relate also for example to electrical contacts with press-fit pins.

Fig. 1 shows an exterior view of a side wall 110 of an electrical contact 1, which is connected in an electrically conductive manner to a printed conductor 200 of a printed-circuit board 2. For this purpose, the electrical contact 1 has on its underside at least one, but in the illustrated embodiment, three electrical terminations 150, which project through
5 the printed-circuit board 2 and the corresponding printed conductor 200 and are soldered by means of a filler metal 210 to the printed conductor 200. The electrical terminations 150 form a second electrical contact region 12 of the electrical contact 1 and are preferably connected integrally to the first electrical contact region 10 of the contact 1. The electrical terminations 150 are preferably hollow inside and have a diameter adapted
10 relative to a dimension of the printed conductor 200 so that as much electric current as possible is transferable from an electrical termination 150 to the printed conductor 200. Besides the task of transferring the electric current, the terminations 150 are used to fix the electrical contact 1 mechanically on the printed-circuit board 2.

The first electrical contact region 10 of the electrical contact 1 has on its
15 underside, positioning aids 160 in the form of saddles 160, which during equipping of the printed-circuit board 2 with the contact 1, determine the insertion position thereof on the printed-circuit board 2 and prevent the contact 1 from being moved further forward relative to the printed-circuit board 2. In a fitted position of the electrical contact 1 on the printed-circuit board 2, at one side, the electrical terminations 150 project through the
20 printed-circuit board 2 and, at the other side, the positioning aids 160 are seated on the printed-circuit board 2, preferably in a non-electrical region.

A plurality of electrical spring contacts 120 (see, in this respect, Figs. 2 and 3) are bent into an electrical contact box 100 of the electrical contact 1 that is formed by bending from two end walls 140 and two side walls 110. In the present case, as Fig. 3 in
25 particular reveals, the electrical spring contacts 120 are bent in toward an inner side of a side wall 110 and disposed with clearance relative thereto; in other words, a spring contact plane 121 is provided parallel and with clearance relative to the side wall 140. The electrical spring contacts 120 are bent round before the contact box 100 is bent together. In this case, from a two-dimensional punched blank of the electrical contact 1,
30 first the electrical spring contacts 120 are shaped by bending (inward bending of lug 125, electrical contact zones 126, 127, and overstretch protection 128) and then the entire spring contact 120 is bent through approximately 180° toward the (subsequent) side wall

110. Then, the contact box 100 and the electrical termination 150 are shaped by bending and the contact box 100 is closed (see below).

In the illustrated embodiment, ten electrical spring contacts 120 are provided in the electrical contact 1, wherein, in each case, two spring contacts 120 lie directly opposite one another, and so five spring contact pairs 120, 120 are provided in the contact 1 in a row (i.e. in two mutually opposing rows each of five spring contacts 120). The number of electrical spring contacts 120 inside the electrical contact 1 is naturally variable, wherein at least a single spring contact 120 is provided. Preferably, as in the present embodiment, an even number of electrical spring contacts 120 is provided, preferably, in mutually opposite spring contact pairs 120, 120. A mating connector, for example, a tab connector, is insertable into an intermediate space 170 between the electrical spring contact pairs 120, 120.

According to the invention, it is then possible in the course of production of the electrical contact 1 to adjust the spring force that may be exerted by the electrical spring contacts 120 or is exerted on an inserted mating connector. This is effected by seating each electrical spring contact 120 against a corresponding region of the inner side wall 110. Adjustability is guaranteed in that the side wall 110 in the corresponding region has a first projection 115, against which the respective electrical spring contact 120 may be or is seated. By means of altering a height of the first projection 115, a spring force of the electrical spring contact 120 is adjustable. This relates, in particular, to a spring normal force that acts at right angles upon the inserted mating connector, i.e. at right angles to the spring contact plane 121 indicated in Fig. 3.

In preferred embodiments of the invention, this projection 115 is an embossed portion 115 or a bead 115 that is provided from an outer side of the side wall 110 in the side wall 110. Such an embossed portion 115 or bead 115 may be provided in the electrical contact 1, for example, in the course of punching out a blank for the electrical contact 1. During this process, the height of the first projection 115 is adjusted, this later influencing the spring normal force of each electrical spring contact 120 that is bent round in the electrical contact 1. In this case, according to the invention, it is possible to employ one and the same method to manufacture a plurality of different electrical contacts 1, which all present different spring forces of the electrical spring contacts 120. This merely entails adjustment of a height of the embossed portion 115 or bead 115, this

corresponding, in the case of manufacture by punching, to a different punching force. According to the invention, it is therefore also possible during the standard process of manufacturing an electrical contact 1, to adapt it to different conditions, or, in the event of electrical contacting problems arising during operation of the contact 1, to alter or
5 readjust the spring forces of the electrical spring contacts 120 of a new contact 1 without difficulty.

A seating of an electrical spring contact 120 against/on a relevant first projection 115 occurs preferably remote from an attached portion 124 of the spring contact 120. The attached portion 124 preferably forms a cohesively integral transition from the side wall
10 110 to the electrical spring contact 120. Preferably, the region of the electrical spring contact 120 that interacts with the first projection 115 takes the form of a lug 125, which extends from the spring contact plane 121 toward the side wall 110, to which the respective electrical spring contact 120 is directly connected. The lug 125 of the electrical spring contact 120, in this case, preferably covers at least a circular segment of
15 90°, which has its beginning in the spring contact plane 121.

The lug 125 is adjoined in the direction of the attached portion 124 of the electrical spring contact 120 by a region of the spring contact 120 that preferably takes the form of a second electrical contact zone 127. This second electrical contact zone 127, which preferably likewise takes the form of a lug of the electrical spring contact 120,
20 extends in the direction of the intermediate space 170 for the mating connector.

The second electrical contact zone 127 is adjoined, again in the direction of the attached portion 124 of the electrical spring contact 120, by an overstretch protection 128 (also referred to as overstretch protection device 128) of the spring contact 120. In the present case, the overstretch protection 128 preferably likewise takes the form of a lug,
25 which extends in the direction of the side wall 110, to which the corresponding electrical spring contact 120 is directly connected. The overstretch protection 128 comes into contact with an inner side of the side wall 110 in the event that a mating connector is not inserted correctly or a mating connector that is too large (thick) is inserted into the intermediate space 170 of the electrical contact 1. In this case, the overstretch protection
30 128 limits a spring deflection of the electrical spring contact 120, thereby preventing the spring contact 120 from being damaged (warped) or even broken off. The overstretch protection 128 may be seated preferably against a second projection 118 of the side wall

110. In this case, a height of a second projection 118 may be used to determine the moment, from which, henceforth, the overstretch protection 128 performs its tasks. Preferably, the second protection 118 likewise takes the form of an embossed portion 118 or bead 118, wherein the statements made with regard to the first projection 155 similarly
5 apply.

As may be seen in Fig. 1, the first projection 115, for example, may take the form of an embossed portion 115, which extends substantially over the entire width of the side wall 110 and interacts with all of the electrical spring contacts 120 of a side wall 110. It is, however, also possible to provide the embossed portions 118 for the corresponding
10 overstretch protection devices 128 in an individually adjustable manner, as in the case of the second projections 118 of the side wall 110 of Fig. 1. It is, of course, possible to provide the first projections 115 in an, in each case, individually adjustable manner and to design the second projections 118 as a single projection. It is, moreover, possible to provide both the projections 115, 118 each as a single projection or to provide the
15 projections 115, 118 such that they are adjustable, in each case, individually for a single electrical spring contact 120.

The overstretch protection 128 is adjoined, again in the direction of the attached portion 124 of the electrical spring contact 120, by a region of the spring contact 120 that takes the form of a first electrical contact zone 126. The first electrical contact zone 126
20 projects in the same direction as the second electrical contact zone 127. The first electrical contact zone 126 is likewise designed to come into electrical contact with the mating connector. Finally, the first electrical contact zone 126 is adjoined by the attached portion 124 of the electrical spring contact 120, via which the spring contact 120 is formed integrally with the side wall 110. In the present case, the attached portion 124 is
25 substantially a portion of the electrical spring contact 120 that is bent round through 180°.

As a whole, an electrical spring contact 120 in section has the shape of alternating wave crests and wave troughs. This sinusoidal rise and fall around the spring contact plane 121 allows each electrical spring contact 120 to effect a multiple electrical contacting that is suitable in particular for high electric currents. Thus, when the mating
30 connector has been inserted, this results in two electrical contacts per electrical spring contact 120, namely, in the region of the first electrical contact zone 126 and the second electrical contact zone 127. The electric current is then conducted, on the one hand,

through the attached portion 124 and, on the other hand, at least through the contact region between lug 125 and first projection 115 into the side wall 110, from there into the electrical terminations 150 and finally into the printed conductor 200 of the printed-circuit board 2. It is, moreover, possible (when the mating connector is not inserted) to design
5 the clearance between the overstretch protection 128 and the second projection 118 in such a way that, when the mating connector is inserted correctly, the overstretch protection 128 comes reliably to be seated against the second projection 118 and a third electrical contacting arises between the electrical spring contact 120 and the side wall 110, so that an electric current may flow through this contact region.

10 In Fig. 3, moreover, the electrical termination 150 may clearly be seen. In a bottom region, the contact box 100 tapers and forms a pin or stub-shaped shoulder, which is hollow inside and which extends through the printed-circuit board 2 and the printed conductor 200 and is soldered (210) to the printed conductor 200 on the opposite end of the printed-circuit board 2 to the electrical contact box 100. Preferably, in this case, the
15 cross sections of the electrical termination 150 in the region of the printed-circuit board 2 are circular or in the shape of a graduated circle.

Figs. 4 and 5 show two end portions 102, 104 of the contact box 100 of the electrical contact 1, which engage one into the other, and during the bending-together of an open contact box are pushed or pressed one into the other. The result of this is a
20 contact box 100 that is closed in peripheral direction. The mutually engaging portions 102, 104, in this case, have at least one undercut so that this connection cannot be undone as quickly. Preferably, a seam region of the two mutually meeting end portions 102, 104 is welded, preferably spot-welded. In Fig. 4, two such weld spots 132 are illustrated.

A preferred profile intersection of the two end portions 102, 104 occurs by means
25 of a dovetailed profile. In this case, Fig. 4 shows such a dovetailed profile, while Fig. 5 shows two (or, dependent on the manner of viewing) three such dovetailed profiles. All other profile intersections are, however, conceivable, although profile intersections with undercuts are preferred. It is possible to use, for example, corresponding circular/elliptical portions, T- or Y-profile intersections, or the like. Also possible,
30 however, is a conventional closure of the contact box 100, in that a lateral edge of the longitudinal end portion of the contact box 100, which is to be bent together, is seated on

an edge of the opposite longitudinal end and connected to it, for example, by welding or gluing.

Claims

1. Electrical contact for a printed-circuit board (2) or a pressed screen of an electrical or electronic appliance, comprising:
 - 5 a first electrical contact region (10) for the electrical connection to a mating connector, and a second electrical contact region (12) for the electrical connection to the printed-circuit board (2) or the pressed screen, wherein
the first electrical contact region (10) comprises an electrical spring contact (120) that is bent round toward a side wall (110) of the electrical contact (1), and a first
10 projection (115) of the side wall (110) is provided, which interacts with the spring contact (120) and by means of which the adjustment of the spring normal force of the spring contact (120) is effected.
 2. Electrical contact according to claim 1, wherein the spring contact (120) is or may be seated against the first projection (115) by means of a lug (125) that is formed on the
15 spring contact (120), and
a seating of the spring contact (120) against the first projection (115) by means of the lug (125) occurs preferably in a longitudinal end portion (122) of the spring contact (120).
 3. Electrical contact according to claim 1 or claim 2, wherein the spring contact
20 (120) has an overstretch protection (128), which projects from a spring contact plane (121) in the direction of the side wall (110), to which the spring contact (120) is directly connected, and
the overstretch protection (128) is or may be seated preferably against a second projection (118) of the side wall (110), and
25 a seating of the spring contact (120) against the second projection (118) by means of the overstretch protection (128) occurs preferably in a middle portion (123) of the spring contact (120).
 4. Electrical contact according to any one of claims 1 to 3, wherein the first projection (115) and/or the second projection (118) are embossed portions (115, 118)
30 and/or beads (115, 118) in the side wall (110).
 5. Electrical contact according to any one of claims 1 to 4, wherein the spring contact (120) comprises at least one, preferably two electrical contact zones (126, 127)

for the mating connector, which project from the spring contact plane (121) in a direction away from the side wall (110), to which the spring contact (120) is directly connected.

6. Electrical contact according to any one of claims 1 to 5, wherein the second electrical contact region (12) of the electrical contact (1) is of a box-shaped construction
5 (100) having two mutually directly opposing side walls (110), and in this contact box (100) at least one, but preferably three, four or five spring contact pairs (120, 120) disposed side by side in a row are provided, wherein the two spring contacts (120) of a spring contact pair (120, 120) are disposed directly opposite one another.

7. Electrical contact according to any one of claims 1 to 6, wherein the respective
10 first electrical contact zones (126) and/or the respective second electrical contact zones (127) of two mutually directly opposite spring contacts (120) are disposed facing one another and directly opposite one another.

8. Electrical contact according to any one of claims 1 to 7, wherein the respective overstretch protection devices (128) and the respective lugs (127) of two mutually
15 directly opposite spring contacts (120) are disposed remote from one another and directly opposite one another.

9. Electrical contact according to any one of claims 1 to 8, wherein the electrical contact (1) is bent from a punching metal sheet and the contact box (100) is closed at its periphery by means of a form-fit box closure (130), wherein
20 the box closure (130) is formed in a wall (110, 140) of the contact box (100) and comprises an engagement of two end portions (102, 104) of the contact box (100) one into the other.

10. Electrical contact according to any one of claims 1 to 9, wherein the two end portions (102, 104) of the contact box (100) engage one into the other by means of a
25 dovetailed profile that is preferably spot-welded.

11. Electrical contact according to any one of claims 1 to 10, wherein the box closure (130) is provided in an end wall (140) of the electrical contact (1).

12. Printed-circuit board or pressed screen having an electrical contact (1) according to any one of claims 1 to 11.

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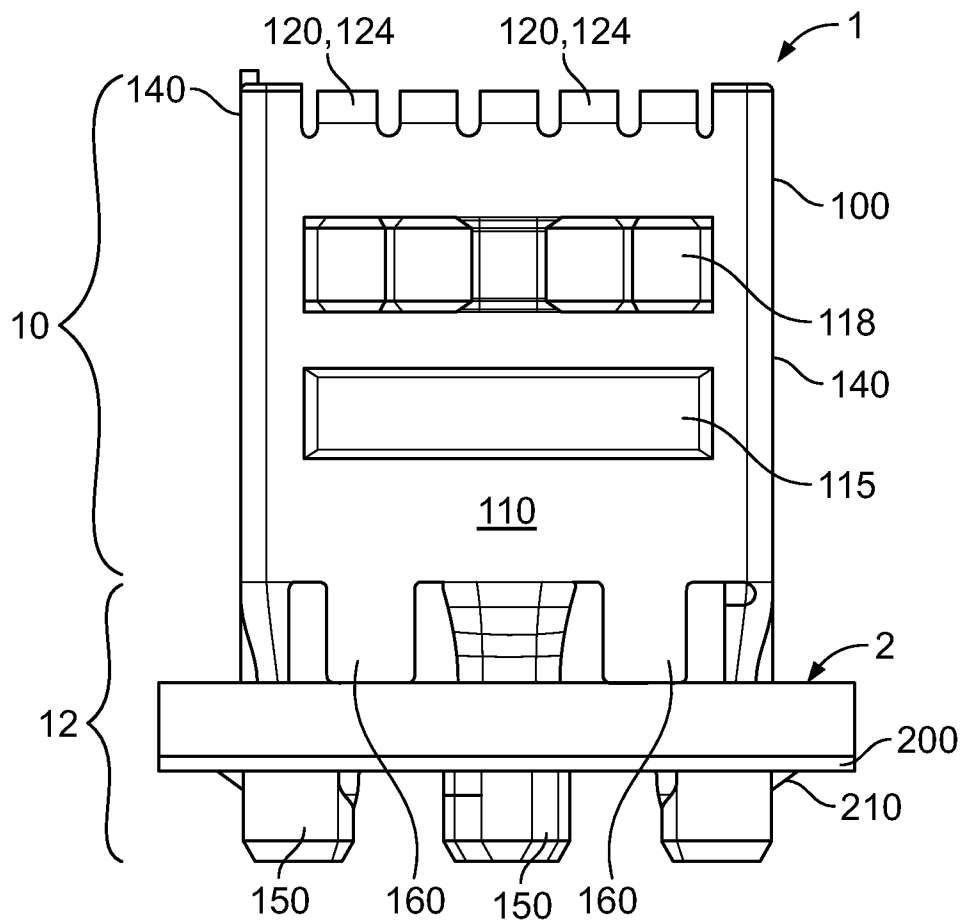


Fig. 1

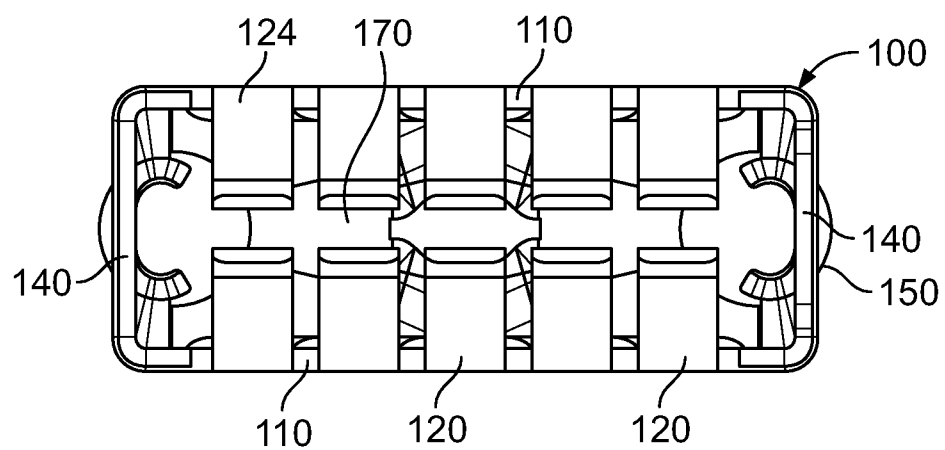


Fig. 2

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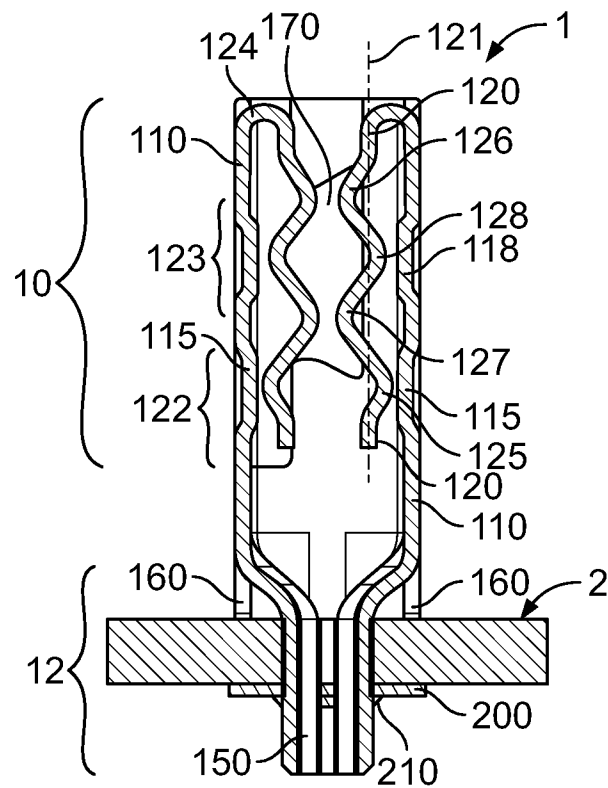


Fig. 3

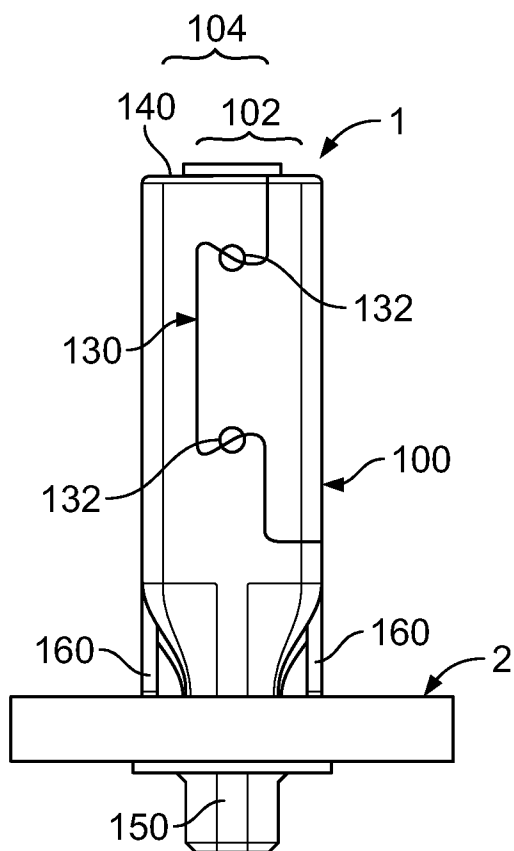


Fig. 4

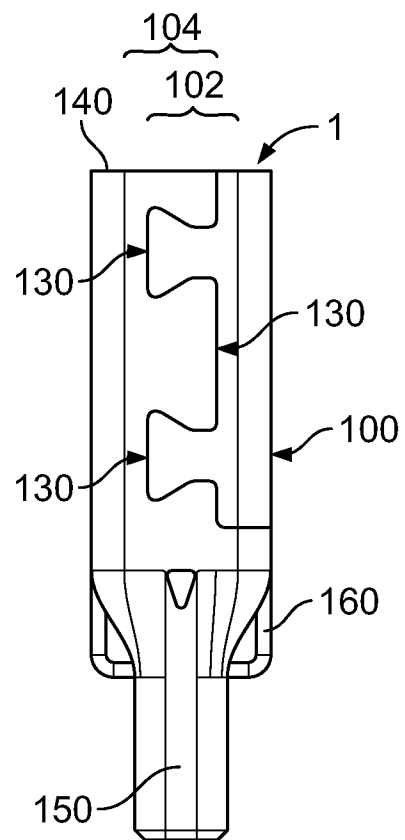


Fig. 5

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2007/057432

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01R13/115

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 practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 99/23723 A (UT AUTOMOTIVE DEARBORN INC [US]; ALVAREZ ANDREU CALAVERA [ES]) 14 May 1999 (1999-05-14)	1,2,4-7, 11,12
Y	the whole document	3,8-10
X	US 6 193 567 B1 (HSIEH SHAO CHUNG [US]) 27 February 2001 (2001-02-27)	1
Y	column 2, line 48 - line 55; figure 2	3,8
X	US 4 087 151 A (ROBERT LAWRENCE A ET AL) 2 May 1978 (1978-05-02)	1
Y	figure 1.3	
Y	WO 2005/046002 A (INTEDIS GMBH & CO KG [DE]; DUEMMEL ROLAND [DE]; HUBER RAIMUND [DE]) 19 May 2005 (2005-05-19)	9,10
	page 10, line 27 - page 11, line 19; figures 4,5	
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☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search

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Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2007/057432

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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