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(54) CUTTING CONTACT AND ELECTRICAL CONNECTOR FOR CONTACTING AN INSULATED WIRE THROUGH INSULATION

SCHNEIDKONTAKT UND ELEKTRISCHER VERBINDER ZUR KONTAKTIERUNG EINES ISOLIERTEN DRAHTES DURCH ISOLATION

CONTACT TRANCHANT ET CONNECTEUR ÉLECTRIQUE POUR CONTACTER UN FIL ISOLÉ PAR ISOLATION

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(73) Proprietor: **TE Connectivity Italia S.r.l.**
10093 Collegno (TO) (IT)

(72) Inventor: **Chiarelli, Davide**
10098 Rivoli (IT)

(74) Representative: **Grünecker Patent- und Rechtsanwälte**
PartG mbB
Leopoldstraße 4
80802 München (DE)

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Description

[0001] The invention relates to a cutting contact, such as an insulation displacement contact or piercing contact, for contacting an insulated wire through its insulation, the cutting contact comprising a plurality of blades which are arranged beside one another in a lateral direction and which protrude from a base in an extension direction which is perpendicular to the lateral direction, each blade having a slanted surface, the slanted surface extending from a free end of the blade towards the base and facing towards a passage for receiving the wire, the passage extending between the blades in the lateral direction. The invention further relates to an electrical connector for contacting an insulated wire through its insulation.

[0002] Cutting contacts which are used in electronics are known in the art. One prior art solution of such cutting contacts are insulation displacement contacts (IDC-contacts) which cut into an insulation of a wire from two sides by means of a fork-shaped connection member. Such IDC-contacts may damage the electrically conductive core of the wire and furthermore require dimensions of the receptacle for the wire and the IDC-contact which are larger than the wire diameter itself. A second prior art solution are piercing connectors, which comprise blades that are pushed through the insulation of a wire and into an electrically conductive core of the wire, wherein the core preferably comprises multiple wire strands.

[0003] Known insulation displacement contacts (IDC) and connectors using such are for instance shown in US 5,800,187 A, US 3,816,818 A or EP 0 437 782 A2. Those are for instance applied to connection strips for high-data rate lines and concern a shielding thereof, to flat cable connectors, wherein the IDCs are adapted to shear-off an outer portion of an inner cable, or to a clamping portion for connecting a card edge, respectively.

[0004] An obvious drawback of IDC-connectors is their large footprint and low fill factor, i.e. the area of the wires in relation to the area necessary for contacting them. A further disadvantage of known piercing connectors is the low stability and reliability of the connections they provide.

[0005] For both power and signal applications, a high piercing connection stability and piercing connection reliability is necessary.

[0006] An aspect of the present invention is therefore to provide a cutting contact and an electrical connector having a smaller footprint and a higher fill factor.

[0007] The above mentioned problems are solved by a cutting contact according to claim 1.

[0008] The electrical connector mentioned in the beginning solves the above problems by comprising at least one wire receptacle for receiving the insulated wire, and at lest one cutting contact according to the invention, wherein the blades protrude into the wire receptacle and the passage extends at least partially parallel to the wire receptacle of the electrical connector towards an opening of the wire receptacle.

[0009] The inventive cutting contact and the inventive electrical connector thus have the advantage that during piercing of the insulator and the core of the wire, an asymmetric force is exerted onto the core of the wire, in particular on a single strand or a plurality of strands of the wire core, such that, compared to solutions of the art, an increased contact pressure between the core of the wire and the slanted surface is obtained. This increased contact pressure results in an improved piercing connection stability and piercing connection reliability.

[0010] The inventive cutting contact and inventive electrical connector may be improved by additional technical features as given in further specific embodiments, which will be described in the following. Technical features of the specific embodiments may be arbitrarily combined with each other or omitted, if the technical effect obtained by the omitted technical feature is not essential to the present invention.

[0011] The inventive cutting contact may for instance comprise in particular three blades which are arranged beside one another in a lateral direction. The cutting contact may be a stamped sheet metal part, wherein the lateral direction as well as the extension direction may preferably be parallel to the sheet metal part, in particular parallel to the surface of the original sheet metal and the cutting contact stamped from the original sheet metal. The surface of the sheet metal is to be understood as the upper or lower surface of the plate of metal and does not relate to the (smaller) side surface of the edge of the plate. The slanted surface is to be understood as a tilted or oblique surface which is preferably a flat surface. In certain embodiments the slanted surface may be additionally curved.

[0012] The slanted surface is therefore not limited to an even plane but may comprise any arbitrary combination of concave, convex or differently shaped surfaces. Thus, adjacent blades may comprise a concave surface, such that the core of the wire may be received in the passage between the blades as it would be gripped by a pair of pliers. In another embodiment, adjacent blades may comprise a convex slanted surface. It is also conceivable that any combination of convex and concave slanted surfaces may be provided with a further embodiment of the inventive cutting contact. The free end of the blade is preferably located further in the extension direction than the base of the blade. The passage for receiving the wire is to be understood as a volume which may be partially limited by the slanted surfaces. Said passage may in particular be accessible from only one side, in particular along a direction opposite the extension direction.

[0013] The asymmetric arrangement of the blades may in particular be understood as an asymmetry of a projection of the blade in the lateral direction. In such a projection the blade is asymmetric with respect to the extension direction. Each blade may, however, show symmetry with respect to a symmetry axis. Such a symmetry axis does not coincide with the extension direction and is oriented

under an angle to a central plane which is defined by the lateral direction and the extension direction, i.e. in particular oriented under an angle to the sheet metal from which the cutting contact may be stamped. The invention is not limited to cutting contacts produced by stamping a sheet metal.

[0014] The slanted surfaces of at least two blades may face towards opposing directions.

[0015] This embodiment of the invention has the advantage that the slanted surfaces, which face into opposite directions, exert a force on the core of the wire, in particular the strands of the wire, which force is directed into different directions. Consequently, fastening and fixing of the wire with respect to the cutting contact and/or the electrical connector may be improved. This results in a more stable electrical connection.

[0016] In a corresponding electrical connector, such an embodiment of the cutting contact helps to center the wire received in the at least one wire receptacle. The wire is therefore not dislocated in the wire receptacle to a side of the wire receptacle. Such a corresponding electrical connector consequently does not require additional supporting or strengthening structures which support a cable which is pushed to one side of the wire receptacle.

[0017] With respect to the cutting contact, the central plane is preferably located centered to the base with respect to the thickness of the cutting contact. In a corresponding electrical connector, the cutting contact is preferably received in the piercing receptacle such that the central plane of the cutting contact is centered with respect to the piercing receptacle and with respect to the wire receptacle. The wire receptacle for one single wire may be asymmetric as well, e.g. if a flat flexible cable or the like is used, wherein wire receptacles for adjacent wire portions of the flat flexible cable are connected to each other as said adjacent wire portions are attached to each other by means of a monolithic insulation. In this case, the center of the wire receptacle is to be understood as the center of the core of the wire portion if such a flat flexible cable is received in the wire receptacles.

[0018] In a further embodiment, two subsets of blades may be defined, wherein each subset comprises at least one blade. The entirety of blades of one subset may define a first cutting plane defined by the edges of the blades of the corresponding subset and the extension direction, wherein a second cutting plane related to the second subset of blades may be defined similarly. The first and second cutting plane may in particular be parallel to each other and may be located on different sides of the central plane.

[0019] In a further embodiment of the inventive cutting contact, the blades are located on different sides of the passage in an alternating manner. This is to be understood as an arrangement of adjacent blades which alternately face in opposite directions towards the passage. In a very specific embodiment, a first slanted surface faces in a first direction, a second slanted surface faces in a second direction which is essentially oriented opposite to the first direction, and a third slanted surface faces the first direction. If a fourth blade is provided, the slanted surface of said fourth blade faces in the second direction.

[0020] With the previously described embodiments, comprising blades with slanted surfaces facing in different directions, an improved fixation of the core of the wire is obtained.

[0021] Apart from this advantage, the electrical connection between the cutting contact and the core of the wire, in particular the strands of the wire, is further improved by the fact that the course of the wire is displaced to the corresponding side of the previously defined central plane.

[0022] This displacement of the wire in different directions results in a deflected path of the core, respectively the wire strands. Such a deflected path, whose path length is increased compared to a straight oriented wire, results in a pulling tension exerted or acting on the core of the wire.

[0023] This pulling tension additionally increases the contact pressure between the core of the wire (or the wire strands) and the slanted surfaces. Depending on the configuration of the slanted surfaces, i.e. the direction in which they face, the deflected path of the core of the wire may comprise an S-shape, a double-S-shape or a continuous shape similar to a sinusoidal curve.

[0024] Independent of the particular shape of the deflected path applied to the core of the wire, a pulling tension of the core of the wire is introduced by means of the slanted surfaces.

[0025] In a further embodiment of the inventive cutting contact, the width of a blade may be substantially constant in the lateral direction. It may be substantially constant in particular up to the free end. In other words, the blade may not show a taper if regarded from a direction perpendicular to the lateral direction.

[0026] In a further embodiment of the inventive cutting contact, a blade may be provided with a back surface which faces in the direction opposite the slanted surface, the back surface being less inclined relative to the extension direction than the corresponding slanted surface.

[0027] The back surfaces of the plurality of blades may thus all face away from the passage. As said back surfaces are less inclined than the slanted surfaces, the volume necessary for receiving the cutting contact may essentially be limited to the dimensions of the cutting contact, in particular to the thickness of the sheet metal, if such a sheet metal is used for stamping the cutting contact.

[0028] In another advantageous embodiment of the inventive cutting contact, the back surface of a blade is oriented essentially parallel to the corresponding base, wherein the back surface is spaced apart from the corresponding base away from the passage.

[0029] Such an embodiment has the advantage that wires having a core which is thicker than the thickness of the cutting contact, in particular the thickness of its base, may also be contacted. The blades of such an em-

bodiment are therefore positioned further away from each other, such that the size of the passage is increased in order to allow larger wires to be contacted. It may be further advantageous if the back surface of a blade, preferably of some blades, more preferably of each blade is flush with the corresponding base, in particular flush with the back surface of the base. The back surface may thus preferably be flush with the surface of the sheet metal from which the cutting contact may have been stamped. Independent of the fabrication method, the advantage of such an embodiment, in which the back surface or surfaces of the blade or blades, respectively, are flush with the base, is the reduced space necessary for receiving this embodiment of the inventive cutting contact.

[0030] In a corresponding inventive electrical connector, the piercing receptacle may thus also be downsized in a thickness direction for receiving the at least one size-reduced cutting contact. Consequently, the form factor of an electrical connector receiving such a cutting contact may be further reduced.

[0031] Preferably, the distance between two of such flush surfaces, whose slanted surfaces face in opposite directions, is smaller than the diameter of the core of the wire. In further different embodiments, this distance may equal the diameter of the core of the wire, wherein a larger distance may result in improper contacting of the core of the wire as only the insulation may be pierced and the core of the wire may not be reached by the blade.

[0032] In a further embodiment of the inventive cutting contact, a blade further comprises side faces which face in the lateral direction, which extend parallel to the extension direction and which are not slanted with respect to the extension direction.

[0033] The inventive cutting contact may be further improved in that at the base, the blades may be separated from one another. Such a separation may be provided by a curved cutout, a rectangular cutout or a triangular cutout.

[0034] Additionally, further shapes of the cutout are conceivable. The cutout may constitute a stop of the cutting contact, i.e. in the form of a stop surface. At such a stop or stop surface, the insertion of the blades into a wire may be limited when the wire is received in the wire receptacle of the electrical connector and the cutting contact is pushed into the wire receptacle and pierces through the insulation of the wire for contacting its core. Consequently, a damage of the edge of the blades by contacting the opposite side of the wire receptacle may be prevented, as the cutout between the blades abuts the insulation and consequently hinders further insertion of the blades into the wire. Alternatively or additionally, a stop or stop surface may be provided at one or both ends of the end of the row of blades.

[0035] The stop at one or both ends of the row of blades may also be applied as a stop for limiting the insertion of the cutting contact in the piercing receptacle.

[0036] In another embodiment the electrical connector may further comprise a first body part and a second body part which together form the wire receptacle, wherein the second body part is arranged opposite the blades and adapted to be mounted to the first body part by being pushed towards the blades.

[0037] In particular in an embodiment of the inventive electrical connector in which the electrical connector comprises a first body part and a second body part, which is attachable to the first body part, wherein at least in the assembled state, the first body part and second body part form the at least one wire receptacle, such a stop may be applied to indicate a final insertion position of the cutting contact in the corresponding piercing receptacle. The stop may therefore comprise two stop surfaces, wherein a first stop surface may face towards the wire receptacle and may be adapted to stop further insertion of the blades into the wire and wherein a second stop surface faces in and opposite the direction away from the first stop surface and may be adapted to abut a counter stop element or counter stop surface provided in the electrical connector for limiting the insertion of the cutting contact into the piercing receptacle of the electrical connector.

[0038] In another embodiment of the inventive cutting contact, the separation of blades between one another in the lateral direction may be as large as the width of the blades in the lateral direction. Such an embodiment may assure that the deflected path of the core of the wire, respectively the wire strands follows a smooth curve and does not show steep kinks or bends which may result in an unintended cutting of the core of the wire.

[0039] In a further embodiment of the inventive cutting contact, the free end of the blades comprises an edge which extends in the lateral direction. The edge may in particular extend in the lateral direction between the side faces and may preferably be a straight edge.

[0040] Ideally, the edge is to be understood as a sharp edge. In reality, however, the edge may be rounded as, due to processing, the metal does not generate perfectly sharp edges, but small, rounded edges.

[0041] Blades with fabrication tolerances are therefore intended to be covered by this embodiment of the cutting contact as well.

[0042] The orientation of the edge in the lateral direction makes sure that the entire edge of the blade may pierce the insulation as well as the wire strands. Consequently, a uniform pressure may be applied to the core of the wire, and an unintended cutting, in particular of individual strands of the core, may be prevented.

[0043] At the edge, the slanted surface of a blade and the back surface of a blade may be connected in a further embodiment of the inventive cutting contact. The slanted surface and the back surface approach each other if seen from the base towards the edge, wherein they finally touch each other forming the edge of the blade.

[0044] The cross-section of a blade cut along a plane perpendicular to the lateral direction of another embodiment of the inventive cutting contact may be asymmetric and triangular with respect to the extension direction. If

a cut along a plane being parallel to the extension direction and perpendicular to the lateral direction is applied to a portion of the cutting contact comprising a blade, such an asymmetric and triangular cut of the blade is obtained. In the previously described specific embodiment in which the back surface of the blade is flush with the base, a right angled triangle may be obtained in such a cut.

[0045] In a further embodiment of the inventive cutting contact, an end of the cutting contact opposite to the blades comprises a clamping section for contacting at least one card edge contact. Such a clamping section is in particular advantageous if a card edge, e.g. the card edge of a printed circuit board (PCB), is to be connected. The corresponding card edge contact is to be understood as an electrically conductive and accessible portion, e. g. a printed circuit path extending up to the edge of said card and eventually being connected to an electrically conductive and mechanically resistant card edge contact member. The card edge contact member may in particular be suitable for repeated contacting with the corresponding clamping section of this embodiment of the inventive cutting contact.

[0046] The base, which may be plate-like, may thus be located between the blades and the clamping section.

[0047] Alternatively or additionally, further contacting means for establishing an electrical connection with the cutting contact may be provided at the end of the cutting contact opposite the blades. Essentially all possible contact interfaces known in the art may be provided at the end of the cutting contact opposite the blade. Such connection means may be embodied as crimp portions, soldering portions or even as further portions allowing contacting additional wires by means of insulation displacement or even insulation piercing. The connection means may also be embodied as an eye which may be attached to another electrical contact member by means of a screw and nut.

[0048] Different embodiments of the inventive electric connector may receive any of the specific embodiments of the previously described cutting contacts and may be improved by incorporation of further technical features which may, similarly as the technical features of the different cutting contacts previously described, be arbitrarily combined with each other or even omitted.

[0049] The electrical connector may comprise a connector housing which may be fabricated by injection molding. The cutting contact may be inserted into the housing after the molding process or may directly be encapsulated by the molding material in the molding step.

[0050] If the electrical connector comprises the first and second body part, said second body part may be produced during the same fabrication step, e.g. by injection molding and may be manually connected to the first body part. This has the advantage that both parts are attached to each other and may be separated from each other at the place of the customer, and thus decreasing the risk that one body part may get lost.

[0051] Additionally, at least one receptacle cover may be provided, which may allow covering at least one side of the at least one wire receptacle. If a plurality of wire receptacles is provided, three different cases may be distinguished; a certain number of said wire receptacles may not be used at all (no wire received) and may thus be covered on both sides by means of two receptacle covers, wherein further cable receptacles may require such a cover only on one side of the wire receptacle, such that the wire terminates in the corresponding wire receptacle. At least one or a plurality of wire receptacles may not be provided with a cover, as the wire received in such a wire receptacle may be fed through the electrical connector whilst being electrically contacted.

[0052] At least one, preferably all of the covers may be fabricated together with the housing or the second body part. Preferably, the covers are monolithically connected to the housing or the second body part. They may be produced by injection molding. This has the advantage that the customer may break away those covers which are not required only when installing the corresponding electrical connector. Such a connector is thus very flexible and versatile.

[0053] The inventive electric connector may further comprise technical features such as locking means for reversibly and/or repetitively attaching the second body part to the first body part, polarization members for determining the orientation of the electrical connector with respect to a mating electrical connector, e.g. card edge or chaining members for attaching a multitude of electrical connectors to each other for effectively providing a multitude of the inventive electrical connectors and for a possible automatization.

[0054] In the following, the inventive cutting contact and the inventive electrical connector will be described using the accompanying nine figures. The figures show specific embodiments of the present invention, wherein technical features of different embodiments shown may be arbitrarily combined with each other. In the figures, the same technical features and technical features having the same technical effect will be denoted with the same reference numeral. A repetitive description will be omitted, whereas differences between the embodiments shown will be emphasized. The described embodiments are not intended to limit the scope of the present invention which is defined by the claims.

[0055] The figures show:

Fig. 1 two embodiments of the inventive electrical connector;

Fig. 2 a cut view of the first embodiment of the inventive electrical connector of Fig. 1;

Fig. 3 a first and second embodiment of the inventive cutting contact;

Fig. 4 the first embodiment of the inventive cutting

contact in a state prior to piercing a wire in a perspective and top view;

Fig. 5 the first embodiment of the inventive cutting contact in a state after piercing eight wires in a perspective and top view;

Figs. 6 and 7 illustrations of the technical effect obtained with the inventive cutting contact in two different views;

Fig. 8 an inventive electrical connector in a preassembly state;

Figs. 9a-9c illustrations of the steps necessary to receive the second embodiment of the electrical connector of Fig. 1 from the preassembly state shown in Fig. 8;

Figs. 10a and 10b further possible embodiments of the cutting contact with differently shaped slanted surfaces; and

[0056] Fig. 11 a further embodiment of the inventive cutting contact. Fig. 1 shows an inventive electrical connector 1 in a first embodiment 3 and in a second embodiment 5. The first embodiment 3 of the electrical connector 1 is also shown in Fig. 2 in a cut view. The following information will refer to both, Fig. 1 and Fig. 2.

[0057] In both embodiments 3, 5, five wires 7 are connected to the electrical connectors 1. In the first embodiment 3 all wires 7 terminate in the electrical connector 1, wherein a non-visible wire end 9 is not accessible, as the electrical connectors provide covers 11.

[0058] The first embodiment 3 comprises five covers 11, whereas the second embodiment 5 comprises three covers 11, as two of the wires 7 applied in the second embodiment 5 are fed through the electrical connector 1, i.e. they are in a fed-through-configuration 13. The other three wires 7 are in a terminated configuration 15, which is characterized by the non-visible wire end 9 being located inside the electrical connector 1 as shown in Fig. 2.

[0059] The electrical connectors 1 comprise a connector housing 17 which is formed by a first body part 19 and a second body part 21 which are attached to each other by means of positive locking features 23 which are for instance shown in Fig. 8, Fig. 9a and 9b.

[0060] In the electrical connectors 1 a multitude of inventive cutting contacts 25 (here, five cutting contacts 25 are provided) is received in the connector housing 17. The cutting contacts 25 are merely visible in Fig. 1, whereas the cut view of Fig. 2 clearly shows one of the cutting contacts 25. The cutting contacts 25 are furthermore shown separately in the following figures.

[0061] The embodiments 3, 5 of the electrical connector 1 shown in the accompanying figures refer to a card edge connector 2, which is characterized by a clamp portion 27 and a cable receiving portion 29.

[0062] The embodiments 3, 5 of the electrical connector 1 shown in the accompanying figures are card edge connectors 2 which are characterized by a clamp portion 27 and a cable receiving portion 29.

[0063] The clamp portion 27 comprises a notch 31 which is adapted to receive a card edge 33. The card edge comprises card edge contacts 34, in particular counter contact elements 35 (only one counter contact element 35 is provided with a reference numeral in Fig. 1) which are electrically and mechanically contacted by means of two clamp legs 37 which form a clamping section 39 of the corresponding cutting contact 25.

[0064] In Fig. 2 it is shown that the cutting contact 25 is received in a piercing receptacle 41 (see also Fig. 8), wherein the clamping section 39 of the cutting contact 25 is received within the piercing receptacle 41 such that the two clamp legs 37 may be resiliently deflected along, respectively against a lateral direction 43 in order to clampingly receive a corresponding counter contact element 35 of the card edge 33.

[0065] In different embodiments of the present invention, a connecting section different than the clamping section 39 may be provided, e.g. a crimp section, a welding section and the like (not shown).

[0066] Fig. 2 furthermore shows that the cutting contacts 25 comprise three blades 45 which extend from a base 47 in an extension direction 49. The cutting contacts 25 and in particular their blades 45 will be described in more detail in the following figures. The base 47 is indicated for the three blades 45, wherein an entire plate-like area 48 of the cutting contact 25 may be considered as a base 47. The clamping section 39 is formed at an end 40 opposite the blades 45 of the cutting contact 25.

[0067] Fig. 2 furthermore shows that the cutting contact 25 comprises two stop surfaces 51 which abut a corresponding counter stop surface 53 of the connector housing 17.

[0068] In an assembled state of the electrical connector 1 of Fig. 2, the blades 45 of the cutting contacts 25 are pierced through insulation 55 into a core 57 of the corresponding wire 7. The electrical contact between the cutting contact 25 and the wire 7 occurs in a contact area 59.

[0069] Fig. 3 shows a first 3 and a second embodiment 5 of the inventive cutting contact 25, wherein the second embodiment 5 of the cutting contact 25 is solely shown in a circle 61 showing a region which is different between the first 3 and the second embodiment 5 of the cutting contact 25.

[0070] The cutting contact of the embodiment shown in Fig. 3 is a stamped sheet metal part 63 comprising the previously mentioned clamping section 39, a contact section 65 which is shown in the previous figure in the contact area 59 and a fastening section 67 which is arranged in between the clamping section 39 and the contact section 65.

[0071] All three sections 39, 65, 67 are embodied mon-

olithically and are flush with each other. The clamping section 39 comprises the two clamp legs 37 and the fastening section 67 is embodied as a plate-like area having a center hole 69 which may be used as a fastening hole in certain embodiments of the electrical connector 1 (which are not shown). Furthermore, the center hole may reduce the weight of the cutting contact 25 without decreasing its stability.

[0072] The cutting contact 25 comprises a plurality of blades 45 which are arranged beside one another in the lateral direction 43. The blades 45 extend from the base 47 in the extension direction 49, wherein the lateral direction 43 is perpendicular to the extending direction 49.

[0073] Each of the blades 45 comprises a slanted surface 71, wherein in Fig. 3 only one slanted surface 71 (the slanted surface 71 of the central blade 45) is visible.

[0074] Each of the slanted surfaces 71 extends from a free end 73 of the blade 45 (the free and 73 is only shown for one blade 45) towards the base 47.

[0075] A passage 75 extends between the blades 45 in the lateral direction 43. The passage 75 is best seen in the top view of Fig. 4 (lower panel).

[0076] Fig. 4 shows the first embodiment 3 of the cutting contact 25 in a state prior to piercing a wire 7 in a perspective and top view. It is to be noted that the cutting contact 25 shown in Fig. 4 is rotated by 180° around the extension direction 49, such that two slanted surfaces 71 are visible in the perspective view.

[0077] The lower panel, showing the top view of the cutting contact 25 and the cable 7, shows the lateral direction 43 and the extension direction 49 which define a central plane 77 which extends into and out of the drawing plane and which is indicated by a dashed and dotted line and which is indicated by a shading in the upper panel showing the perspective view. Both, the lateral direction 43 and the extension direction 49, lie within the plane 77.

[0078] The blades 45 are located on different sides of the central plane 77 and thus also on different sides of the passage 75. Each of the blades 45 is asymmetrically tapered towards its respective free end 73 with respect to the extension direction 49 and the central plane 77, respectively.

[0079] Fig. 4 also shows that two subsets, a first subset 79 and a second subset 81 of blades 45 may be defined, wherein the first subset 79 comprises two blades 45 and the second subset 81 comprises one blade 45.

[0080] Within each of the subsets 79, 81 edges 83 define a first cutting plane 79a and a second cutting plane 81a which are flush with a first element surface 85 and a second element surface 87. Furthermore, back surfaces 101 of the blades 45 are also flush with one of the element surface 85 or 87, respectively.

[0081] Fig. 4 further shows that the first 79a and second cutting plane 81a are spaced apart by a distance 89 which corresponds to the metal sheet thickness 91. The distance 89 is smaller than a diameter 93 of the core 57 of the wire 7 such that upon movement of the cutting contact 25 into extension direction 49, the blades 45 will pierce through the insulation 55 and subsequently pierce into the core 57 of the wire 7.

[0082] A pierced state 95 of the cutting contact 25 is shown in Fig. 5 in a perspective and a top view. During insertion of the blades 45 into the core 57, the core 57 of the wire 7 is at least partially received in the passage 75 and the corresponding slanted surfaces 71 exert a force onto the core 57. The core 57 may comprise wire strands (not shown), wherein the aforementioned force may be exerted onto a plurality of wire strands in such an embodiment. In the following, the description will be given related to the core 57, but may as well be applied to a plurality of wire strands.

[0083] The first subset of blades 79 exerts a first force 97 onto the core 57 and the second subset of blades 81 exerts a second force 99 onto the core 57 which is directed opposite to the first force 97. It is to be noted that the slanted surfaces 71 actually exerts a force which is oriented perpendicularly to the corresponding slanted surface 71. In the figure, however, only those components of the force are considered which are oriented perpendicular to the central plane 77, in other words, force components exerted into the extension direction 49 are not considered in this explanation.

[0084] In Fig. 5, two side faces 123 of the blades 45 are visible. Those side faces 123 face in or against the lateral direction 43 and extend essentially parallel to the extension direction 49.

[0085] The first 97 and second force 99 are illustrated with the same length, i.e. absolute value in Fig. 5. In different embodiments, the absolute values of 97, 99 may be different. However, all embodiments have in common that the directions into which the forces 97 and 99 are exerted onto the core 57 are oriented opposite to each other.

[0086] The technical effect which is obtained with the inventive cutting contact 25 is illustrated in Figs. 6 and 7. In these figures, the slanted surfaces 71 of the blades 45 are shaded and a single strand 103, respectively a plurality of strands 105 is located in the passage 75 which extends between the blades 45 in the lateral direction 43. Due to the first 97 and second force 99, which are exerted on the strand 103 or the plurality of strands 105 in opposing directions (see also Fig. 5), the strand 103 or the plurality of strands 105, a deflected path 107 is obtained which results in a tensioning force 109 which acts on the strand 103 or the plurality of strands 105 from both sides towards the arrangement of blades 45.

[0087] Due to the tensioning force 109, the strand 103 or plurality of strands 105 are abutting the corresponding slanted surface 71 under an increased contact force 111 as compared to solutions of the art. The contact force 111 is indicated in Fig. 7. It is to be noted that the contact force 111 is exerted essentially perpendicular to the corresponding slanted surface 71.

[0088] From the top view shown in Fig. 7 it can be clearly seen that a width 46 of a blade 45 is smaller than a separation 50 of the blades 45. Furthermore, comparing

the other figures, it is to be noted that said width 46 of the blade 45 is essentially constant in the lateral direction 43.

[0089] Fig. 8 shows an inventive electrical connector 1 in a preassembly state 113.

[0090] The electrical connector 1 comprises the first body part 19 and the second body part 21 which are connected to each other monolithically.

[0091] The first body part 19, in particular its five piercing receptacles 41 receive five inventive cutting contacts 25, wherein the passage 75 which extends in between the blades 45 is provided in a portion of the electrical connector 1, which, in an assembled state 115 (see Figs. 1, 2 and 9c), forms a wire receptacle 117 for a wire to be contacted. Each wire receptacle 117 comprises two openings 125, wherein the openings 125 may be closed by the corresponding cover 11 (see Figs. 9a and 9c).

[0092] In Figs. 9a-9c the steps necessary to receive the second embodiment of the electrical connector of Fig. 1 from the electric connector 1 in the preassembly state 113 of Fig. 8 is shown.

[0093] In a first step the second body part 21 is removed from the first body part 19, when this step is not shown in the figures. Second, depending on the desired configuration, i.e. whether the wire 7 to be contacted shall be fed through the electrical connector 1 or whether the wire 7 shall terminate in the electrical connector 1, the corresponding covers 11 may be removed from the second body part 21.

[0094] Fig. 9a clearly shows that the second body part 21 provides a portion of the wire receptacle 117 in the form of a cylindrical wall 119, which is cut along its extension.

[0095] In the next step, the wires 7 are aligned with respect to the first body part 19 and the second body part 21 and are at least partially received in the corresponding cylindrical wall 119 and in particular between separation walls 121 formed on the second body part 21.

[0096] The first body part 19 and a second body part 21 may be attached to each other by means of the positive locking features 23, wherein during the step of attaching both parts 19, 21, the blades 45 pierce through the insulation 55 of the wire 7 and a core 57 of the wire 7 is received in the passage 75 formed by the blades 45.

[0097] In the assembled state 115 all five wires 7 are contacted by means of the blades 45 and the clamping section 39 allows for establishing an electrical connection between further elements, e.g. the card edge 33 shown in Fig. 1.

[0098] In Figs. 10a, 10b and 11, different embodiments of the contact section 65 of the inventive cutting contact 25 are shown.

[0099] If Figs. 10a and 10b are considered, the blades 45 of the inventive embodiments shown differ from the previous embodiments in that either a concave slanted surface 72a or a convex slanted surface 72b are provided. In the different embodiments shown in Fig. 10a and Fig. 10a, the passages 75 for receiving the wire 7 have a different shape and size. The width 46 of the passage 75, however, corresponds to the metal sheet thickness 91.

[0100] Fig. 11 shows a further embodiment of the inventive cutting contact 25, wherein in this embodiment, the back surfaces 101 of the blades 45 are spaced apart by a spacing distance 127 from the base 47, wherein the back surfaces 101 are oriented essentially parallel to the base 47. The back surfaces 101 are spaced apart from the base 47 away from the passage 75. This embodiment has the advantage that an increased width 46, which is larger than the metal sheet thickness 91, is obtained. Thus, wires 7 with core diameters that are larger than the metal sheet thickness may be pierced and contacted.

Reference Numerals

[0101]

1	electrical connector
2	card edge connector
3	first embodiment
5	second embodiment
7	wire
9	wire end
11	cover
13	fed-through configuration
15	terminated configuration
17	connector housing
19	first body part
21	second body part
23	positive locking feature
25	cutting contact
27	clamp portion
29	cable receiving portion
31	notch
33	card edge
34	card edge contact
35	counter contact element
37	clamp leg
39	clamping section
40	end
41	piercing receptacle
43	lateral direction
45	blade
46	width
47	base
48	plate-like area
49	extension direction
50	separation
51	stop surface
53	counter stop surface
55	insulation
57	core
59	contact area
61	circle
63	stamped sheet metal part
65	contact section

67	fastening section
69	center hole
71	slanted surface
72a	concave slanted surface
72b	convex slanted surface
73	free end
75	passage
77	central plane
79	first subset
79a	first cutting plane
81	second subset
81a	second cutting plane
83	edge
85	first element surface
87	second element surface
89	distance
91	metal sheet thickness
93	diameter
95	pierced state
97	first force
99	second force
101	back surface
103	strand
105	plurality of strands
107	deflected path
109	tensioning force
111	contact force
113	preassembly state
115	assembled state
117	wire receptacle
119	cylindrical wall
121	separation wall
123	side faces
125	opening
127	spacing distance

Claims

1. Cutting contact (25) for contacting an insulated wire (7) through its insulation (55), the cutting contact (25) comprising a plurality of blades (45) which are arranged beside one another in a lateral direction (43) and which protrude from a base (47) in an extension direction (49) which is perpendicular to the lateral direction (43), each blade (45) having a slanted surface (71), the slanted surface (71) extending from a free end (73) of the blade (45) towards the base (47) and facing towards a passage (75) for receiving the wire, the passage (75) extending between the blades (45) in the lateral direction (43), wherein the blades (45) taper asymmetrically towards their respective free ends (73) with respect to the extension direction (49), **characterized in that** the slanted surfaces (71) of at least two blades (45) face towards the passage (75) from different sides of a central plane (77) which is defined by the lateral direction (43) and the extension direction (49).

2. Cutting contact (25) according to claim 1, **characterized in that** the blades (45) are located on different sides of the passage (75) in an alternating manner.

3. Cutting contact (25) according to any of claims 1 or 2, **characterized in that** the width (46) of a blade (45) is substantially constant in the lateral direction (43).

4. Cutting contact (25) according to any of claims 1 to 3, **characterized in that** a blade (45) is provided with a back surface (101) which faces in the direction opposite the slanted surface (71), the back surface (101) being less inclined relative to the extension direction (49) than the corresponding slanted surface (71).

5. Cutting contact (25) according to claim 4, **characterized in that** the back surface (101) of a blade (45) is oriented essentially parallel to the base (47), wherein the back surface (101) is spaced apart from the corresponding base (47) away from the passage (75).

6. Cutting contact (25) according to claim 4, **characterized in that** the back surface (101) of a blade (45) is flush with the base (47).

7. Cutting contact (25) according to any one of claims 1 to 6, **characterized in that** a blade (45) further comprises side faces (123) which face in the lateral direction (43), which extend parallel to the extension direction (49) and which are not slanted.

8. Cutting contact (25) according to any one of claims 1 to 7, **characterized in that** at the base (47), the blades (45) are separated from one another.

9. Cutting contact (25) according to claim 8, **characterized in that** the separation (50) of blades (45) between one another in the lateral direction (43) is at least as large as the width (46) of the blades (45) in the lateral direction (43).

10. Cutting contact (25) according to any one of claims 1 to 9, **characterized in that** the free end (73) of the blades (45) comprises an edge (83) which extends in the lateral direction (43).

11. Cutting contact (25) according to claim 10, **characterized in that,** at the edge (83), the slanted surface (71) of a blade (45) and a back surface (101) of a blade (45) are connected.

12. Cutting contact (25) according to any one of claims 1 to 11, **characterized in that** in the lateral direction (43), the cross-section of a blade (45) cut along a

plane perpendicular to the lateral direction (43) is asymmetric and triangular with respect to the extension direction (49).

13. Cutting contact (25) according to any one of claims 1 to 12, **characterized in that** an end (40) of the cutting contact (25) opposite the blades (45) comprises a clamping section (39) for contacting at least one card edge contact (34).

14. Electrical connector (1) for contacting an insulated wire (7) through its insulation (55), wherein the electrical connector (1) comprises at least one cutting contact (25) according to any one of claims 1 to 13 and a wire receptacle (117), and wherein the blades (45) protrude into the wire receptacle (117) and the passage (75) extends at least partially parallel to the wire receptacle (117) of the electrical connector (1) towards an opening (125) of the wire receptacle (117).

15. Electrical connector (1) according to claim 14, further comprising a first body part (19) and a second body part (21) which together form the wire receptacle (117) and wherein the second body part (21) is arranged opposite the blades (45) and adapted to be mounted to the first body part (19) by being pushed towards the blades (45).

Patentansprüche

1. Schneidkontakt (25) zum Herstellen von Kontakt mit einem isolierten Draht (7) durch dessen Isolierung (55) hindurch, wobei der Schneidkontakt (25) eine Vielzahl von Schneiden (45) umfasst, die in einer Querrichtung (43) nebeneinander angeordnet sind und die von einer Basis (47) in einer Ausdehnungsrichtung (49) vorstehen, die senkrecht zu der Querrichtung (43) ist, wobei jede Schneide (45) eine abgeschrägte Fläche (71) aufweist, sich die abgeschrägte Fläche (71) von einem freien Ende (73) der Schneide (45) zu der Basis (47) hin erstreckt und einem Durchlass (75) zum Aufnehmen des Drahtes zugewandt ist, der Durchlass (75) sich zwischen den Schneiden (45) in der Querrichtung (43) erstreckt, die Schneiden (45) sich asymmetrisch auf ihre jeweiligen freien Enden (73) zu in Bezug auf die Ausdehnungsrichtung (49) verjüngen, **dadurch gekennzeichnet, dass** die abgeschrägten Flächen (71) von wenigstens zwei Schneiden (45) dem Durchlass (75) von verschiedenen Seiten einer Mittelebene (77) aus zugewandt sind, die durch die Querrichtung (43) und die Ausdehnungsrichtung (49) definiert wird.

2. Schneidkontakt (25) nach Anspruch 1, **dadurch gekennzeichnet, dass** die Schneiden (45) abwechselnd an verschiedenen Seiten des Durchlasses (75) angeordnet sind.

3. Schneidkontakt (25) nach einem der Ansprüche 1 oder 2, **dadurch gekennzeichnet, dass** die Breite (46) einer Schneide (45) in der Querrichtung (43) im Wesentlichen konstant ist.

4. Schneidkontakt (25) nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** eine Schneide (45) mit einer Rückseite (101) versehen ist, die in die der abgeschrägten Fläche (71) entgegengesetzte Richtung weist, wobei die Rückseite (101) relativ zu der Ausdehnungsrichtung (49) weniger stark geneigt ist als die entsprechende abgeschrägte Fläche (71).

5. Schneidkontakt (25) nach Anspruch 4, **dadurch gekennzeichnet, dass** die Rückseite (101) einer Schneide (45) im Wesentlichen parallel zu der Basis (47) ausgerichtet ist, wobei die Rückseite (101) von der entsprechenden Basis (47) von dem Durchlass (75) weg beabstandet ist.

6. Schneidkontakt (25) nach Anspruch 4, **dadurch gekennzeichnet, dass** die Rückseite (101) einer Schneide (45) mit der Basis (47) bündig ist.

7. Schneidkontakt (25) nach einem der Ansprüche 1 bis 6, **dadurch gekennzeichnet, dass** eine Schneide (45) des Weiteren Seitenflächen (123) umfasst, die in die Querrichtung gewandt sind, sich parallel zu der Ausdehnungsrichtung (49) erstrecken und nicht abgeschrägt sind.

8. Schneidkontakt (1) nach einem der Ansprüche 1 bis 7, **dadurch gekennzeichnet dass** die Schneiden (45) an der Basis (47) voneinander getrennt sind.

9. Schneidkontakt (25) nach Anspruch 8, **dadurch gekennzeichnet, dass** der Abstand (50) der Schneiden (45) zueinander in der Querrichtung (43) wenigstens so groß ist wie die Breite (46) der Schneiden (45) in der Querrichtung (43).

10. Schneidkontakt (25) nach einem der Ansprüche 1 bis 9, **dadurch gekennzeichnet, dass** das freie Ende (73) der Schneiden (45) eine Kante (83) umfasst, die sich in der Querrichtung (43) erstreckt.

11. Schneidkontakt (25) nach Anspruch 10, **dadurch gekennzeichnet, dass** an der Kante (83) die abgeschrägte Fläche (71) einer Schneide (45) und eine Rückseite (101) einer Schneide (45) verbunden sind.

12. Schneidkontakt (25) nach einem der Ansprüche 1 bis 11, **dadurch gekennzeichnet, dass** in der Quer-

richtung (43) der Querschnitt einer Schneide (45) entlang einer Ebene senkrecht zu der Querrichtung (43) asymmetrisch und dreieckig in Bezug auf die Ausdehnungsrichtung (49) ist.

13. Schneidkontakt (25) nach einem der Ansprüche 1 bis 12, **dadurch gekennzeichnet, dass** ein den Schneiden (45) gegenüberliegendes Ende (40) des Schneidkontakts (25) einen Klemmabschnitt (39) zum Herstellen von Kontakt mit wenigstens einem Platinen-Kantenkontakt (34) umfasst.

14. Elektrischer Verbinder (1) zum Herstellen von Kontakt mit einem isolierten Draht (7) durch dessen Isolierung (55) hindurch, wobei der elektrische Verbinder (1) wenigstens einen Schneidkontakt (25) nach einem der Ansprüche 1 bis 13 sowie eine Drahtaufnahme (117) umfasst, und wobei die Schneiden (45) in die Drahtaufnahme (117) hinein vorstehen und sich der Durchlass (75) wenigstens teilweise parallel zu der Drahtaufnahme (117) des elektrischen Verbinders (1) in Richtung einer Öffnung (125) der Drahtaufnahme (117) erstreckt.

15. Elektrischer Verbinder (1) nach Anspruch 14, der des Weiteren einen ersten Körper-Teil (19) sowie einen zweiten Körper-Teil (21) umfasst, die zusammen die Drahtaufnahme (117) bilden, und wobei der zweite Körper-Teil (21) den Schneiden (45) gegenüberliegend angeordnet und so eingerichtet ist, dass er an dem ersten Körper-Teil (19) angebracht wird, indem er auf die Schneiden (45) zu geschoben wird.

Revendications

1. Contact coupant (25) permettant d'établir un contact avec un fil isolé (7) au travers de son isolant (55), le contact coupant (25) comprenant une pluralité de lames (45) qui sont agencées l'une en dessous de l'autre dans une direction latérale (43) et qui dépassent d'une base (47) dans une direction d'extension (49) qui est perpendiculaire à la direction latérale (43), chaque lame (45) présentant une surface inclinée (71), la surface inclinée (71) s'étendant depuis une extrémité libre (73) de la lame (45) en direction de la base (47) et étant tournée vers un passage (75) destiné à recevoir le fil, le passage (75) s'étendant entre les lames (45) dans la direction latérale (43),
dans lequel les lames (45) vont en s'effilant de manière asymétrique vers leurs extrémités libres (73) respectives par rapport à la direction d'extension (49) ; **caractérisé en ce que** les surfaces inclinées (71) d'au moins deux lames (45) sont tournées vers le passage (75) depuis des côtés différents d'un plan central (77) qui est défini par la direction latérale (43) et la direction d'extension (49).

2. Contact coupant (25) selon la revendication 1, **caractérisé en ce que** les lames (45) sont en variante situées sur différents côtés du passage (75).

3. Contact coupant (25) selon l'une quelconque des revendications 1 ou 2, **caractérisé en ce que** la largeur (46) d'une lame (45) est pratiquement constante dans la direction latérale (43).

4. Contact coupant (25) selon l'une quelconque des revendications 1 à 3, **caractérisé en ce qu'une** lame (45) est dotée d'une surface arrière (101) qui fait face dans la direction opposée à la surface inclinée (71), la surface arrière (101) étant moins inclinée par rapport à la direction (49) que la surface inclinée (71) correspondante.

5. Contact coupant (25) selon la revendication 4, **caractérisé en ce que** la surface arrière (101) d'une lame (45) est orientée pratiquement parallèlement à la base (47), la surface arrière (101) étant éloignée de la base (47) correspondante à distance du passage (75).

6. Contact coupant (25) selon la revendication 4, **caractérisé en ce que** la surface arrière (101) d'une lame (45) affleure à la base (47).

7. Contact coupant (25) selon l'une quelconque des revendications 1 à 6, **caractérisé en ce qu'une** lame (45) comprend en outre des faces latérales (123) qui sont tournées dans la direction latérale (43), lesquelles s'étendent parallèlement à la direction d'extension (49) et ne sont pas inclinées.

8. Contact coupant (25) selon l'une quelconque des revendications 1 à 7, **caractérisé en ce qu'au** niveau de la base (47), les lames (45) sont séparées l'une de l'autre.

9. Contact coupant (25) selon la revendication 8, **caractérisé en ce que** la séparation (50) entre les lames (45) dans la direction latérale (43) est au moins aussi importante que la largeur (46) des lames (45) dans la direction latérale (43).

10. Contact coupant (25) selon l'une quelconque des revendications 1 à 9, **caractérisé en ce que** l'extrémité libre (73) des lames (45) comprend une bordure (83) qui s'étend dans la direction latérale (43).

11. Contact coupant (25) selon la revendication 10, **caractérisé en ce qu'au** niveau de la bordure (83), la surface inclinée (71) d'une lame (45) et la surface arrière (101) d'une lame (45) sont raccordées.

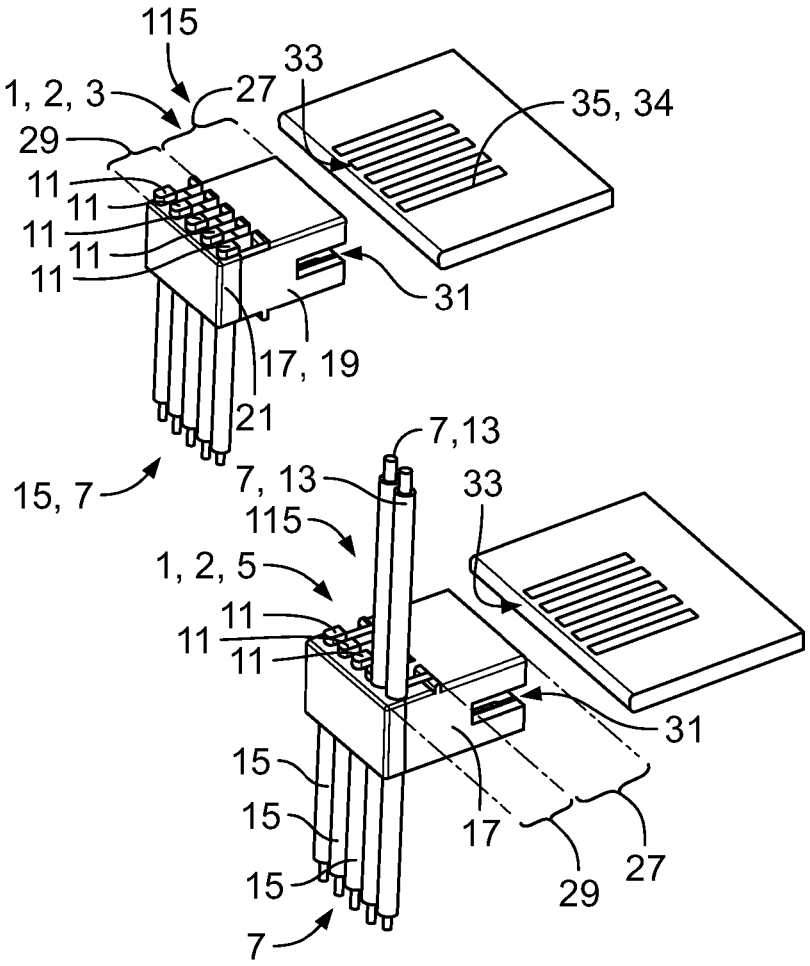
12. Contact coupant (25) selon l'une quelconque des revendications 1 à 11, **caractérisé en ce que** dans

la direction latérale (43), la section transversale d'une lame (45) coupée le long d'un plan perpendiculaire à la direction latérale (43) est asymétrique et triangulaire par rapport à la direction d'extension (49).

13. Contact coupant (25) selon l'une quelconque des revendications 1 à 12, **caractérisé en ce qu'une** extrémité (40) du contact coupant (25), opposée aux lames (45), comprend une section de blocage (39) permettant d'établir le contact avec au moins un contact de bord de carte (34).

14. Connecteur électrique (1) permettant d'établir un contact avec un fil isolé (7) au travers de son isolant (55), le connecteur électrique (1) comprenant au moins un contact coupant (25) conforme à l'une quelconque des revendications 1 à 13 ainsi qu'un réceptacle de fil (117), et où les lames (45) dépassent dans le réceptacle de fil (117) et le passage (75) se déploie au moins partiellement parallèlement au réceptacle de fil (117) du connecteur électrique (1) vers une ouverture (125) du réceptacle de fil (117) .

15. Connecteur électrique (1) selon la revendication 14, comprenant en outre un premier composant formant corps (19) et un second composant formant corps (21) qui forment ensemble le réceptacle de fil (117), et où le second composant formant corps (21) est agencé à l'opposé des lames (45) et conçu pour être monté sur le premier composant formant corps (19) en étant poussé vers les lames (45) .


115
1, 2, 3
27
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17, 19
21
15, 7
7,13
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33
115
1, 2, 5
11
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31
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15
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27
7

Fig. 1

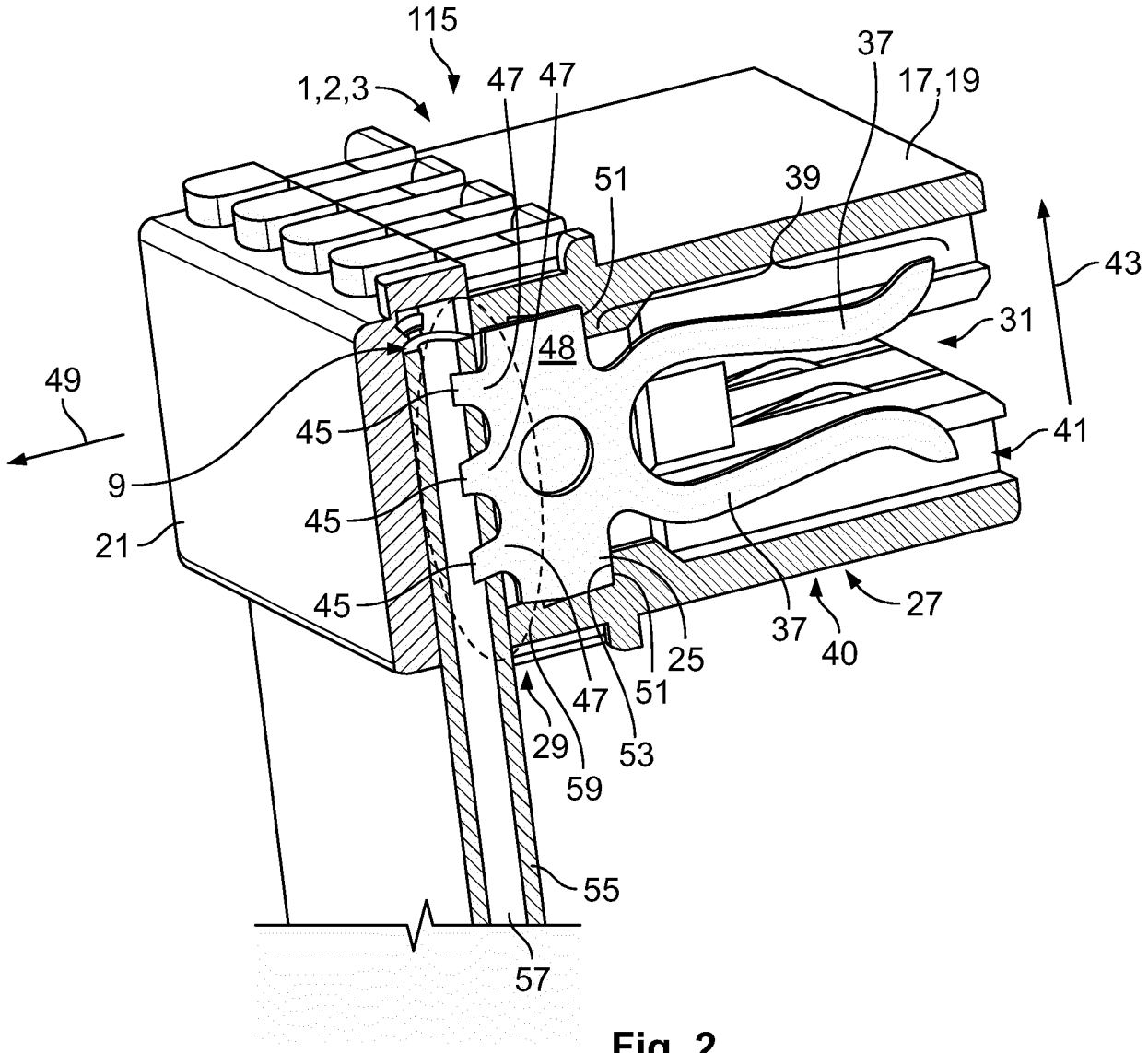
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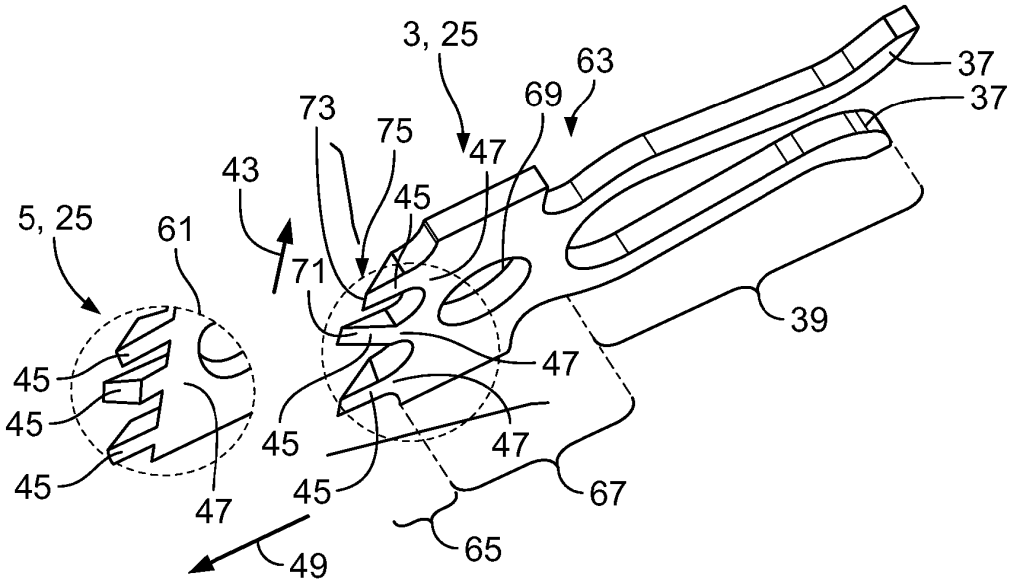
Fig. 2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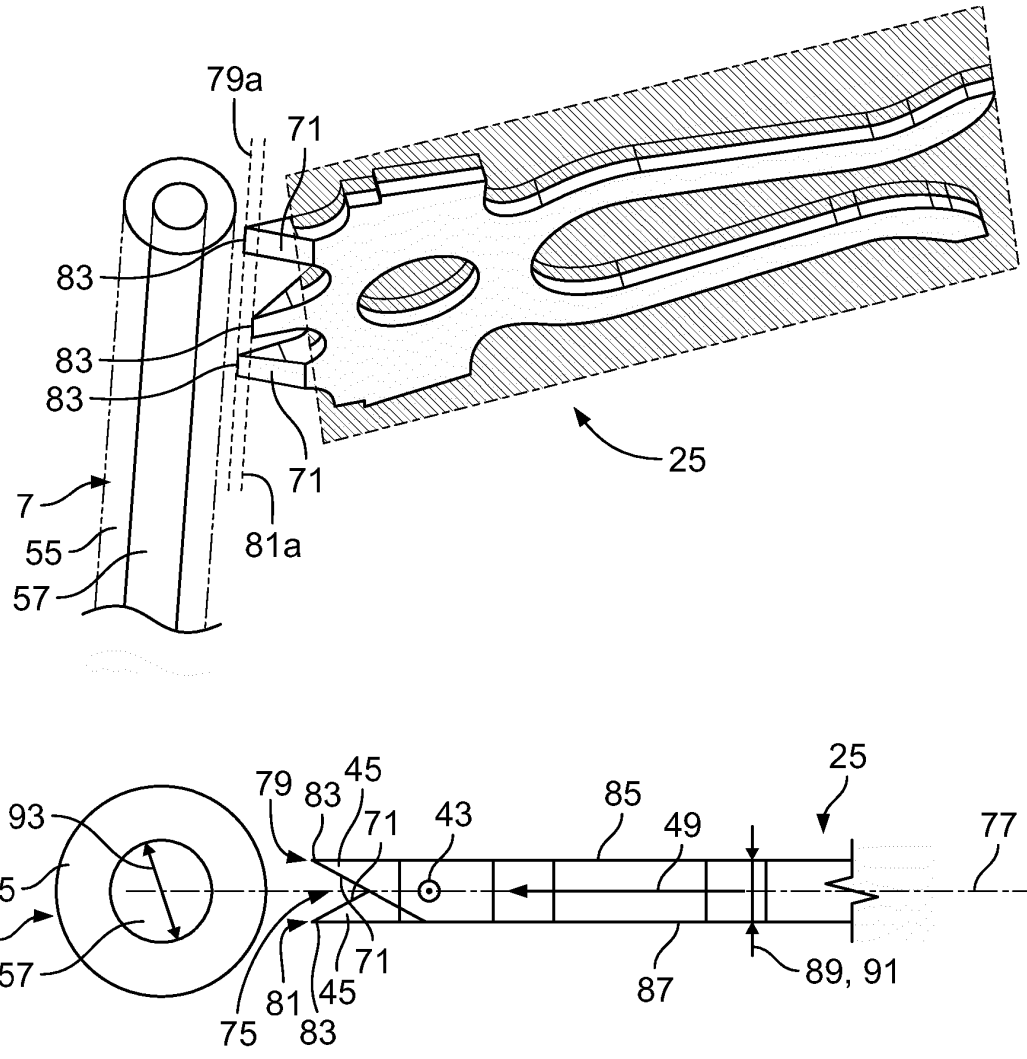
67
65
49

Fig. 3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71
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89, 91
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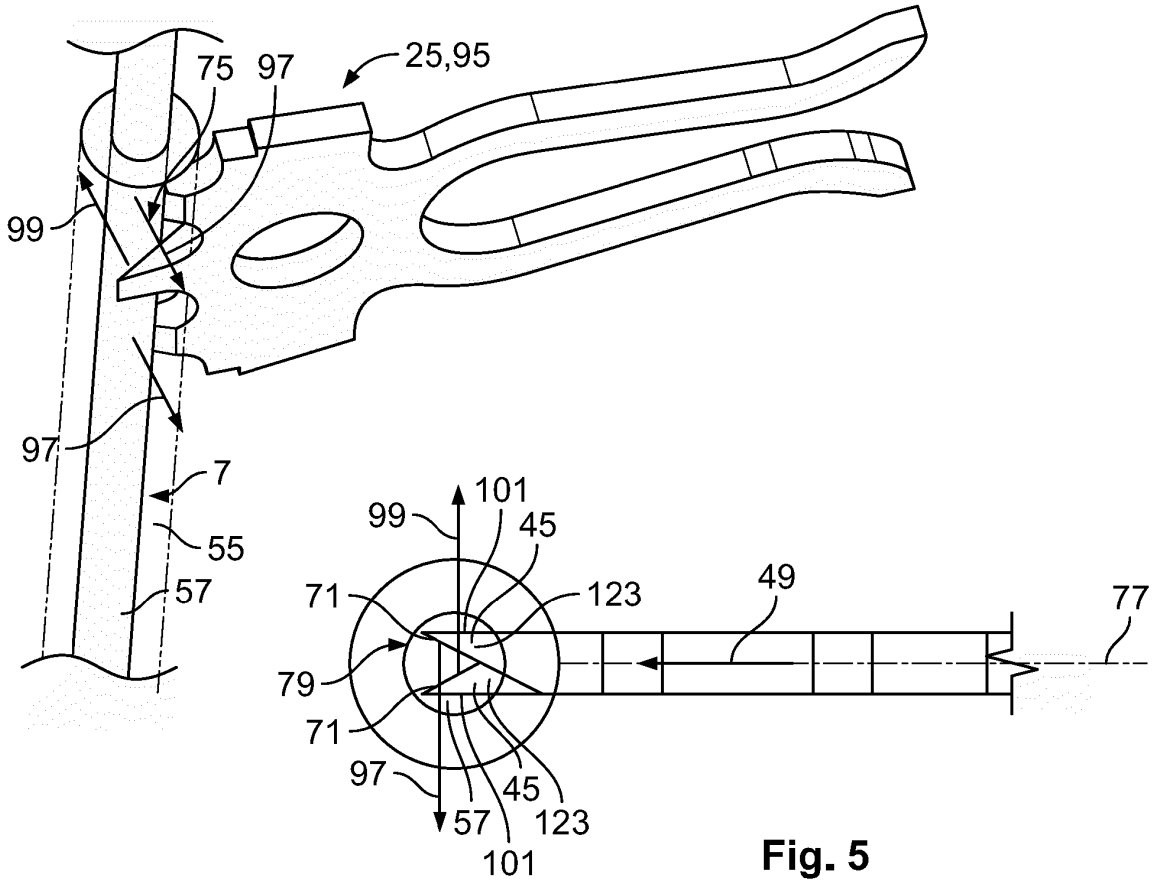
45
83

Fig. 4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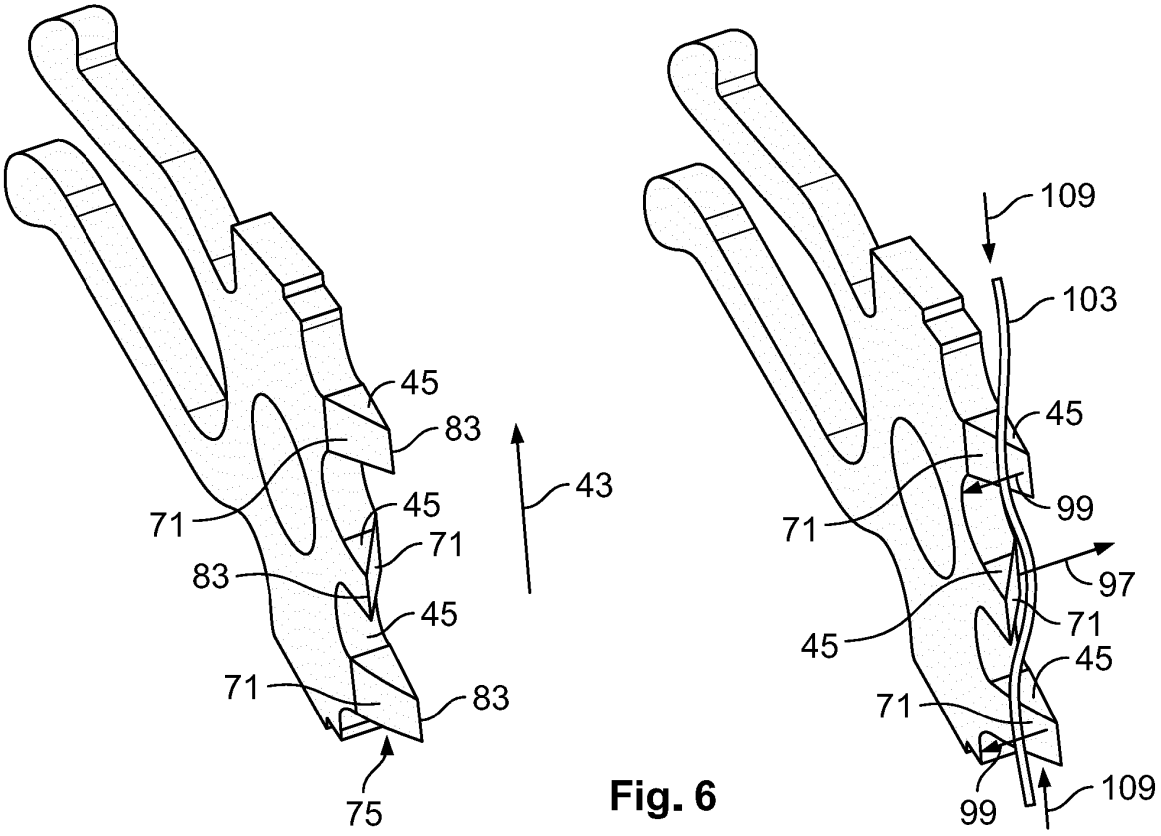
123
101

Fig. 5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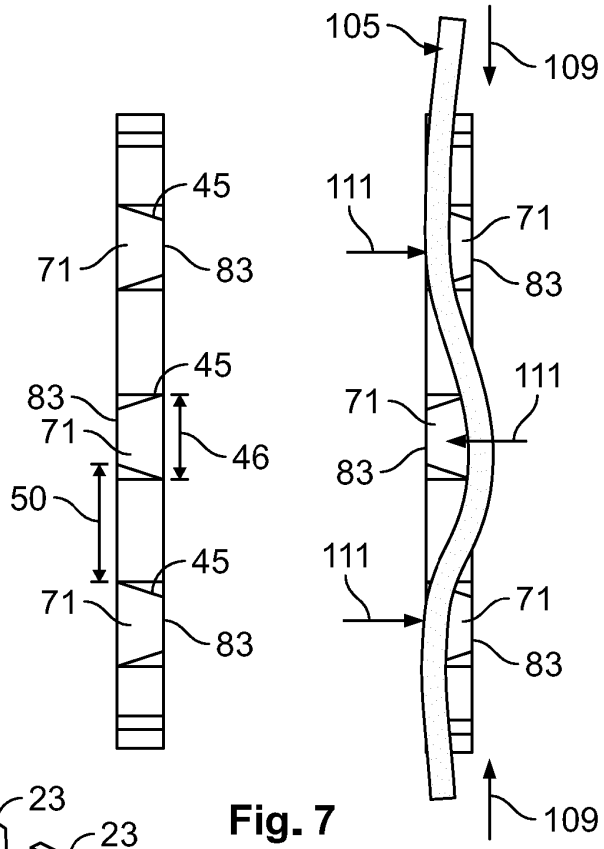
71
99
109

Fig. 6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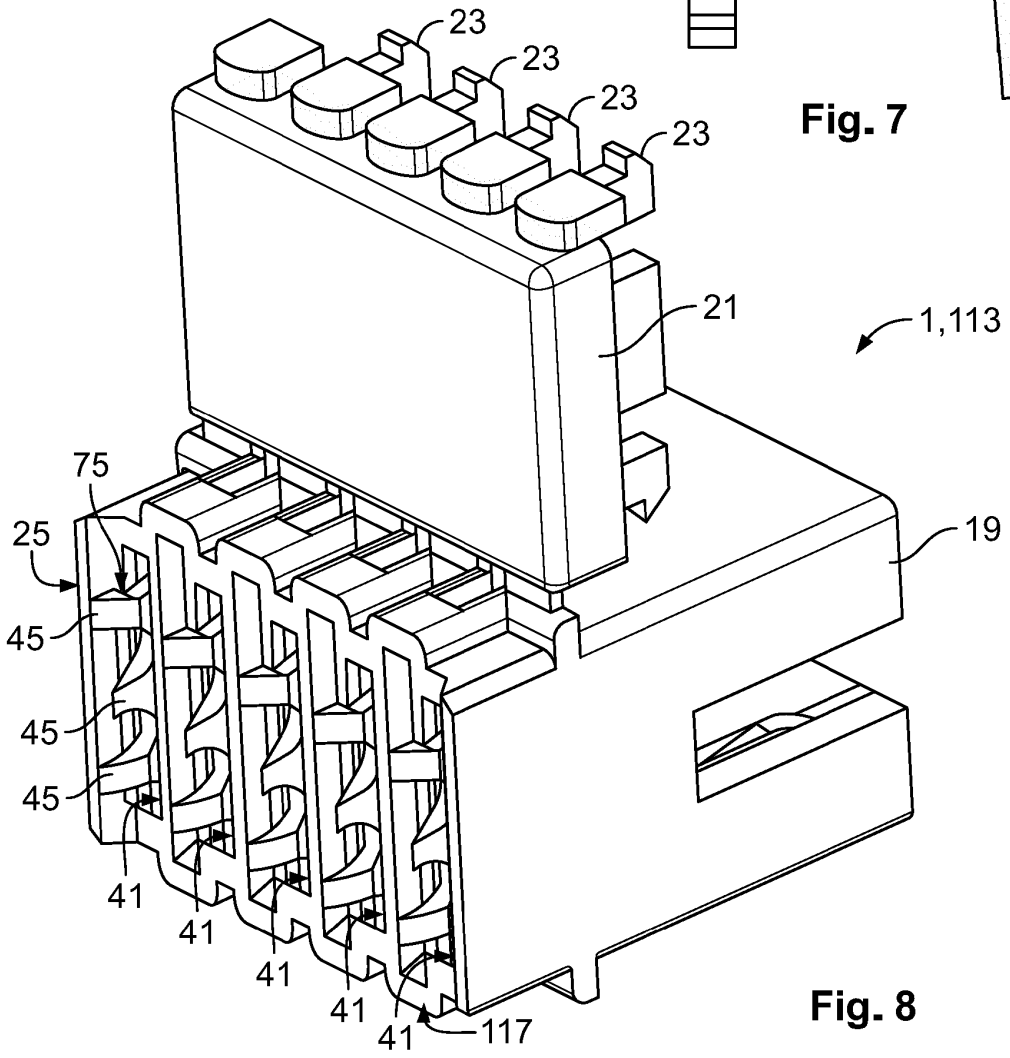
109

Fig. 7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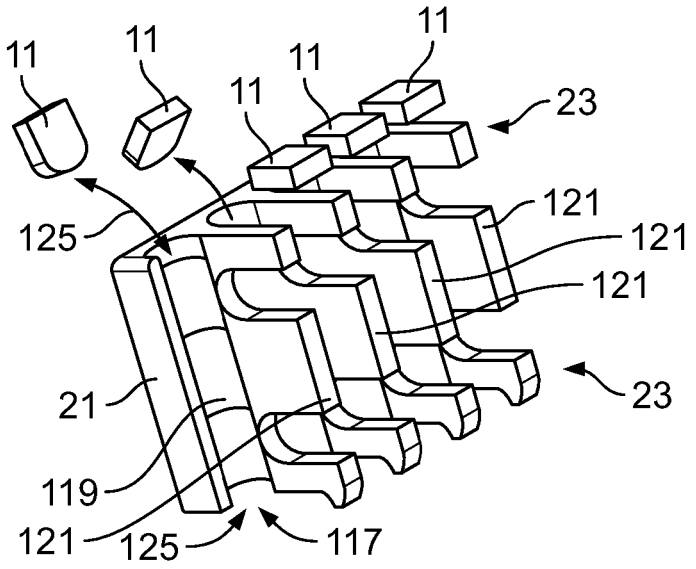
117

Fig. 8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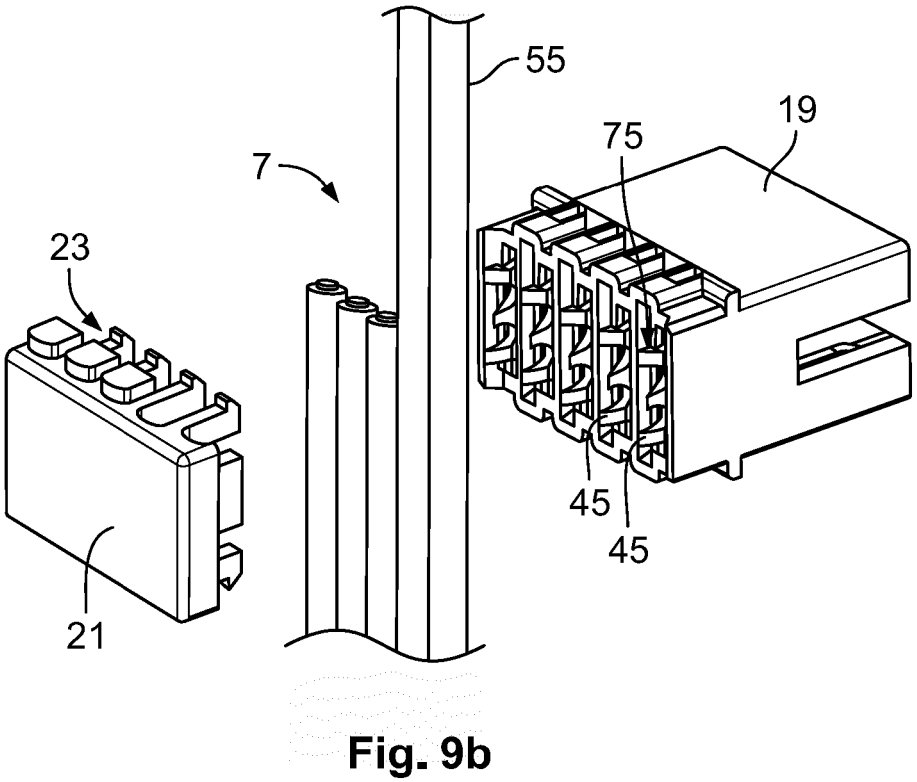
119
121
125
117

Fig. 9a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45
21

Fig. 9b

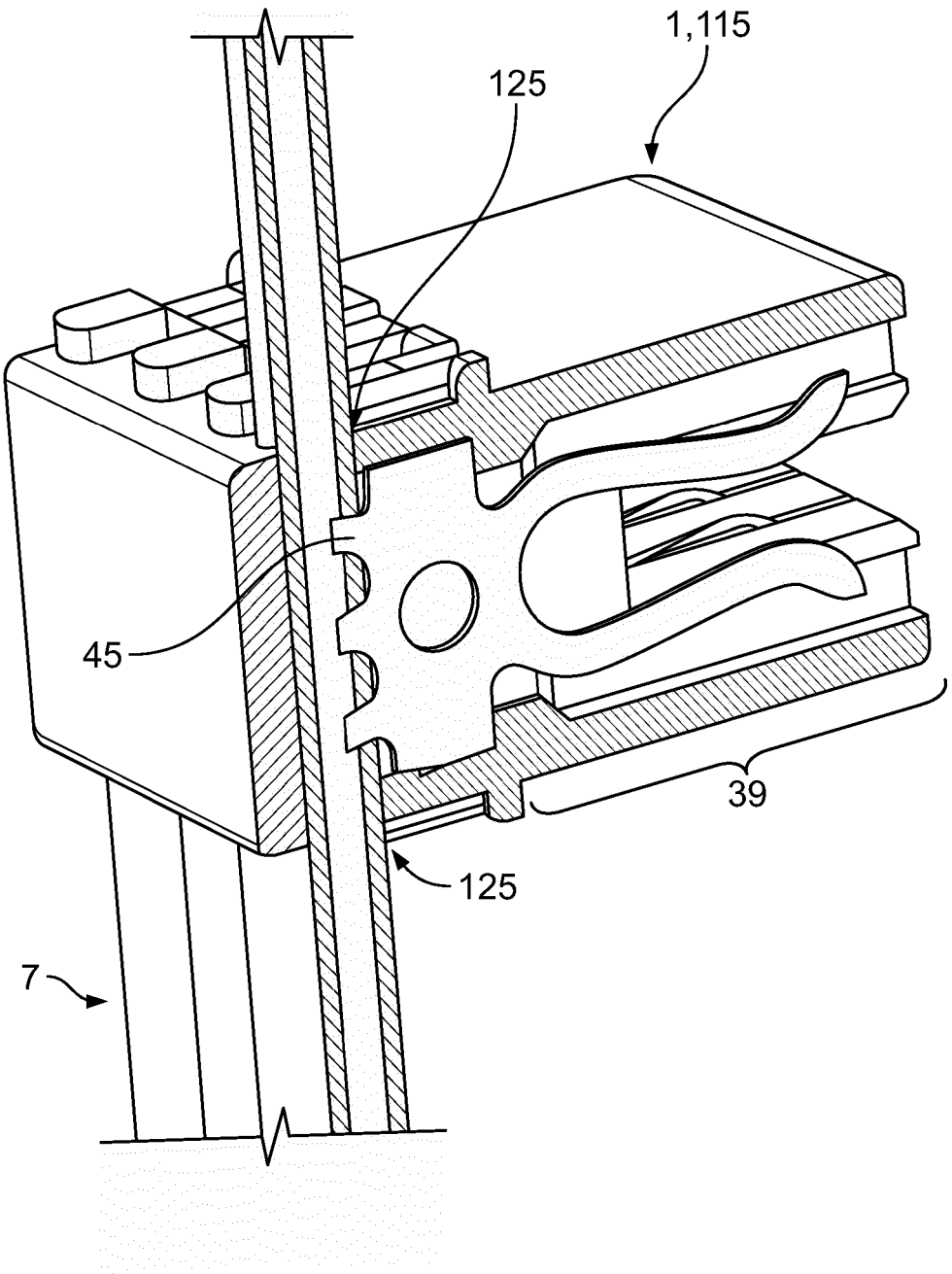

Fig. 9c

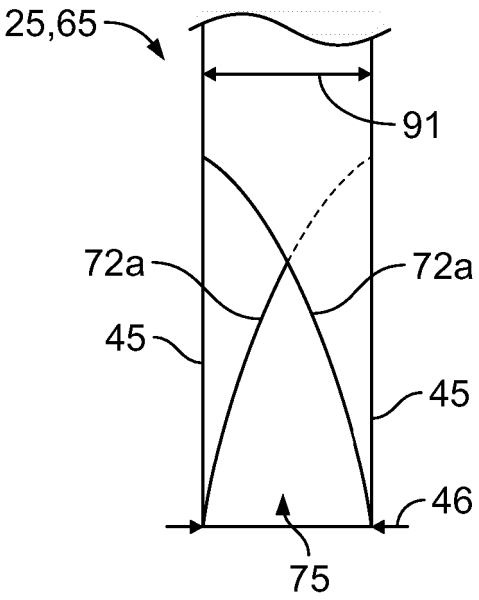

Fig. 10a

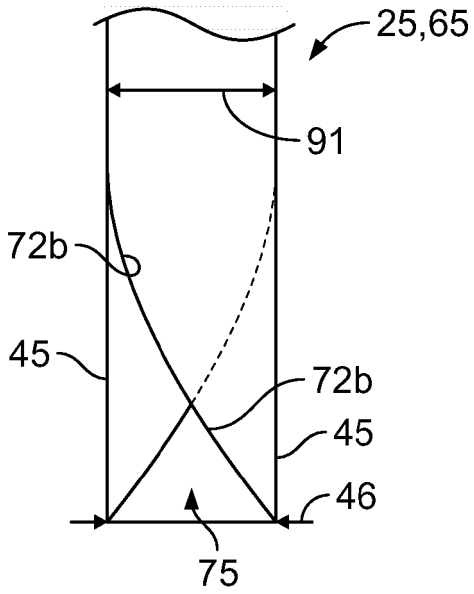

Fig. 10b

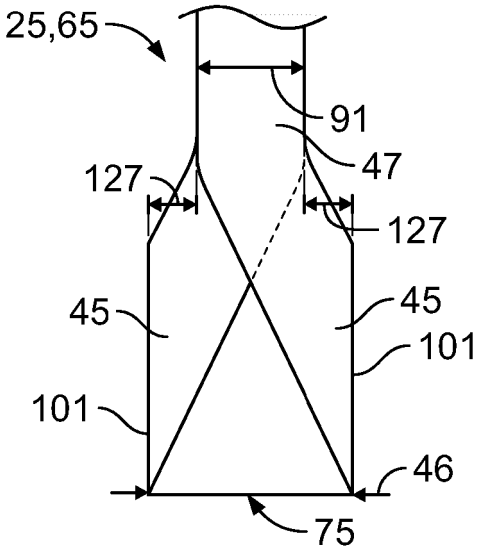

Fig. 11

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 5800187 A **[0003]**
- US 3816818 A **[0003]**
- EP 0437782 A2 **[0003]**