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(71) Applicant (*for all designated States except US*): **FCI** [FR/FR]; 145/147, rue Yves Le Coz, F-78000 Versailles (FR).

(72) Inventors; and
(75) Inventors/Applicants (*for US only*): **DE BRUIJN, Jeroen** [NL/NL]; Van Grevenbrouckstraat 34, NL-5175 Loon Op Zand (NL). **DROESBEKE, Gert** [BE/BE]; Pallo 15, B-2440 Geel (BE). **POTTERS, Paul** [NL/NL]; Nassaustratt 5, NL-5616 AG Eindhoven (NL).

(74) Agent: **REGI, François-Xavier**; FCI, IP Department, 145/147, rue Yves le Coz, F-78035 Versailles Cedex (FR).

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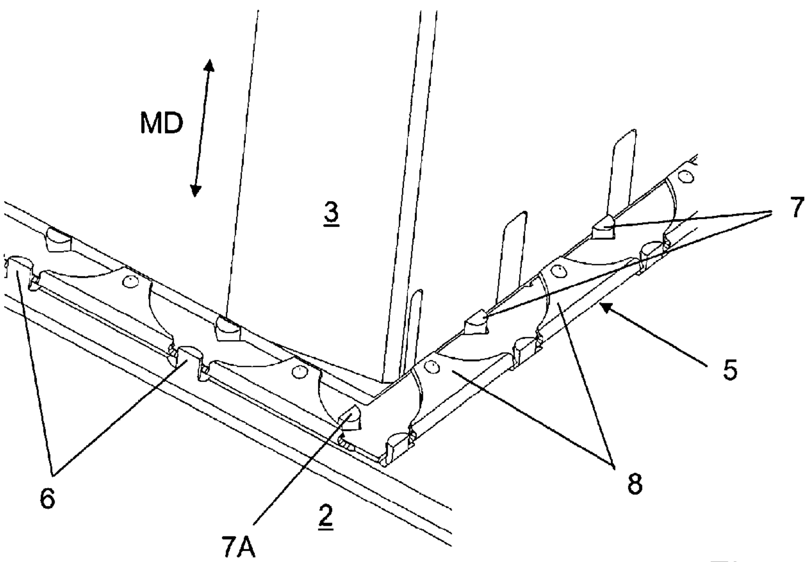

Fig. 5

(57) Abstract: A connector (1) comprises a housing (2), substantially surrounding at least one contact terminal and having a front surface (4) substantially perpendicular to a mating direction (MD) for mating with a counterpart. At least one contact spring (5) is attached to the housing, comprising at least one elastically deformable spring element (8) and being arranged for making contact with and deflecting against a surface of the counterpart facing the connector front surface when the connector is mated to the counterpart. The housing (2) comprises a plurality of first protrusions (6) protruding in the mating direction and being arranged for making contact with, when the connector is mated to a counterpart, the surface of the counterpart and thereby substantially limiting the deflection of the spring element within its elastic deformation range.

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EMI/RFI-shielding for electrical connector

FIELD OF THE DISCLOSURE

The present disclosure relates to a structure for a connector and more particularly to an arrangement for establishing electrical connection between a connector and a counterpart for electromagnetic/radio frequency shielding.

BACKGROUND OF THE DISCLOSURE

In general, it is desired that electrical and/or optical connectors comprise means for providing electromagnetic/radio frequency shielding (EM/RF shielding) to the connection being made by the connector and a counterpart. Such shielding relies on sufficient electrical contact of shielding arrangements on both connecting parts with at most small holes, smaller that the shortest wavelength from which shielding is desired.

However, abutting surfaces, even substantially flat ones, of connecting parts may not be sufficiently parallel to prevent gaps. Thus, shielding may be inadequate.

Forcefully clamping together the connecting parts for improving the electrical contact may not be desired or possible, e.g. for reasons of operation, space or fragility of the parts.

Contact springs which elastically engage both connecting parts have been successfully used for overcoming unparallelism of substantially flat parts. However, these are generally made of thin sheet- or strip metal which is relatively delicate and relatively sharp. Thus, a contact spring may relatively easily be damaged and/or cause damage during handling. Such damage may be e.g. breaking off of a spring finger, or the contact spring cutting or tearing insulating material or wounding an operator.

To prevent damage to the spring, it should be made relatively strong, stronger than required for sufficient electrical contact. This may hinder mating and increases material and manufacturing costs.

There is consequently a need for an EM/RF shielding connector wherein a relatively weak contact spring may be used.

SUMMARY OF THE DISCLOSURE

A connector is provided, comprising a conductive housing, substantially surrounding at least one contact terminal and having a front surface substantially perpendicular to a mating direction for mating with a counterpart. At least one contact spring is attached to the housing and comprises one or more elastically deformable spring elements, e.g. spring fingers. A plurality of spring elements may be arranged substantially surrounding the at least one contact terminal. The one or more spring elements are arranged for making electrical and/or mechanical contact with and deflecting against a surface of the counterpart facing the connector front surface, when the connector is mated to a counterpart. The housing comprises a plurality of protrusions protruding in the mating direction and being arranged for making electrical and/or mechanical contact with the surface of the counterpart, when the connector is mated to a counterpart, and thereby substantially limiting the deflection of at least some of the spring fingers within their elastic deformation range.

Thus, a connector is provided which allows that, during mating of the connector to a counterpart, the contact spring gets compressed for ensuring proper contact and thus EM/RF shielding. At the same time, the protrusions block further mating motion of the connector and the counterpart and therewith prevent the spring elements from being bent beyond the point of elastic deformation, which would effectively cause folding or crushing of the spring elements and would reduce their functionality or lead to their breaking off. The contact spring therefore need not be sized for withstanding excessive bending and/or flattening forces.

The protrusions further concentrate the mating contact force relative to flat engaging surfaces, thus locally improving the electrical contact between the housing of the connector and the counterpart and therewith improving the shielding function of the connection. The electrical contact of the connecting parts, and thus their shielding, is therefore not dependent on all spring fingers making optimum contact. The contact spring may therefore be relatively weak, which provides that the connector and the counterpart remain in physical contact even if they are not tightly fixed together.

The separation between adjacent protrusions is advantageously chosen smaller than an EM/RF noise-frequency cut-off gap, for further improving the shielding arrangement and/or providing redundancy. Thus a relatively reliable shielding arrangement is provided.

A connector according to claim 2 assists in preventing damage by or to the spring fingers by cutting or snagging behind objects. Thus protected, the contact spring may be relatively delicate.

In a connector according to claim 3 the protrusions may be relatively robust while still allowing to provide a localised contact force and an adequate shielding of the contact spring.

In a connector according to claim 4, the spring elements may be further protected against excessive bending. At least some of the second protrusions may be sized to limit the deflection of the corresponding spring elements within their elastic deformation range. The second protrusions may serve as back-up, should the first protrusions become damaged or flattened during use.

Claim 5 defines a connector which facilitates mounting the contact spring. The first and/or second protrusions may operate as fixation protrusions. A different set of dedicated fixation structures may also be provided.

Claims 6 and 7 define connectors adapted for relatively efficient mounting of the contact spring.

With the design of a connector according to claim 8 it may be assured that the side walls of the protrusions extend essentially perpendicular to the plane of the surface from which the protrusions extend, any radiuses and/or rounding-off effects of the manufacturing process being “hidden” inside the groove. Such grooves may be realised relatively straightforwardly and reliably by die-cast techniques. Further, this allows to prevent relatively sharp angles, which might lead to destructive concentrations of stresses.

Claim 9 defines a connector with a an efficient and reliable attachment of the contact spring to the housing, since it also may prevent sharp angles in the transition zone between the post portion and the head portion of the rivet formed by the riveted protrusion.

In a connector according to claim 10 the parts may be manufactured to relatively lower tolerances, and thus be more cost-efficient, since the contact spring may be fit between the protrusions and be allowed to “snake” somewhat between the protrusions, accepting variations in size of positions of the protrusions. Thus, essentially, fitting to only one protrusion at a time has to be considered.

Similarly, in a connector according to claim 11, the contact spring comprises relative weak points for bending the spring in the plane of the web. The constrictions in the design may also serve for efficiently sizing, e.g. by breaking or tearing, a contact spring provided on a strip.

Claim 12 allows the contact spring to be bent in the plane of the contact spring. It further allows the sideways strength of the spring element to remain relatively high, e.g. protecting against sideways bending, snagging etc., whereas the spring constant of the spring may be tailored by the relative sizes of the legs and the opening of the V-shape. This holds in particular for a contact spring wherein the spring elements are reverse-bent spring fingers.

In a connector according to claim 13, the contact spring may be made as or from a substantially flat strip of material which is relatively flexible and possibly resilient in all three dimensions with respect to the plane of the strip. This allows relatively course tolerances in the parts.

In addition, a connector is provided which comprises a conductive housing, substantially surrounding at least one contact terminal and having a front surface substantially perpendicular to a mating direction for mating with a counterpart. A contact spring is attached to the housing and comprises a plurality of elastically deformable spring elements being arranged for making contact with and deflecting against a surface of the counterpart facing the connector front surface when the connector is mated to the counterpart. The housing comprises a plurality of first and second protrusions protruding in the mating direction. The first protrusions are arranged for making contact with, when the connector is mated to a counterpart, the surface of the counterpart and thereby substantially limiting the deflection of at least some of the spring elements within their elastic deformation range. The second protrusions are arranged for substantially defining a maximum deflection of at least some of the spring elements within their elastic deformation range which is further than the deflection defined by the first protrusions.

Such a connector provides an EM/RF shielding arrangement for the connection being made, having a contact spring which is substantially mechanically protected. This improves the robustness of the connector. It further protects an operator or delicate parts nearby the connector from being harmed. The contact spring may be manufactured relatively weak, saving manufacturing costs.

Further, a connector is provided which comprises a conductive housing, substantially surrounding at least one contact terminal and having a front surface substantially perpendicular to a mating direction for mating with a counterpart. A contact spring is attached to the housing and comprises a plurality of elastically deformable spring elements. At least one of the elements is formed as a generally V-shaped spring finger. Advantageously a plurality, e.g. all spring elements are thus formed. The spring elements are arranged for making contact with and deflecting against a surface of the counterpart facing the connector front surface when the connector is mated to the counterpart. The housing of the connector comprises a plurality of first and second protrusions protruding in the mating direction. The first protrusions are arranged for making contact with, when the connector is mated to a counterpart, the surface of the counterpart and thereby substantially limiting the deflection of at least some of the spring elements within their elastic deformation range. The second protrusions are sized and arranged for substantially defining a maximum deflection of at least some of the spring elements within their elastic deformation range which is further than the deflection defined by the first protrusions.

Thus, an EM/RF shielding connector is provided which allows to use a contact spring having a relatively weak spring constant, yet is relatively mechanically robust against sideways forces or torsion. Such connector may provide increased reliability during handling, such as repeated mating and unmating and shipping, while facilitating mating to a counterconnector.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of a connector without a contact spring.

Fig. 2 is a perspective view of a connector with a contact spring.

Fig. 3A is a plan view of a connector housing without a contact spring.

Fig. 3B is a plan view of a connector with a contact spring.

Fig. 4 is a side plan view of a connector with a contact spring.

Fig. 5 is a perspective view of a detail of a connector with a contact spring, as indicated in the figures 2, 3B and 4.

Figs. 6A-6C are different views of the contact spring of Figs. 2, 3B-5.

Fig. 7 is a perspective view at an enlarged scale of a different embodiment of a connector housing without a contact spring.

Fig. 8 is a plan view of the housing of Fig. 7.

Figs. 9A-9C are different views of an alternative contact spring.

Fig. 10 is a cross-sectional detail of a contact spring attached to the housing by means of a riveted protrusion.

DETAILED DESCRIPTION OF EMBODIMENTS

Figs. 1 and 2 show an electrical cable connector 1 comprising a housing 2 and a mating portion 3. The mating portion defines a mating direction, here indicated with an arrow MD. The housing 2 comprises two half-shells 2A and 2B of a conductive material, preferably of made by means of die casting. The housing 2 and the mating portion 3 surround at least one contact terminal for contacting with a wire of a cable (not shown). The housing 2 has a front surface 4, substantially perpendicular to the mating direction MD. In Fig. 2, a contact spring 5 is shown attached to the housing 2.

Figs. 3A and 3B are plan views in the direction of the mating direction MD of the connector 1 of Figs. 1 and 2, showing the front surfaces 4 without a contact spring (Fig. 4A) and with a contact spring 5 (Fig. 4B). Fig. 4 is a side plan view of the connector 1 with the contact spring 5. Fig. 5 shows a detail on an enlarged scale of the connector 1 with a contact spring 5, as indicated in Figs. 2, 3B and 4.

The housing 2 comprises a plurality of first, outer, protrusions 6 and second, inner, protrusions 7 protruding in the mating direction MD. Additional protrusions 7A are provided at the corners of the housing 2. The protrusions 6, 7, 7A are arranged for making contact with the surface of a counterpart (not shown), when the connector 1 is mated to the counterpart. The contact spring 5 comprises a plurality of elastically deformable spring elements 8 which are arranged for making contact with and deflecting against a surface of a counterpart facing the connector front surface 4 when the connector 1 is mated to the counterpart. The protrusions 6, 7 and 7A are sized, particularly with respect to their height, to substantially limit the deflection of the spring element within its elastic deformation range.

As is most clearly visible in Figs. 2, 3B and 5, the contact spring 5 and the protrusions 6, 7 are arranged along the circumference of the connector housing 2, the protrusions 6 being nearer the circumference, protecting the spring 5 at the outside of the connector 1. In Fig. 3B it is visible that the contact spring 5 is divided in two generally U-shaped parts, 5A and 5B, corresponding to the housing comprising two half-shells 2A, 2B. This allows to (dis-)assemble the housing 2 with the contact spring 5 attached thereto. The contact spring parts 5A and 5B are substantially identical to each other, with the exception of their lengths for fitting the respective half-shells 2A, 2B.

The connector housing 2 may effectively be made of cast metal or of a plastics material which is rendered conductive by additives or by a conductive coating. Die casting allows to realise a relatively large variety of shapes for the housing 2, including providing details such as the protrusions 6, 7, 7A.

The protrusions 6, 7, 7A may have convex ends and may be somewhat deformable for adapting to unparallelism of the mating connector surfaces. The protrusions 6, 7, 7A may thus effectively serve for providing shielding of the connection between the connector 1 and the counterpart against EM/RF noise. The deformation may wear off the protrusions 6, 7, 7A over repeated mating/unmating, especially when a connector 1 is used with different counterparts. This effect may be overcome by clamping the connector 1 against the counterpart, possibly increasingly hard, and/or the use of the contact spring 5.

Figs. 6A-6C are different views of the half contact spring 5B of Figs. 2, 3B-5. Figs. 6A and 6B are plan views from above and below of the spring, respectively. Fig. 6C is a detail view on an enlarged scale, as indicated in Fig. 6A.

The spring 5 comprises a plurality of elastically deformable spring elements in the form of reverse-bent spring fingers 8, which are connected to an essentially elongated web 9. The spring 5, or rather the web 9 thereof, has two approximately 90 degree angles, thus being generally U-shaped. The web 9 has a plurality of constrictions 10 and holes 11, which here are positioned close to the corners of the spring 5. The spring fingers 8 are provided with protrusions 12 to reduce the contact surface between the spring 5 and the front surface of the counterpart and increase the local contact force in order to pierce through a layer of dirt or contamination, e.g. from handling, and/or oxide which may be present on that surface.

The half springs 5A, 5B is formed from a single piece of material, e.g. by stamping or punching out of a sheet metal blank and bending the spring fingers 8. To facilitate the bending and its regulation for a controlled spring geometry and thus also a controlled spring constant, the spring fingers 8 are provided with incisions 13. The spring fingers 8 are further formed with spring curves 14, to divide internal stress equally inside the spring finger 8. This results in an relatively good relation between spring constant, spring movement and resistance against plastic deformation of the spring element 8.

The constrictions 10 and holes 11 fit to the protrusions 6, 7, 7A of the housing 2 for attachment of the spring thereto. The width of the web 9 is chosen such that the spring fits tightly between the protrusions 6, 7. The web 9 may be provided with incisions (indicated with dotted lines 15) adjacent one or more constrictions 10 so as to provide attachment springs for holding the spring 5 against the corresponding protrusions 6, 7. The attachment springs may facilitate pressing the spring 5 over the protrusions 6, 7 but substantially prevent pulling the spring 5 off again. One or more of the protrusions 6, 7, 7A may be riveted for attaching the spring 5 to the housing 2. The height of at least some of the protrusions 6, 7, 7A is such that flattening and folding of the spring fingers 8 due to compression of the connector 1 against the counterpart is substantially prevented. The outer protrusions 6 may be higher than the inner protrusions 7, providing an additional protection to the spring 5 from the outside and reducing the chance of gaps remaining between the connector housing 2 and the front surface of the counterpart.

The separation between (the protrusions 12 of) the spring fingers 8 is preferably chosen smaller than the shortest relevant EM/RF-noise wavelength for the connection between the connector 1 and the counterpart. The same holds for (the separation of) the protrusions 6, 7, 7A. Typical separations are approximately 7 mm or below, preferably below approx. 6 mm, typically about 5 mm or 4 mm.

Figs. 7 and 8 are different views of an alternative embodiment of a housing 2, which is largely identical to that of Figs 1-5. Figs. 9A-9C are different views of an alternative embodiment of a contact spring 5. Fig. 10 is a detail of yet an alternative contact spring 5. In these figures, elements and aspects which substantially correspond with those of Figs. 1-6C are indicated with the same reference numerals.

Fig. 7 is a partial view of a housing 2, which comprises two half-shells 2A, 2B. Fig. 8 is a plan view of the housing 2 of Fig. 7. The housing 2 comprises a plurality of protrusions 6, 7. The protrusions 6 and 7 are arranged along the circumference of the housing 2, the protrusions 6 being arranged essentially at the circumference. The protrusions 6 are elongated in a direction along the circumference. Between the protrusions 6 ridges 16 extend, which here interconnect the protrusions 6. The protrusions 6 and the ridges 16 together form a rim 16A around the circumference of the housing 2. Here, the rim 16A is castellated due to the height difference between the protrusions 6 and the ridges 16. The protrusions 7 are surrounded by a groove 17 over their circumference.

The protrusions 6 are higher than the protrusions 7, i.e. they protrude further from the front surface 4, such that they are adapted for making contact with, when the connector 1 is mated to a counterpart, the surface of the counterpart, before the protrusions 7 do. Thus, the protrusions 6 are adapted for limiting the deflection of the spring element within its elastic deformation range. At the same time, the protrusions 6 are adapted for making electrical contact with the surface of the counterpart themselves, providing EM/RF shielding and preventing gaps between the connector 1 and the counterpart which may collect dirt etc. The tops of at least some of the protrusions 6 are formed somewhat pointed or at least rounded off, to reduce the contact surface between the protrusions 6 and the front surface of the counterpart and increase the local contact force in order to pierce through a layer of dirt and/or oxide which may be present on that surface, improving both the electrical and mechanical contact.

Figs. 9A-9C show one part of the contact spring 5 adapted for use with the housing 2 of Figs. 7 and 8. Fig. 9A is a side view, Fig. 9B is a perspective view and Fig. 9C is a partial view at an enlarged scale. The shown part of the spring 5 is generally U-shaped.

The contact spring 5 of Figs. 9A-9C comprises a plurality of elastically deformable spring elements in the form of reverse-bent spring fingers 8 connected to an essentially elongated web 9. The spring fingers 8 are V-shaped, having two legs 8A defining an opening 18 in the spring element 8. This may result in a relatively weak spring in the mating direction MD, since the legs 8A may be relatively narrow compared to the entire spring element 8. Yet, at the same time, the spring element 8 is relatively robust against forces substantially perpendicular to the mating direction MD. The tips of the spring fingers 8 are provided with a bent portion forming a protrusion 12 for increasing and localising contact pressure.

To facilitate the bending of the spring fingers 8 and the regulation thereof for a controlled spring geometry and thus also a controlled spring constant, the spring fingers 8 are provided with incisions 19. The incisions 19 extend into the web 9, forming constrictions as well as allowing the web 9 to bend somewhat in the plane of the web 9. The incisions 19 may also be used for clamping and/or tearing the web 9 to a desired length.

The web 9 is provided with holes 11 for attaching the spring 5 to the protrusions 7 of the housing 2. The holes 11 in the web 9 are elongated for allowing relatively large manufacturing tolerances between (the protrusions 7 of) the housing 2 and the spring 5.

The web 9 comprises optional bridges 20 between the legs 8A of the spring fingers 8, fortifying the web 9 and the V-shaped spring fingers 8. Without the bridges 20, the contact spring 5 is generally formed as an undulating strip, wherein the holes 18 are fully open cut-outs.

The contact spring 5 of Figs. 9A-9C is mounted to the connector housing 2 of Figs. 7, 8 by fitting the holes 11 over the protrusions 7. The spring 5 is attached to the housing 2 by clamping forces between the circumference of the holes 11 to the protrusions 7 and/or riveting of the protrusions 7. Other means of attachment such as screwing or gluing are also conceivable. The protrusions 6 and 7 are arranged staggered with respect to each other, facilitating fitting the spring 5 to the housing with some flexibility to (the positions of) the protrusions. At the same time, the staggered arrangement allows to provide the housing relatively narrow while designing the web 9 with a relatively small and substantially constant net width.

When mounted to the housing of Figs. 7, 8, the contact spring 5 is partially hidden behind and thus protected to the outside by the castellated rim 16A. The protrusions 6 are arranged at the positions of the spring fingers 8, providing extra, localised, protection. Additional protrusions may be provided for attachment and/or bending protection purposes. The outer protrusions 6 are higher than the inner protrusions 7, providing protection against too far bending, flattening and possibly folding of the contact spring elements 8. The protrusions 7 serve the same purpose at a further degree of bending. Thus the protrusions 7 protect the tips of the spring fingers from too far bending while the protrusions 6 protect the bending portion itself from being bent to a too small bending radius. The inner protrusions 7 thus protect against a not-flat contact surface of the counterpart and form a general second line of defence, behind the outer protrusions 6, against too far bending.

Fig. 10 is a view a cross-section through a hole 11 of a web 9 of an alternative embodiment of a contact spring 5, which web 9 is attached to a connector housing 2 by means of a riveted protrusion 7. As is shown schematically in Fig. 10, the circumference of the hole 11 is curved concave or bent downwards, i.e. away from the spring fingers 8, for at least partially fitting in the groove 17 surrounding a protrusion 7. When the protrusion 7 is riveted, the protrusion 7 is deformed to form a rivet post 7A with a rivet "mushroom" head 7B, fixing the web 9.

The curved circumference of the hole 11 in the web 9 causes a generally gradual transition of the diameter of the riveted protrusion 7 between the post 7A and the head 7B. This prevents the substantially step-wise increase in diameter between the post 7A and the head 7B of a regular rivet. At such step-wise increase in diameter, stress may focus and build up, allowing the rivet head 7B to break off and the spring 5 to become detached from the housing 2. A concave circumference of a hole in a substrate for at least partially surrounding a rivet thus may result in a relatively strong and reliable attachment.

From Fig. 10 it may also be seen that the front surface 4 of the housing 2 and the side wall of (the rivet post 7A of) the protrusion 7 extend substantially perpendicular to each other, while the groove 17 allows for a rounding-off of the connection between the protrusion and the main body of the housing. This reduces demands on the mold for a die-cast molded connector housing. It also prevents stress build-up at the base of the protrusion 7, similar to the transition rivet post-to-rivet head as set out above, allowing to design a relatively thin protrusion which still is capable of withstanding relatively rough handling during manufacturing, e.g. tumble-polishing and/or sand blasting. A relatively thin protrusion enables relatively small holes 11 and thus a relatively narrow (web 9 of a) spring 5.

Although the invention has been explained with respect to different embodiments, it will be appreciated by the skilled person that the invention is not limited to these examples and that variations within the scope of the appended claims are possible. E.g., the spring elements may be bent or oriented outwards instead of inwards, for contacting the front face of the counterpart further outwards. This allows relatively larger tolerances between the connector and (a receiving hole in) the counterpart.

The spring element may be a flexible, reversely bent band, not having separate spring fingers. The spring fingers may also extend from the web without being reverse-bent. Similarly, the contact spring may be a generally undulating band, e.g. essentially VVV-shaped, with one or more tips or bent out of the plane.

Additional protrusions may be provided in the opening of the V-shape of the spring fingers. The protrusions may be angular, e.g. substantially hexagonal, rectangular or square.

The connector 1 may be an optical connector, contact terminal of the connector being an optical terminal.

The connector may comprise a plurality of mating portions in a single housing, each of these mating portions may be provided and/or surrounded individually by a plurality of protrusions and/or a contact spring.

Although the description refers to embodiments in which the spring fingers are adapted to make contact with and deflecting against a front surface of the counterpart, the present invention can be applied to the case where the spring fingers extend along a parallel direction with the mating direction and contact and deflect against an edge of the counterpart, such as an edge of a front panel cut-out.

It should further be noted that elements and aspects of different embodiments discussed herein may be suitably combined.

CLAIMS

1. Connector (1), comprising:

a housing (2) having a front surface (4) substantially perpendicular to a mating direction (MD) for mating with a counterpart; and

at least one contact spring (5) attached to the housing and comprising at least one elastically deformable spring element (8) arranged for making contact with and deflecting against the counterpart, when the connector is mated to the counterpart,

wherein the housing (2) comprises a plurality of first protrusions (6) protruding in the mating direction and being arranged for making contact with, when the connector is mated to a counterpart, a surface of the counterpart and thereby substantially limiting the deflection of the spring element within its elastic deformation range.

2. Connector (1) according to claim 1, wherein a front surface (4) of the housing (2) has a circumference, and wherein the contact spring (5) and the protrusions (6) are arranged along at least a portion of the circumference, the protrusions being arranged nearer the circumference than the contact spring.

3. Connector (1) according to claim 2, wherein at least some of the first protrusions (6) are elongated in a direction along the circumference.

4. Connector (1) according to one of the preceding claims, wherein the connector is provided with a plurality of second protrusions (7), the protrusions being sized and arranged for substantially defining a maximum deflection of the spring element (5) which is further than the deflection defined by the first protrusions (6).

5. Connector (1) according to one of the preceding claims, wherein the connector is provided with a plurality of protrusions (6, 7, 7A) for fixing the contact spring (5) thereto.

6. Connector (1) according to claim 5, wherein at least one of the protrusions (6, 7, 7A) for fixing the contact spring (5) is adapted for fixing the contact spring by riveting.

7. Connector (1) according to claim 5 or 6, wherein the contact spring (5) is provided with at least one attachment spring for attaching the contact spring to a protrusion (6, 7, 7A).

8. Connector (1) according to one of the preceding claims, wherein at least some of the protrusions (6, 7, 7A) are surrounded by a groove (17) over at least a portion of their circumference.

9. Connector (1) according to claims 6 and 8, wherein the contact spring (5) is provided with a hole (11) whose circumference is curved, e.g. bent, for at least partially fitting in the groove (17) surrounding a protrusion (6, 7, 7A) for riveting the contact spring to the connector housing (2).

10. Connector (1) according to one of the preceding claims, wherein the first and second protrusions (6, 7, 7A) are arranged staggered with respect to each other.

11. Connector (1) according to one of the preceding claims, wherein the contact spring (5) comprises a plurality of spring elements (8), e.g. spring fingers, connected to an essentially elongated web (9), which web has a plurality of constrictions (10, 19).

12. Connector (1) according to one of the preceding claims, wherein the spring element (8) of the contact spring (5) is a generally V-shaped spring finger.

13. Connector (1) according to one of the preceding claims, wherein the contact spring (5) comprises an undulating strip.

14. Connector (1), comprising

a conductive housing (2), substantially surrounding at least one contact terminal and having a front surface (4) substantially perpendicular to a mating direction (MD) for mating with a counterpart; and

a contact spring (5) attached to the housing and comprising a plurality of elastically deformable spring elements (8) being arranged for making contact with and deflecting against a surface of the counterpart facing the connector front surface when the connector is mated to the counterpart,

wherein the housing comprises a plurality of first and second protrusions (6, 7) protruding in the mating direction, the first protrusions (6) being arranged for making contact with, when the connector is mated to a counterpart, the surface of the counterpart and thereby substantially limiting the deflection of at least some of the spring elements within their elastic deformation range, and

the second protrusions (7) being sized and arranged for substantially defining a maximum deflection of at least some of the spring elements within their elastic deformation range which is further than the deflection defined by the first protrusions.

15. Connector (1), comprising

a conductive housing (2), substantially surrounding at least one contact terminal and having a front surface (4) substantially perpendicular to a mating direction (MD) for mating with a counterpart; and

a contact spring (5) attached to the housing and comprising a plurality of elastically deformable spring elements (8), at least one of the elements being formed as a generally V-shaped spring finger, being arranged for making contact with and deflecting against a surface of the counterpart facing the connector front surface when the connector is mated to the counterpart,

wherein the housing comprises a plurality of first and second protrusions (6, 7) protruding in the mating direction,

the first protrusions (6) being arranged for making contact with, when the connector is mated to a counterpart, the surface of the counterpart and thereby substantially limiting the deflection of at least some of the spring elements within their elastic deformation range, and

the second protrusions (7) being sized and arranged for substantially defining a maximum deflection of at least some of the spring elements within their elastic deformation range which is further than the deflection defined by the first protrusions.

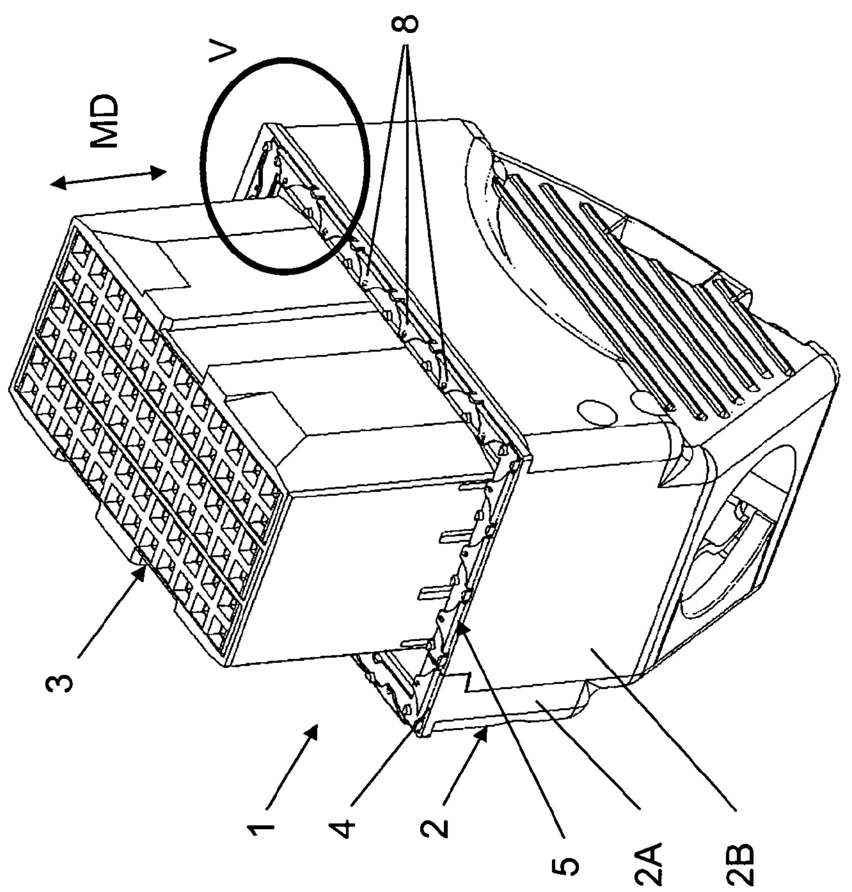

Fig. 2

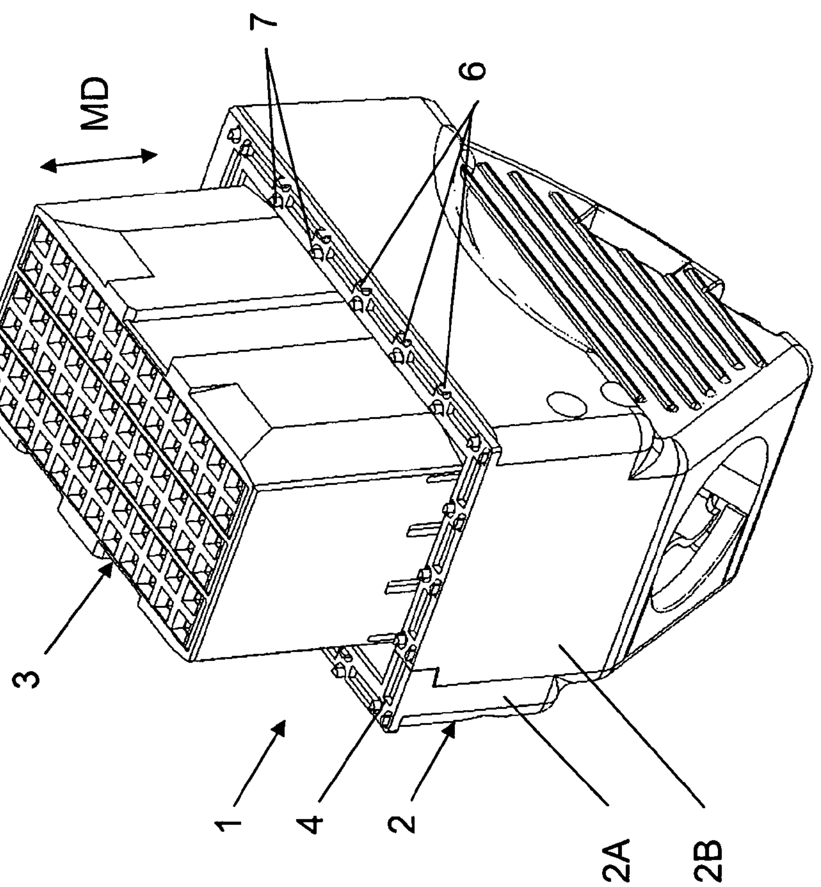

Fig. 1

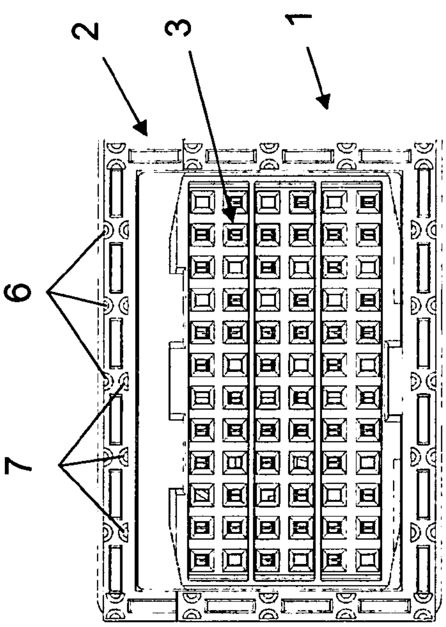

Fig. 3A

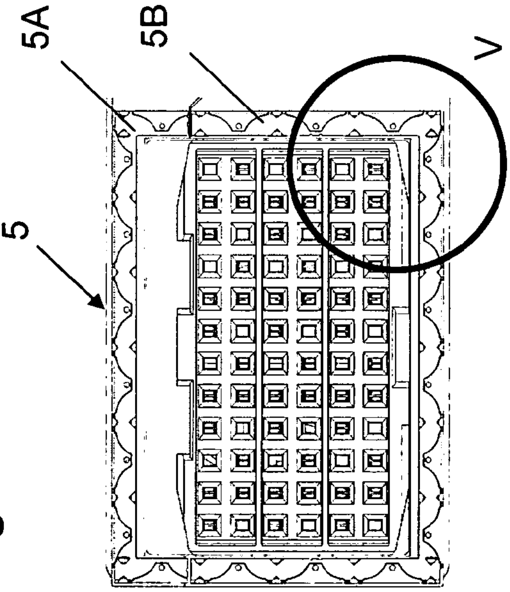

Fig. 3B

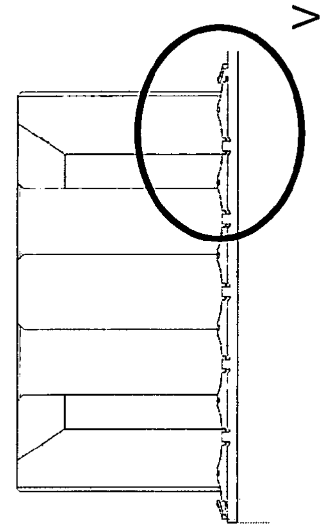

Fig. 4

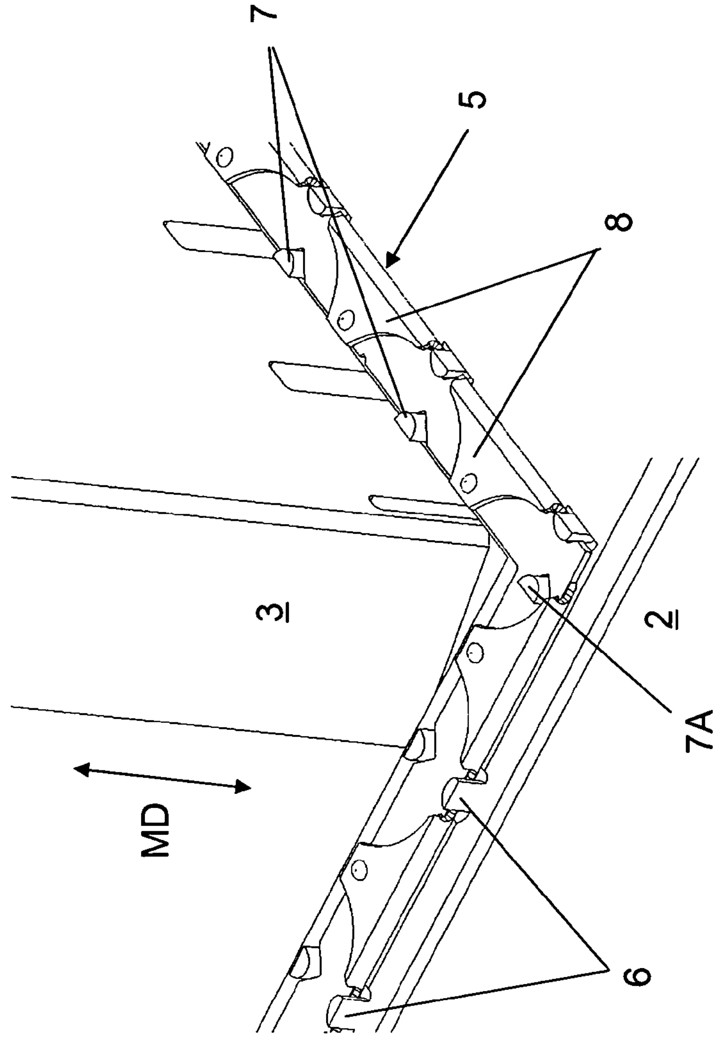

Fig. 5

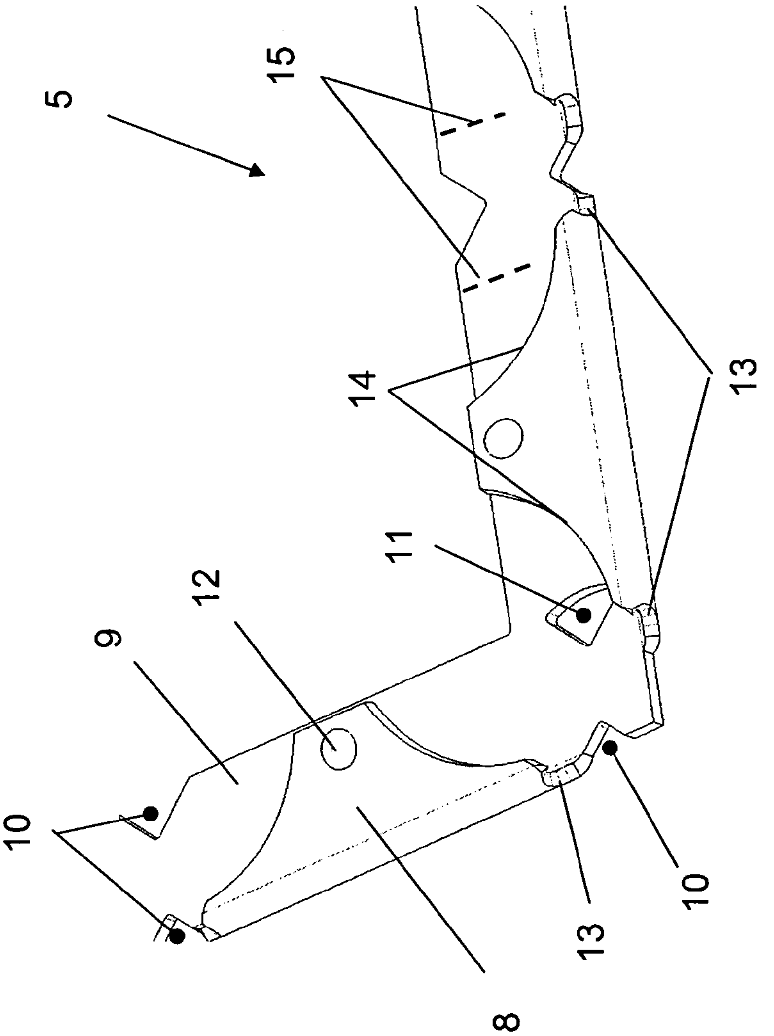

Fig. 6C

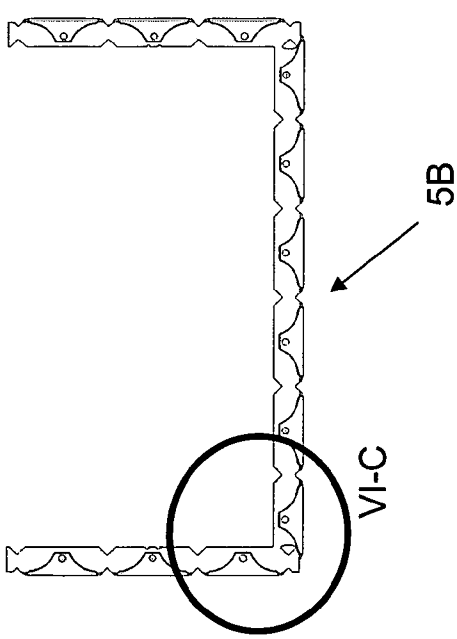

Fig. 6A

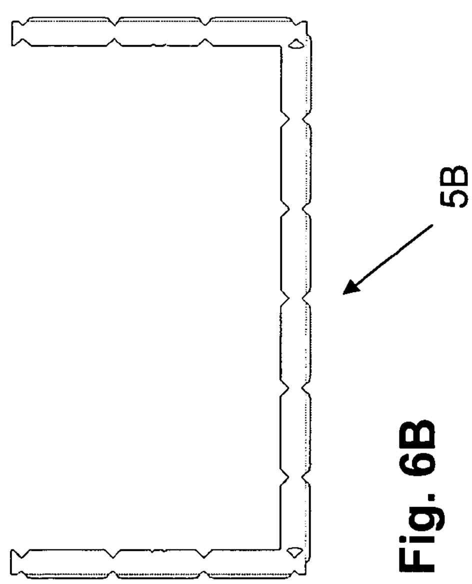

Fig. 6B

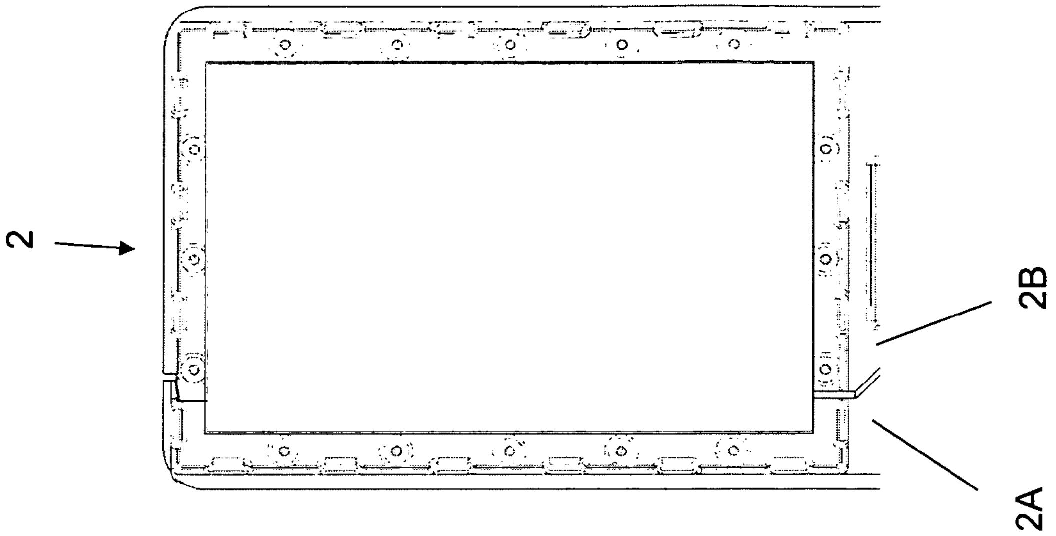

Fig. 8

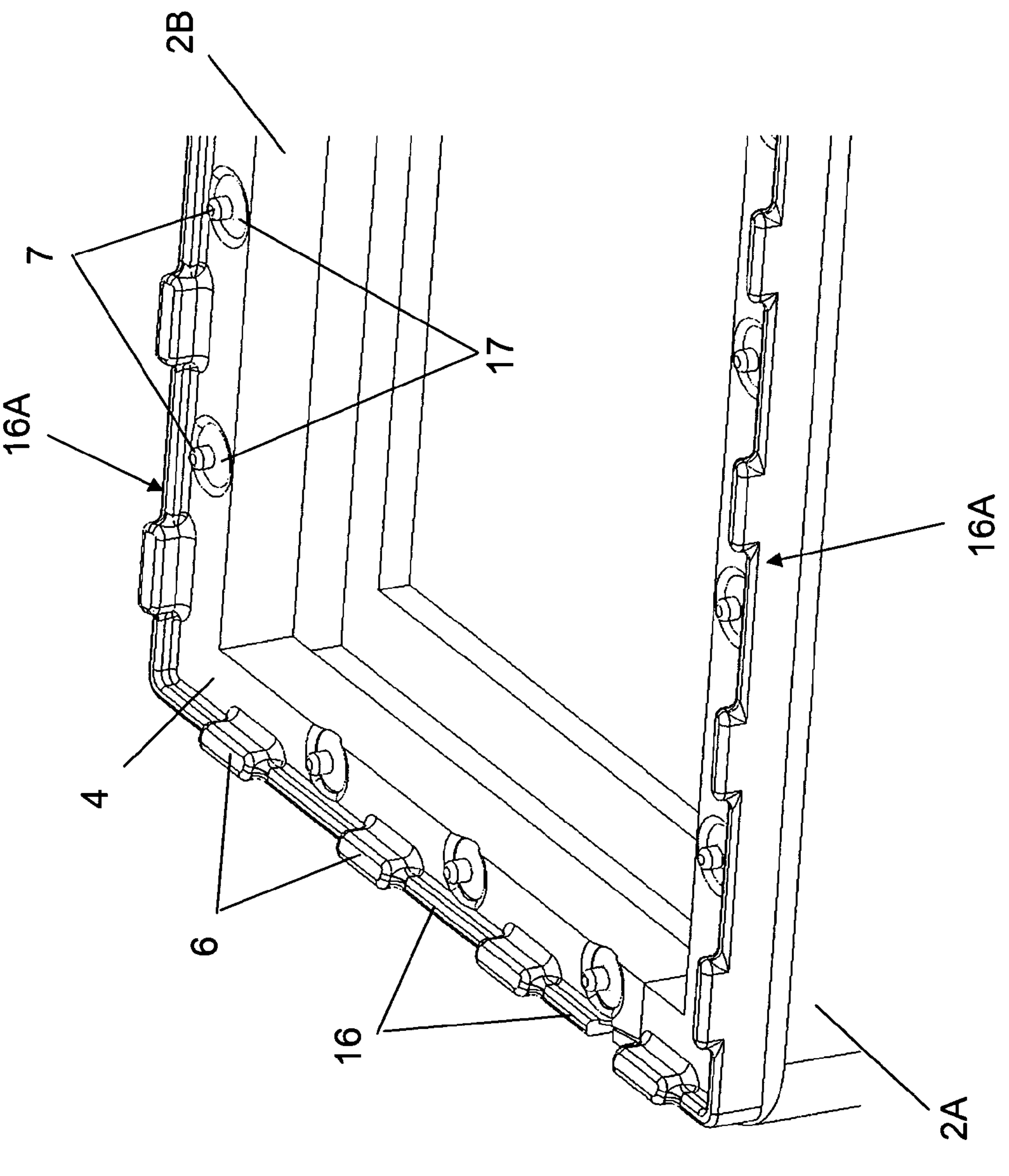

Fig. 7

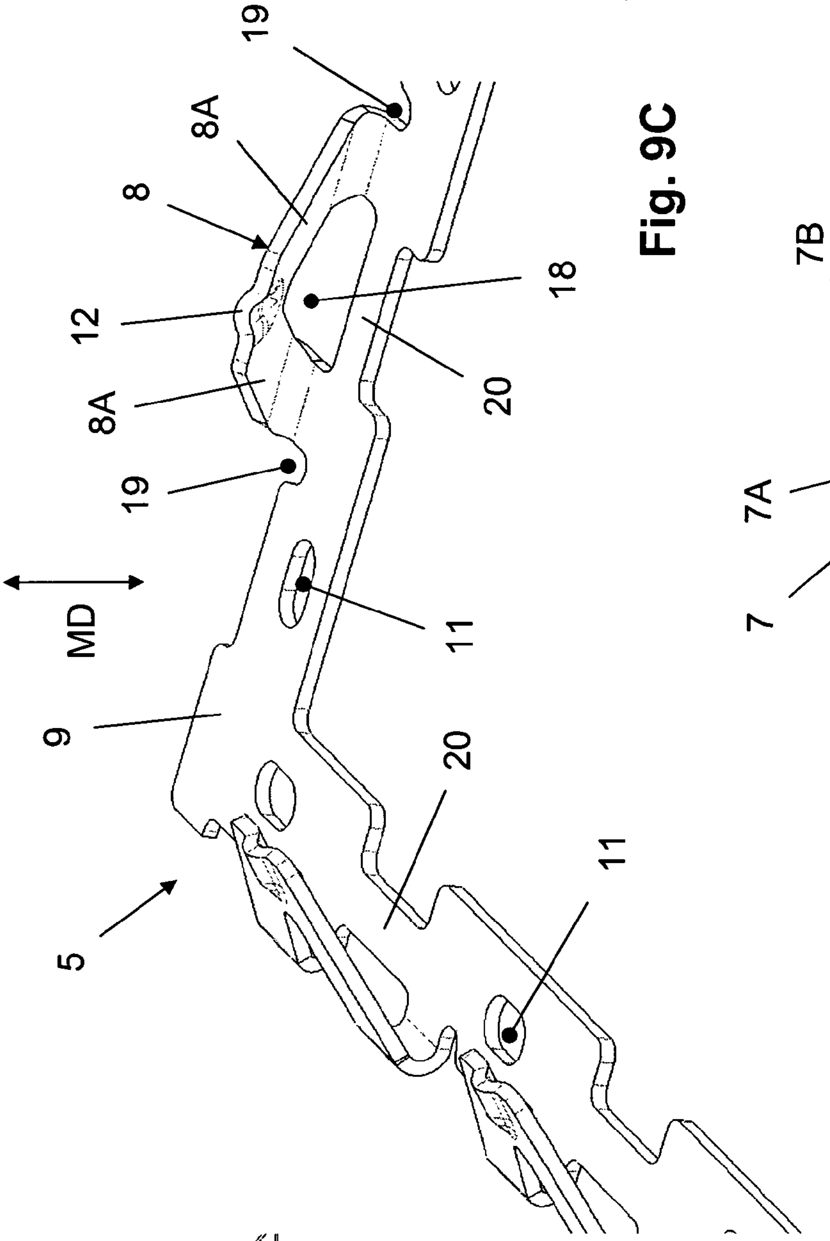

Fig. 9C

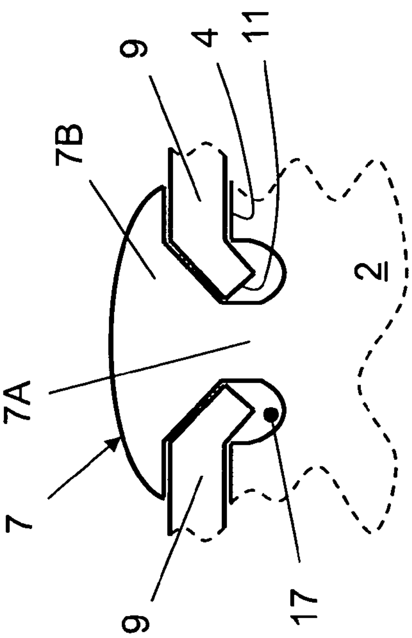

Fig. 10

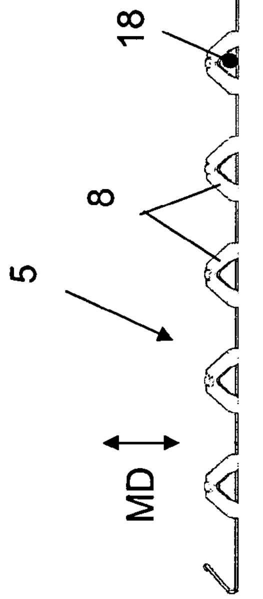

Fig. 9A

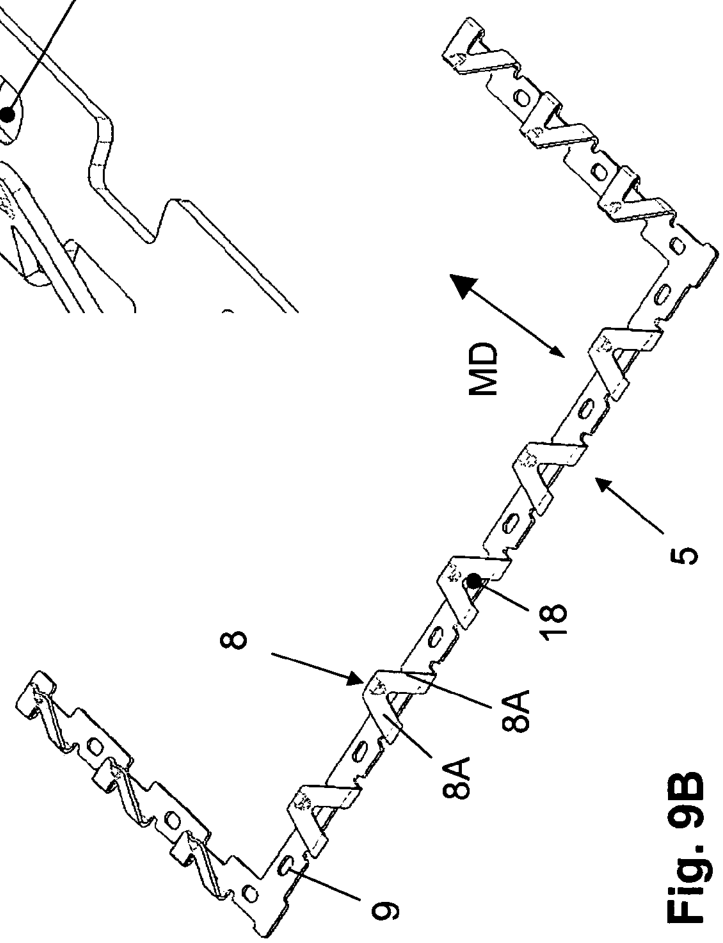

Fig. 9B

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2008/067801

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01R13/658

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.
A	US 2006/264104 A1 (OLSON STANLEY W [US] ET AL) 23 November 2006 (2006-11-23) paragraph [0053] -----	1,14,15

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

☒ See patent family annex.

* Special categories of cited documents :

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

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"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

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 February 2009	26/02/2009

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Bertin, Michel

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2008/067801

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2006264104 A1	23-11-2006	NONE	