



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
01.06.2016 Bulletin 2016/22

(51) Int Cl.:
H01R 4/64 (2006.01) H01R 4/26 (2006.01)

(21) Application number: **14195222.6**

(22) Date of filing: **27.11.2014**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(72) Inventors:
• **Simonsohn, Thilo**
81735 München (DE)
• **Heindl, Christian**
80807 München (DE)

(71) Applicant: **Tyco Electronics Raychem GmbH**
85521 Ottobrunn (DE)

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

(54) **Connecting element for contacting a shielding of a power cable**

(57) The present invention relates to connecting element which is used for contacting an electrically conductive shield of a cable. A connecting element (100) for contacting a shielding layer or a plurality of shielding wires of a power cable according to the present invention comprises an electrically conductive contact element (102) for electrically contacting the shielding. Further-

more, an electrically conductive connecting lead (104) is provided for connecting the connecting element to another cable or a grounding point. According to the present invention, the contact element (102) comprises a plurality of electrically conductive contact segments (106) which are interconnected by means of at least one hinge element (108).

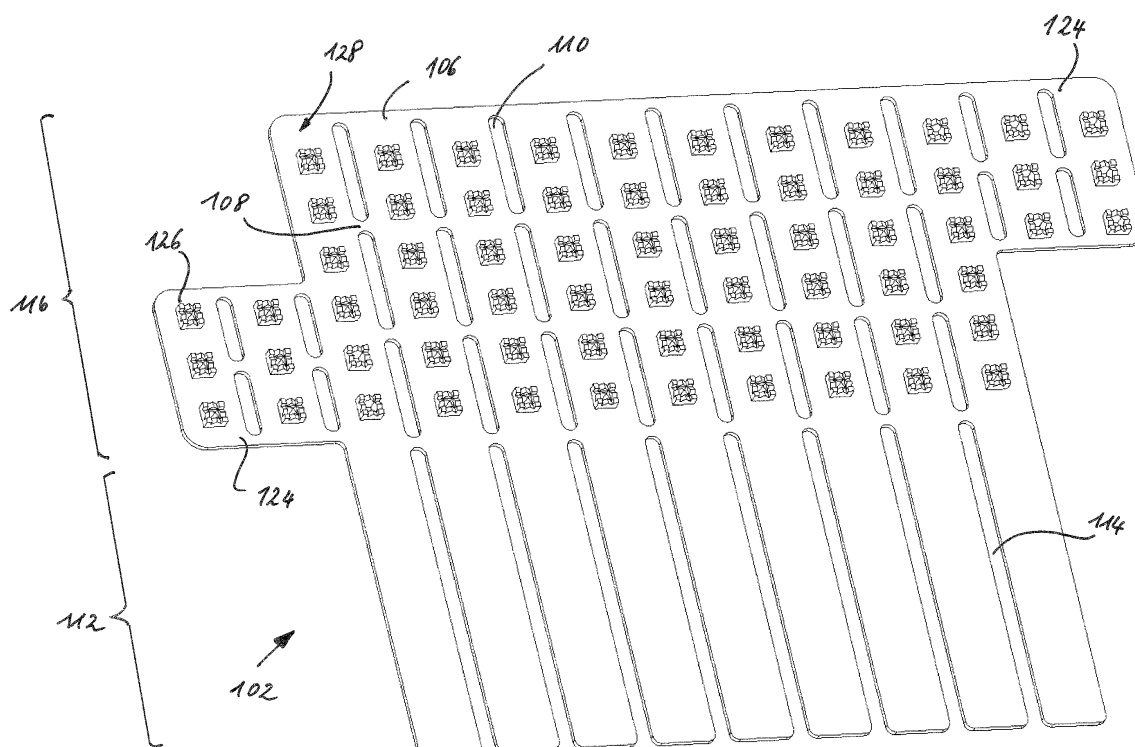


Figure 5

Description

[0001] The present invention relates to a connecting element which is used for contacting an electrically conductive shield, in particular a shielding layer or a plurality of shielding wires of a cable, for either connecting same to the conductive shield of another cable or directly to ground.

[0002] Cable installations for the transmission of bulk power are often made with single-core cables with metal sheaths or other forms of earth-return conductors, which are usually covered with an electrically insulating oversheath (or jacket), in most cases of plastics material, both to avoid uncontrolled earthing (grounding) and to protect the conductor from corrosion.

[0003] A cable shield, the metallic barrier that surrounds the cable insulation, holds the outside of the cable at or near ground potential. It also provides a path for return current and for fault current. The shield also protects the cable from lightning strikes and from current from other fault sources. The metallic shield is also called the sheath. Medium voltage (MV, voltages above 1000 volts and below 69000 volts) power cables normally have copper wire shields, in some cases also aluminum wire shields. Alternatively, power cables often also have a copper tape shield or an aluminum tape shield. These are wrapped helically around the cable with some overlap. In the tape shield cable, the shield is not normally expected to carry unbalanced load current. There is an advantage in having a higher resistance shield: the cable ampacity can be higher because there is less circulating current.

[0004] Particularly in MV power cable constructions, the ground-potential metallic shield is an important element because it serves to protect both the cable itself and the power system to which the cable is connected. It protects the cable itself by confining the cable's dielectric field, and by providing symmetrical radial distribution of voltage stress. This limits the stress concentration at any one insulation point. It also helps dissipate heat away from the current-carrying conductor. The metallic shield can also protect the power system by conducting any fault current to the ground. Moreover, the metallic shield reduces interference with electronic equipment and also reduces the hazards of shock to anyone working with the cable.

[0005] It is therefore essential that cable shields are well connected to each other, e. g. at cable joints, and in some cases that the connection of the metallic shield to a defined grounding point is established with sufficiently high electrical and mechanical performance.

[0006] Presently, there exist several contacting systems for the metal tape shield of cables. Many of these products comprise contact elements having a number of sharp upstanding protrusions which are directed outwardly when mounted on a cable. These protrusions contact or even puncture the metal film of the cable shield from the inside, being arranged between the cable shield and the inner cable insulation. The contact elements having such protrusions are sometimes called "cheese graters".

[0007] In order to form such protrusions at a contact element fabricated from a metal sheet, this metal sheet has to be of a certain thickness, usually around 500 μm when using copper or copper alloys as the metal. Typically, 50 or more such protrusions are provided, resulting in a size of the contact element of e. g. 60 mm x 30 mm. From this thickness and size results a rather high rigidity of the contact element, so that the contact element tends to give way outwardly when mounted on a cable. While this is no problem for arrangements where the contact element is located beneath the cable shield and where the protrusions are provided on the outer surface of the contact element, the rigidity leads to a deteriorated electrical contact for arrangements in which the contact element encompasses the cable shield. For many applications, however, and in particular for tape shields, it is desirable to mount the connecting element from the outside with or without having to fold back the cable shield.

[0008] Figures 11 and 12 show an example of a connecting element which is mounted on a cable so that it encompasses the cable shielding from the outside as disclosed in the published international application WO 2014/072258 A1. The connecting element comprises a contact element 702 which is connected in a connection region 706 to an electrically conductive connecting lead 704. A roll spring 708 is provided for fixing the contact element 702 over cable shielding (not shown in the figures). As shown in figure 12, the inner surface of the contact element 702 is provided with protruding sharp edges 703 which grip the cable shielding in the mounted state. In order to allow the fabrication of the protrusions 703, however, the contact element 702 has to be made from a comparatively thick copper or copper alloy sheet. Thus, the contact element 702 is more rigid than would be desirable for a satisfactory electrical contact to the underlying cable shielding.

[0009] Therefore, the object underlying the present invention is to provide an improved connecting element for contacting the shielding layer of a power cable, which can be mounted easily as a wrap around, i. e. after the cable connection is assembled, may be adapted to a wide range of cable diameters with little forces, so that it can be installed manually, has a low spring effect, so that the connecting element essentially maintains its dimensions and geometry when being folded around the cable shield, and ensures a robust and reliable electrical contact between a grounding point or an attached lead and the shielding.

[0010] This object is solved by the subject matter of the independent claim. Advantageous embodiments of the present invention are the subject matter of the dependent claims.

[0011] The present invention is based on the idea that by dividing an electrically conductive contact element for electrically contacting the shielding layer into at least two contact segments which are interconnected by means of at least one hinge element, a much more flexible structure can be achieved. Furthermore, a reduced mechanical force is necessary for bending the contact element around the cable. The hinge element on the one hand provides a region with high flexibility for reducing the rigidity of the contact element. On the other hand, it provides a circumferential current path from one contact segment to the other.

[0012] The contact segments are formed from an electrically conductive material, preferably a metal like copper, or a copper alloy. The at least one interconnecting hinge element may be formed from the same material or from a different material. Moreover, the at least one interconnecting hinge element may be formed integrally or as at least one separate element.

[0013] According to the present invention, the contact segments and the hinge elements are formed integrally from one metal sheet. However, the contact element may also be fabricated from an electrically insulating foil carrying separate contact segments, wherein the hinge element is formed by the insulating foil. Other forms of connections or latches may of course also be used to interconnect the contact segments. Generally, it is advantageous to use an electrically conductive material for the hinge element because current can flow from one segment to another. Such an arrangement may also be more cost effective to manufacture.

[0014] The electrical and mechanical contact between the contact segments and the underlying shielding layer of the cable can be improved by providing at least one contact protrusion which in a mounted state protrudes inwardly towards the shielding layer of the cable. Such protrusions grip the shielding layer and may even puncture the surface of the shielding layer in order to overcome contact deterioration due to oxide or contamination layers.

[0015] According to an advantageous embodiment of the present invention, the at least one contact protrusion is formed by stamped and bent cutouts which thereby form sharp teeth that grip the cable shielding layer in a mounted state. Alternatively, also sharp elongated contact blades can be arranged on the contact element in order to improve the electrical contact towards the cable shielding.

[0016] In order to connect the contact element to a grounding point or to the shield of another cable, an electrically conductive connecting lead is provided. According to an advantageous embodiment, the connecting lead comprises a metal braiding. Such a metal braiding has the advantage that it is highly flexible, has a low ohmic resistance, and can be compressed to fit into tight spaces if necessary. Furthermore, metal braidings can be connected to the contact element by most of the commonly used electrical contacting techniques. These kinds of braids are standard low cost products.

[0017] In particular, the connecting lead may be connected to the contact element by at least one solder connection, at least one crimp connection, at least one welded connection and/or at least one riveted connection. Preferably, a welded connection is used to attach a metal braiding to a copper contact element. Such an embodiment has the advantage that it is a well established, economic technique for providing a robust and reliable electrical contact. Alternatively, the connecting lead may also be connected to the contact element by means of a press-on connection that is only assembled when mounting the connecting element on the cable shield.

[0018] In order to distribute the current path around the whole circumference of the contact element around the cable, the connecting lead is electrically connected to each of the contact segments. This can firstly be achieved by aligning contact points along the length of a part of the connecting lead. Preferably, these contact points are arranged to be equidistant along this part of the connecting lead.

[0019] Alternatively, the connecting lead can also comprise a plurality of fanned out terminal elements. Each of these terminal elements can be connected to one of said contact segments. This arrangement has the advantage that the connecting lead extends in a direction along the cable and can be arranged under a cover sheath more easily.

[0020] According to an advantageous embodiment of the present invention, the contact element is fabricated from a stamped metal sheet, wherein clearances define the contact segments and the at least one hinge element. These clearances may be stamped, but can also be laser cut, water jet cut, or fabricated by any other suitable fabrication technique. For being mounted around the cable, the contact element is bent to fit around the shielding layer. The fabrication of the contact element as one integral part has the advantage of being cost effective, while maintaining sufficient flexibility of the contact element and thus ensuring a reliable electrical contact.

[0021] A particularly simple outline can be realized when fabricating the contact element with a rectangular outline and bending it to form at least a part of a cylindrical sleeve around the cable in the assembled state. The bending of the contact element can at least partly be effected already in the factory. In order to facilitate the bending process, a suitable material treatment can be employed, such as applying heat.

[0022] For geometric reasons, the contact element preferably does not overlap with itself when being mounted on the cable. Consequently, its dimensions are usually adapted to fit around the cable with the smallest diameter. For cables with larger diameters an increasing fraction of the cable shielding's circumference remains where the contact element is not touching the cable shielding. For an optimized contacting, however, it is desirable to cover the circumference of the cable shielding to the largest possible extent with the contact element. Consequently, according to an advantageous embodiment, extension segments are provided at peripheral regions of the contact element which enhance the part of

the cable circumference which is covered by the contact element, but do not overlap with the respective opposing peripheral part of the contact element in the mounted state.

[0023] In order to ensure a particularly robust and low ohmic contact between the contact element and the underlying shielding layer, an additional clamping element can be provided which presses the contact element onto the cable. Preferably the clamping element comprises at least one worm drive clip, cable tie, and/or recoverable sleeve. The recoverable sleeve may be a heat shrink sleeve or an elastic cold shrink sleeve, or a combination of both.

[0024] According to an advantageous embodiment of the present invention, the hinge elements are only provided in the particular region that is pressed onto the shielding layer, whereas in a region where the connecting lead is attached to the contact element, the contact segments are not interconnected by hinge elements, thereby having an increased radial flexibility to compensate for the connecting lead, for bulky solder bumps or other irregularities due to the attachment of the connecting lead.

[0025] In order to increase the flexibility, the connecting lead may be formed prior to or after connecting the same to the contact element. These deformations may be undulations which lead to an increased circumferential length when bent around the smallest cable. However, such undulations or any other shape should not hinder the installation on any size of cable.

[0026] The accompanying drawings are incorporated into the specification and form a part of the specification to illustrate several embodiments of the present invention. These drawings, together with the description serve to explain the principles of the invention. The drawings are merely for the purpose of illustrating the preferred and alternative examples of how the invention can be made and used, and are not to be construed as limiting the invention to only the illustrated and described embodiments. Furthermore, several aspects of the embodiments may form-individually or in different combinations-solutions according to the present invention. The following described embodiments thus can be considered either alone or in an arbitrary combination thereof. Further features and advantages will become apparent from the following more particular description of the various embodiments of the invention, as illustrated in the accompanying drawings, in which like references refer to like elements, and wherein:

FIG. 1 is a plan view of a contact element according to an advantageous embodiment of the present invention;

FIG. 2 is a plan view of a connecting element according to a first embodiment in the pre-assembled state;

FIG. 3 is a plan view of a connecting element according to a second embodiment in the preassembled state;

FIG. 4 is a plan view of a contact element according to another advantageous embodiment;

FIG. 5 is a perspective view of a contact element according to another advantageous embodiment;

FIG. 6 is a perspective view of a contact element according to another advantageous embodiment;

FIG. 7 is a top view of a connecting element according to another advantageous embodiment;

FIG. 8 is a sectional view of the connecting element of fig. 7;

FIG. 9 is a top view of a connecting element according to another advantageous embodiment;

FIG. 10 is a sectional view of the connecting element of fig. 9;

FIG. 11 is a schematic perspective view of a conventional connecting element;

FIG. 12 is a detail of figure 11.

[0027] The present invention will now be further explained referring to the figures, and firstly referring to figure 1. Figure 1 shows a plan view of a contact element 102 which is part of a connecting element 100 according to the present invention.

[0028] According to the present invention, the contact element 102 is divided into a plurality of contact segments 106 that are each interconnected by hinge elements 108. As shown in the figure, the contact element 102 is formed from a cut and punched metal sheet. The hinge elements 108 are fabricated by providing a plurality of narrow and elongated clearances 110. In a mounted state, the planar metal sheet is bent to have hollow cylindrical shape or C-shape which encompasses the cable. Each of the contact segments 106 has a length L which extends along a longitudinal axis of the cable and a width W extending along the circumference of the cable.

[0029] It is desirable that the connecting element 100 according to the present invention can be used with a larger

range of cable diameters without modification. Due to the fact that the contact element 102 may not overlap itself, the overall width D may not exceed $\pi \cdot d$, wherein d denotes the outer diameter of the cable shield where an electrical contact is to be established. For a cable diameter of $d=29$ mm, the maximum admissible width is therefore $D=\pi \cdot d=91$ mm.

[0030] By providing contact segments 106 which are interconnected only via the hinge elements 108 the contact element 102 is much more flexible than a solid metal sheet as the one shown in figure 11. Nevertheless, the same alloy and sheet thickness and size can be used, thus ensuring a sufficient ampacity and allowing for the fabrication of protrusions for contacting the cable shielding. For instance, copper alloy sheets with a thickness of about 500 μm can be used.

[0031] According to the example shown in figure 1, the contact element 102 is fabricated from a rectangular metal sheet with a width of around 66 mm and a length L of about 50 mm. Each of the nine contact segments 106 has a width W of 6 mm. The clearances 110 have dimensions of 1.5 mm around the circumference and 12 mm in the longitudinal direction. Thereby, hinge elements 108 are formed, which extend in a circumferential direction approximately 1.5 mm and in the longitudinal direction approximately 1.0 mm.

[0032] The contact element 102 comprises a connecting region 112 which is adapted to be connected to a connecting lead 104. In order to enhance the flexibility of the contact segments 106 in the connecting region 112 elongated cut-outs 114 separate the contact segments 106 in the connecting region 112. These elongated cut-outs 114 may for instance have a length of 25 mm.

[0033] In figures 1 to 4 the protrusions for contacting a cable shielding are not shown. However, the contact element 102 may comprise an arrangement of protrusions similar to the one shown in figures 5 and 6. For instance, in a contact region 116, seven protrusions may be arranged on each contact segment 106. The contact region 116 is the particular region of the contact element 102 which is in direct contact with the cable shielding and exerts a contact pressure onto the cable shielding. The contact region 116 has a length of about 35 mm in this particular example. It is clear for a person skilled in the art that all given dimensions are only exemplary values which of course may vary significantly.

[0034] In the connecting region 112, a connecting lead 104 comprising a metal braiding or the like can be attached by a press fit with roll springs, ties, heat shrink sleeves, worm drive clips or the like. The connecting lead 104 may also be attached by means of welding, soldering, or riveting when fabricating the connecting element 100.

[0035] There exist several possibilities to fabricate the contact element shown in figure 1. Firstly, a solid metal sheet may be provided with the clearances 110 and the cut-outs 114 by means of appropriate processing techniques, such as punching, water jet cutting, or laser cutting. However, the thickness of the hinge elements 108 may also differ from the thickness of the contact segments 106. This may be achieved by deforming the metal blank by pressing with high forces using an appropriate blade tool. Bonding individual stripes forming the contact segments onto plastic film or a thinner metal blank is another option.

[0036] The orientation of the contact segments 106 is essentially parallel to the longitudinal axis of the cable.

[0037] Moreover, the shape of the contact segments 106 is preferably rectangular, but may of course have any other arbitrary shape. Within one and the same contact element 102, the contact segments 106 are either identical or contact segments 106 with different shapes can be combined.

[0038] Referring now to figure 2, a connecting element 100 based on the contact element 106 of figure 1 is shown in the pre-assembled state, i. e. before it is bent for an assembly around the cable. For connecting the connecting element 100 to a grounding point or to another cable shielding, the connecting element 100 further comprises an electrically conductive connecting lead 104. According to the embodiment shown in figure 2, the connecting lead 104 comprises a metal braiding. Such a metal braiding may for instance be a tubular sleeve made from stainless steel or from tinned copper. Of course, all other suitable forms of the connecting lead 104 may also be combined with the contact element 102 according to the present invention, such as cables or flat band conductors.

[0039] According to the exemplary embodiment of figure 2, a plurality of terminal leads 120 fan out from a common main lead 118. With their peripheral ends these terminal leads 120 are connected to the contact segments 106 of the contact element 102 in the connecting region 112. In the shown embodiment one terminal lead 120 is connected to one contact segment 106 each. However, it is clear for a person skilled in the art that any other suitable distribution of the connection points 122 can also be used according to the present invention. For instance, it may be sufficient for particular applications to contact only every second or third contact segment 106.

[0040] The connection between the contact element 102 and the connection lead 104 can be established while assembling the connecting element at the cable by means of clamping devices such as a roll spring, a cable tie or a heat shrink or cold shrink recoverable sleeve. In most cases, it is, however, advantageous to pre-assemble the complete connecting element 100 in the factory.

[0041] Consequently, the terminal leads 120 are connected to the connecting regions 112 of the contact segments 106 using well-established contacting techniques, such as welding, soldering, crimping, or riveting.

[0042] Alternatively, the connection of the connection lead 104 can also be located in the contact region 116. In this case, the contact element 102 dispenses with a separate connecting zone 112.

[0043] The arrangement shown in figure 2 has the advantage that the main lead 118 of the connecting lead 104 leads away from the connecting region 112 in a straight manner and in line with the longitudinal axis of the cable. Hence, no

sharp bending of the lead 104 is necessary which could be a problem for any sleeves covering the connecting element 100. However, separating the main lead 118 into a plurality of terminal leads 120 represents an additional fabrication step. In order to avoid such an additional step, according to an alternative embodiment which is shown in figure 3, the metal braiding 104 is oriented across the longitudinal axis and is connected to said contact segments 106 at a plurality of connecting points 122 which are aligned along a part of the length of said metal braiding 104. The metal braiding 104 usually is flexible enough to be bent to the lead over the jointing area to the shield connection on the opposite side.

[0044] The connection points 122 may be arranged on each contact segment 106 to be aligned equidistantly as shown in figure 3. Alternatively, also a smaller number of connection points or even only one single connection point 122 may be provided.

[0045] In order to ensure a sufficient mechanical stability also in the connecting region 112 where no hinge elements 108 are provided, the metal braiding 104 can be rolled flat and/or compacted before being connected to the contact element 102. Moreover, according to an advantageous embodiment, a welding of the metal braiding 104 onto the contact element 102 is only performed after bending the initially flat contact element 102 at least partially into its final cylindrical or C-shaped form.

[0046] Due to the fact that the contact element may not overlap itself when being mounted on the cable, there always remains a region not covered by the contact element for all cables with a larger diameter than the smallest rated one. In order to enhance the length of the circumference of the shielding layer that is covered by the contact element 102, the outline of the contact element 102 may have extension segments 124 that are preferably not extending along the complete length in the longitudinal direction of the cable. When being wrapped around the cable, the contact element 102 according to the embodiment shown in figure 4 allows a larger length of the cable circumference to be electrically contacted by the connecting element 100. As can be seen from figure 4, each of the width dimensions D1 and D2 has to satisfy the condition

$$D1, D2 \leq \pi \cdot d,$$

wherein d denotes the diameter of the smallest cable shield to which the connecting element is mounted.

[0047] Advantageously, the overall width D is larger than D1 or D2, and therefore an improved electrical contact also for thicker cables can be achieved.

[0048] It has to be noted that for extension segments 124 that are not directly connected to the connecting region 112, significant current flow may occur through the hinge elements to neighboring contact segments 106. Consequently, the geometry of the hinge elements must be optimized in a way that, on the one hand, a sufficient flexibility can be ensured and, on the other hand, a sufficient ampacity is maintained.

[0049] Figure 5 shows in a perspective view of a further advantageous embodiment of the contact element 102. According to this embodiment, two extension segments 124 are arranged in the contact region 116.

[0050] This enlarged covered circumference improves the overall electrical performance of the connecting element 100.

[0051] Moreover, figure 5 also shows schematically an example of the protrusions 126 which are formed at the surface 128 coming into contact with the cable shielding in the mounted state. In the shown embodiment, the protrusions have a crown shaped outline with a plurality of sharp teeth. However, any other suitable geometry of such a gripping protrusion 126 may also be used. Preferably, the protrusions 126 are generated by punching through the metal sheet that forms the contact element 102.

[0052] Figure 6 shows still another advantageous embodiment of the contact element 102 according to the present invention. According to this embodiment, the fraction of the circumference of the cable which is covered by the connecting region of the contact element 102 is less than the area that is covered by an extended part of the contact region 116. This embodiment has the advantage, that the connecting region 112 which is bulky by carrying the connection points to the connecting lead 104 is reduced in its size (width) and thus fits more easily under a cover sleeve and is easier to bond. Moreover, the overall number of welding points is reduced for this embodiment compared to the number of contact segments 106 and extension segments 124. Of course, the number of contact segments 106 has to be at least the certain minimum required to transmit the current from all the protrusions 126 through the contact segments 106 having a distinct cross-section to the lead 104. This means that only the minimum number of welding points of the connecting lead 104 is being designed into the product. Furthermore, by providing extension segments 124, the circumference of the shielding layer of the cable is covered to the best possible extent.

[0053] Crown shaped protrusions 126 are provided in order to enhance the mechanical and electrical performance of the contact between the contact element 102 and the cable shielding.

[0054] With reference to figures 7 and 8 a further advantageous embodiment of the present invention will be described.

[0055] It was found that the dimensions of the contacting element in a direction along the longitudinal axis of the cable have an important impact on the performance of the connecting element 100. In particular, this overall length L should

be kept as short as possible.

[0056] Therefore, the connecting element 100 can also be formed in a way that the connecting lead 104 is attached to the contact element 102 directly in the contact region 116. In this case, a separate connecting region 112 is dispensed with. As shown in fig. 7, the connecting lead 104 is formed by a metal braiding that is connected to the contact element at a plurality of welding spots which form the connection points 122. Advantageously, the welding spots are arranged between the locations of the protrusions 126. In the particular embodiment shown in fig. 7, the metal braiding 104 is arranged to enclose an angle with the circumferential axis 130. Such a diagonal arrangement facilitates leading off the metal braiding 104, at the same time avoiding sharp bends. However, alternatively the metal braiding 104 is arranged essentially in parallel to the circumferential axis 130 of the contact element 102.

[0057] Fig. 8 shows a schematic sectional view of fig. 7. According to this embodiment, the metal braiding 104 comprises an undulated cross-sectional shape which facilitates the bending around the cable as indicated by the arrows 132. The stretched length of the undulations corresponds to the circumferential length the connecting lead 104 takes when the contact element 102 is wound around the smallest rated cable. The connecting lead 104 preferably is undulated prior to being welded or otherwise connected on to the contact segments 106. Of course, any other suitable cross-sectional shape that provides such a bellow function can also be used according to the present invention.

[0058] Figures 9 and 10 show a further advantageous embodiment using an undulated connecting lead 104 which is directly connected to that part of the contact element that is provided with the protrusions 126. In particular, the connecting lead 104 is attached to the surface 134 which is opposite to the surface 128 that is directed towards the cable shield.

[0059] According to this particular embodiment, two arms 138 with contacting regions 116 are arranged at a back bone region 136 which extends in a longitudinal direction of the cable. The two arms 138 are arranged at the back bone region 136 in a staggered manner, so that they do not overlap in the assembled state. According to this embodiment, two separate connecting leads 104 are provided. Each of these connecting leads 104 is welded onto one arm 138 of the contact element 102 directly in the contact region 116. As can be seen more clearly from fig. 10, the connecting leads 104 are also provided with an undulated cross-section in the region of the connection points 122.

[0060] In summary, the present invention provides an improved connecting element for contacting the shield of a cable. The preferred type of shielding is tape shielding. However, according to this invention also wire shields can be contacted. In particular, an easy-to-bend contact plate is provided to which a connecting lead can be attached already in the factory or only during the assembly at the cable.

REFERENCE NUMERALS

Reference Numeral	Description
100	Connecting element
102	Contact element
104	Connecting lead
106	Contact segment
108	Hinge element
110	Clearance
112	Connecting region
114	Elongated cut-outs
116	Contact region
118	Main lead
120	Terminal lead
122	Connection point
124	Extension segment
126	Protrusion
128	Surface in contact with cable shield
130	Circumferential axis
132	Direction of bending
134	Surface opposite to the one in contact with cable shield

(continued)

Reference Numeral	Description
136	Back bone region
138	Arms of contact element
L	Length of contact segment
W	Width of contact segment
D	Width of contact element
702	Conventional contact element
703	Punched protrusion
704	Grounding lead of conventional contact element
708	Roll spring

Claims

1. Connecting element for contacting a shielding of a power cable, said connecting element (100) comprising:

an electrically conductive contact element (102) for electrically contacting said shielding, wherein said contact element (100) comprises a plurality of electrically conductive contact segments (106) which are interconnected by means of at least one hinge element (108).
2. Connecting element according to claim 1, wherein said at least one hinge element (108) is electrically conductive.
3. Connecting element according to claim 1 or 2, wherein at least one of said contact segments (106) carries at least one contact protrusion (126) which in a mounted state protrudes inwards towards the shielding.
4. Connecting element according to claim 3, wherein said at least one contact protrusion (126) is formed by stamped and bent cut-outs, or by elongated contact blades provided at a surface (128) of the contact element (102) which in the mounted state is directed towards said power cable.
5. Connecting element according to one of the preceding claims, further comprising an electrically conductive connecting lead (104) for connecting said connecting element (100) to a grounding point or another cable shielding.
6. Connecting element according to claim 5, wherein said connecting lead (104) comprises a metal braiding.
7. Connecting element according to claim 5 or 6, wherein said connecting lead (104) has an undulated cross-section.
8. Connecting element according to one of the claims 5 to 7, wherein said connecting lead (104) is connected to the contact element (102) by a press-on connection, at least one solder connection, at least one crimp connection, at least one welded connection and/or at least one rivet connection.
9. Connecting element according to one of the claims 5 to 8, wherein said connecting lead is connected to said contact segments (106) at connection points (122) which are aligned along at least a part of the length of said connecting lead (104).
10. Connecting element according to one of the claims 5 to 9, wherein said connecting lead (104) comprises at least two fanned out terminal leads (120) being connected to at least one of said contact segments (106).
11. Connecting element according to one of the preceding claims, wherein said contact element (102) is fabricated from a stamped metal sheet, wherein clearances (110) define said contact segments (106) and the at least one hinge element (108).
12. Connecting element according to one of the preceding claims, wherein said contact element (102) has a rectangular

outline and is bent to form at least a part of a cylindrical sleeve in the mounted state.

- 5 13. Connecting element according to claim 12, wherein at the peripheral regions which in the mounted state extend along a longitudinal axis of the cable, at least one extension segment (124) is provided which increases the circumferential dimension of the contact element (102) in a part of its length in the longitudinal direction.
- 10 14. Connecting element according to one of the preceding claims, further comprising a clamping element for pressing the contact element onto said shielding of the power cable, wherein said clamping element comprises at least one worm drive clip, cable tie and/or recoverable sleeve..
- 15 15. Connecting element according to one of the preceding claims, wherein said contact element (102) has a contact region (116) which in the mounted state is pressed onto said shielding layer of the power cable, and a connecting region (112) adjacent to said contact region (116), wherein said hinge elements (108) are arranged only in the contact region (116).
- 20 16. Connecting element according to one of the preceding claims, wherein said contact element (102) comprises a back bone region (136) and at least one arm (138) extending from said back bone region (136), wherein said contact segments (106) form said arms (138).
- 25 17. Connecting element according to one of the preceding claims, wherein, in the mounted state, at least one connecting lead (104) is attached directly to a surface (134) opposing to the surface (128) in contact with the cable shield.
- 30
- 35
- 40
- 45
- 50
- 55

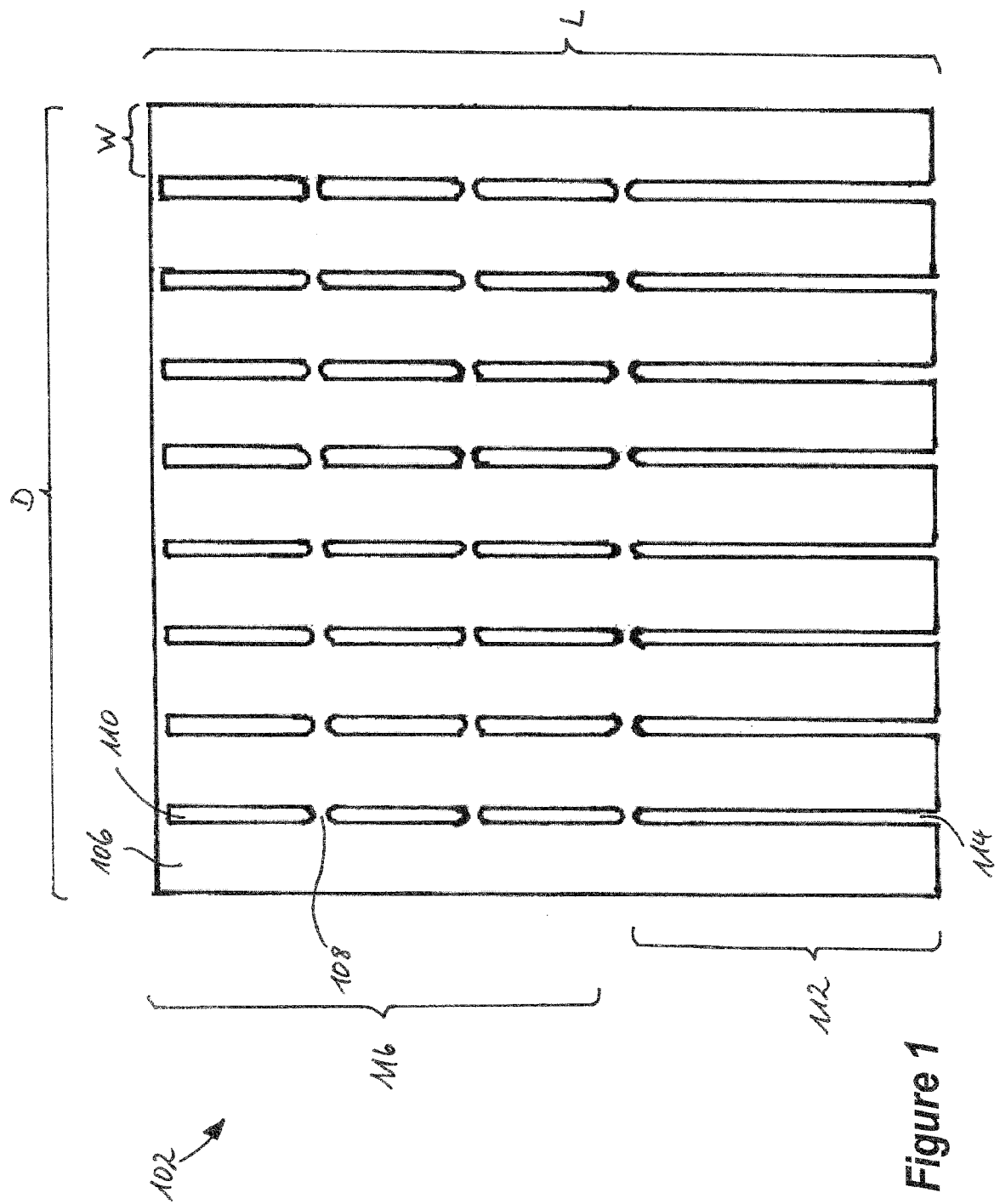


Figure 1

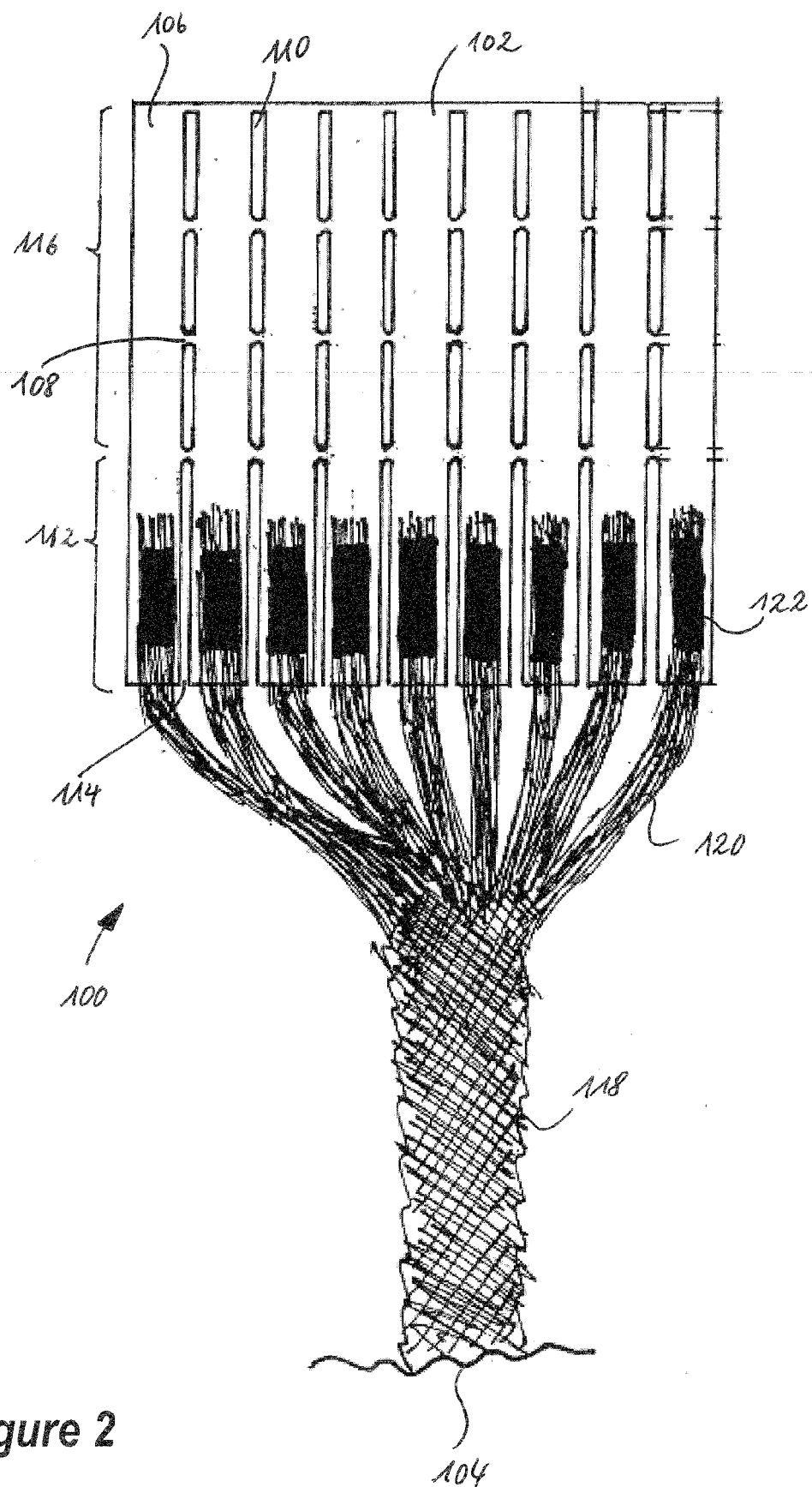


Figure 2

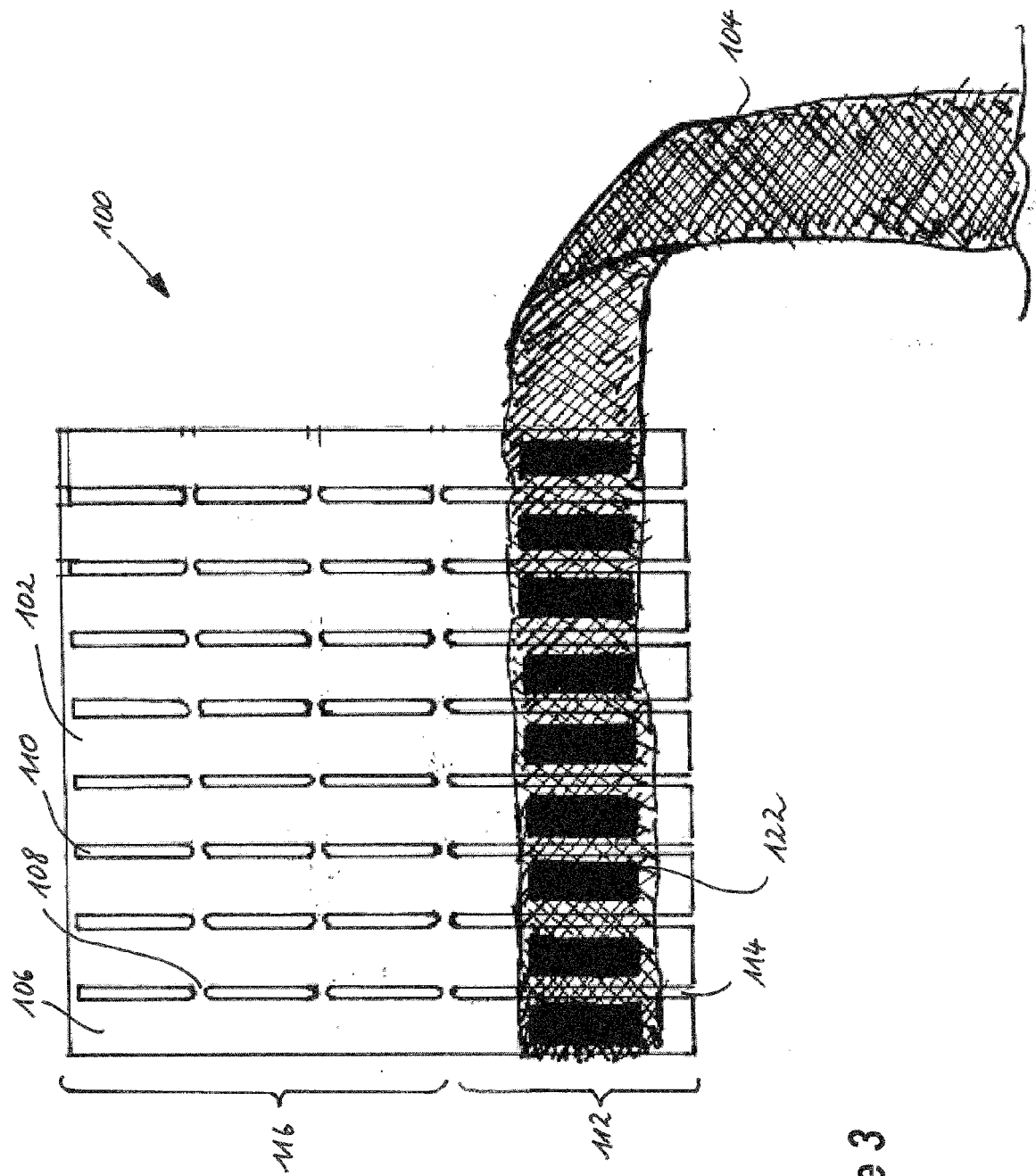


Figure 3

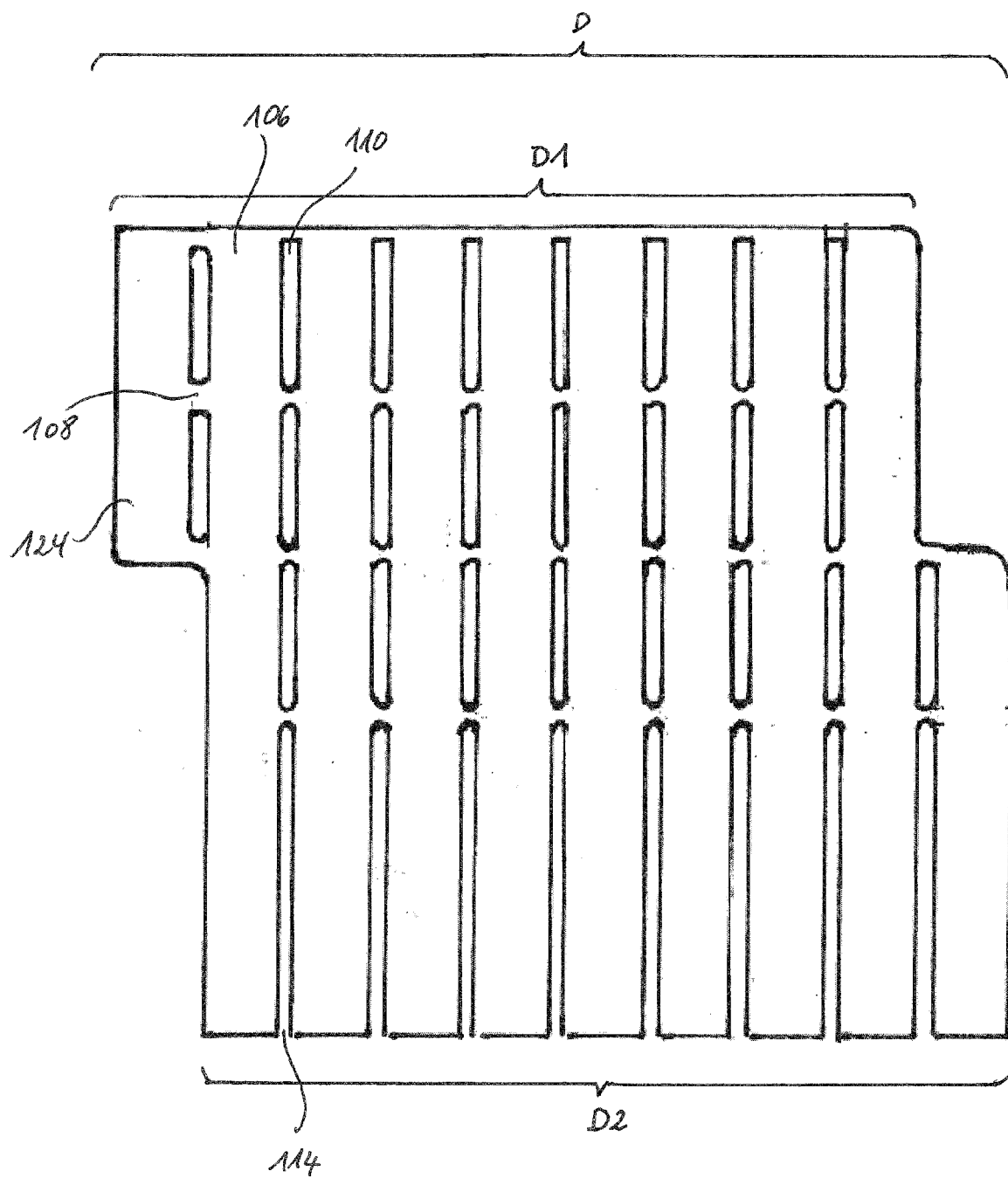


Figure 4

102

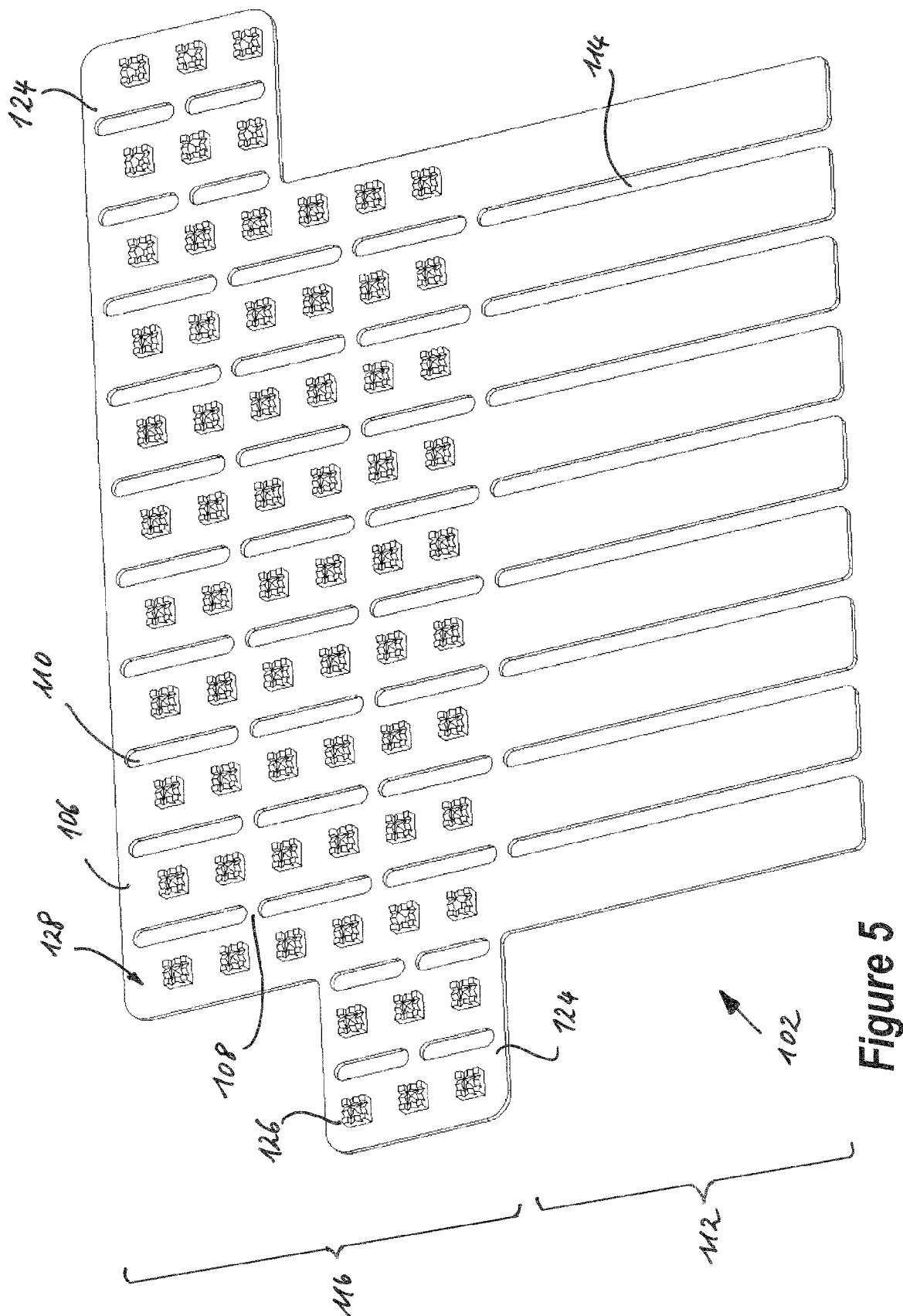


Figure 5

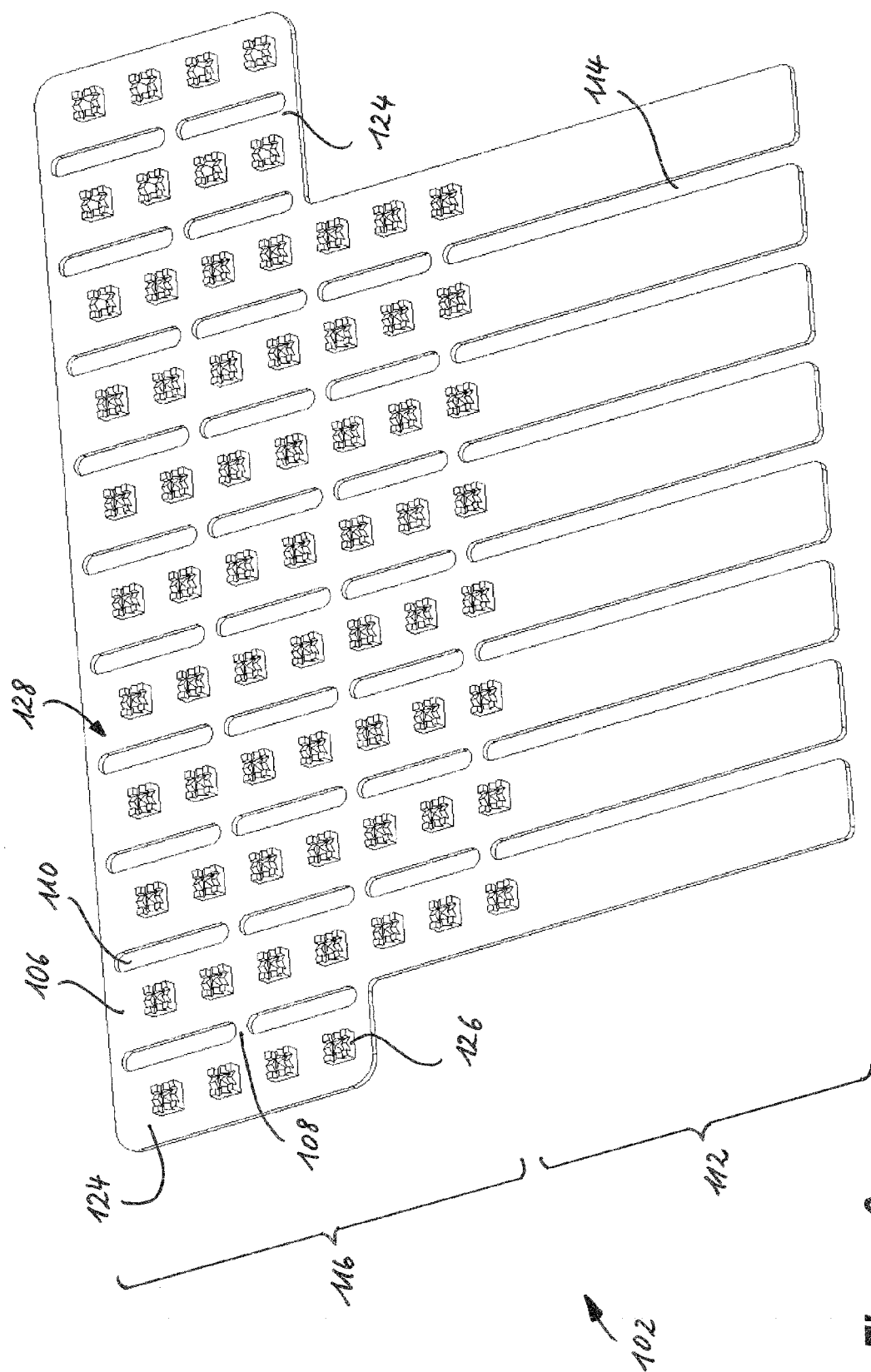


Figure 6

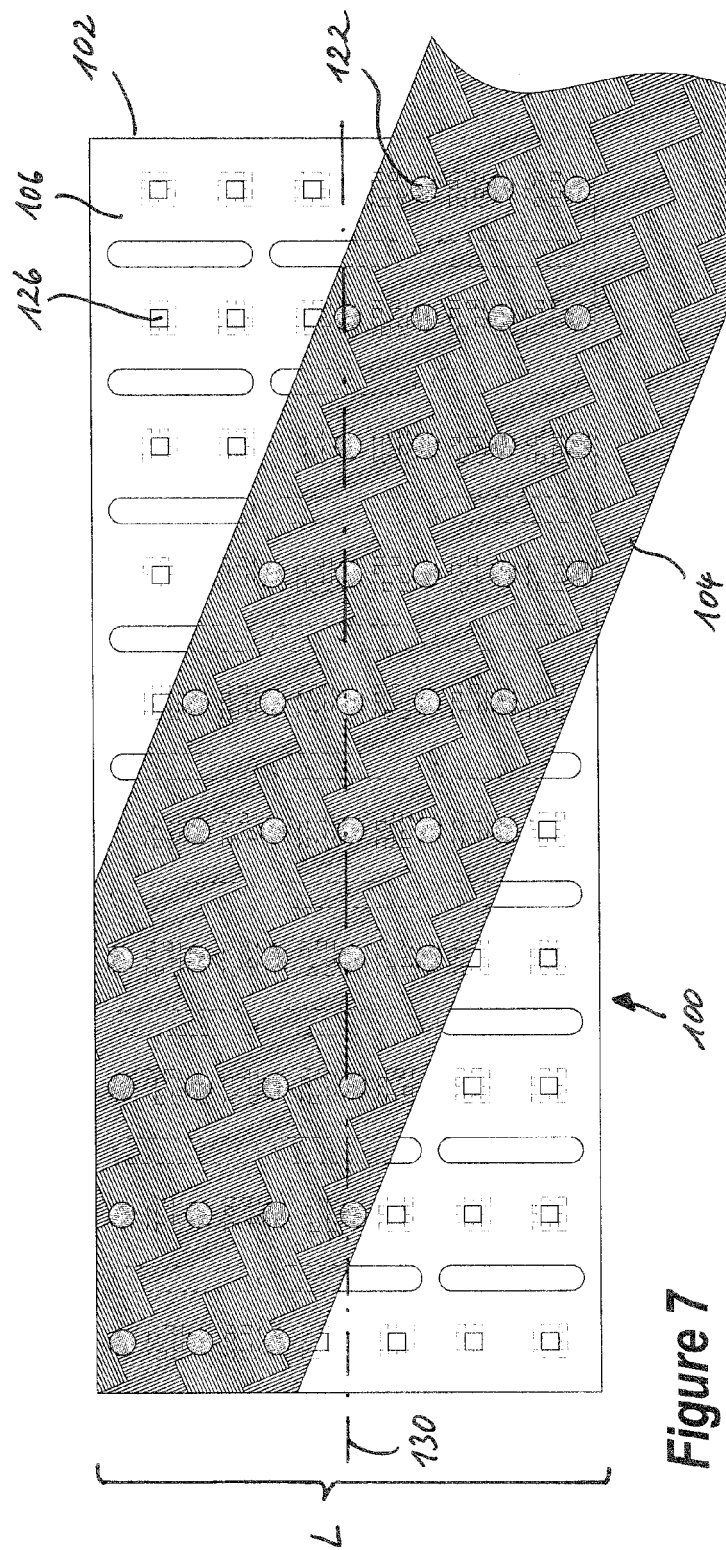


Figure 7

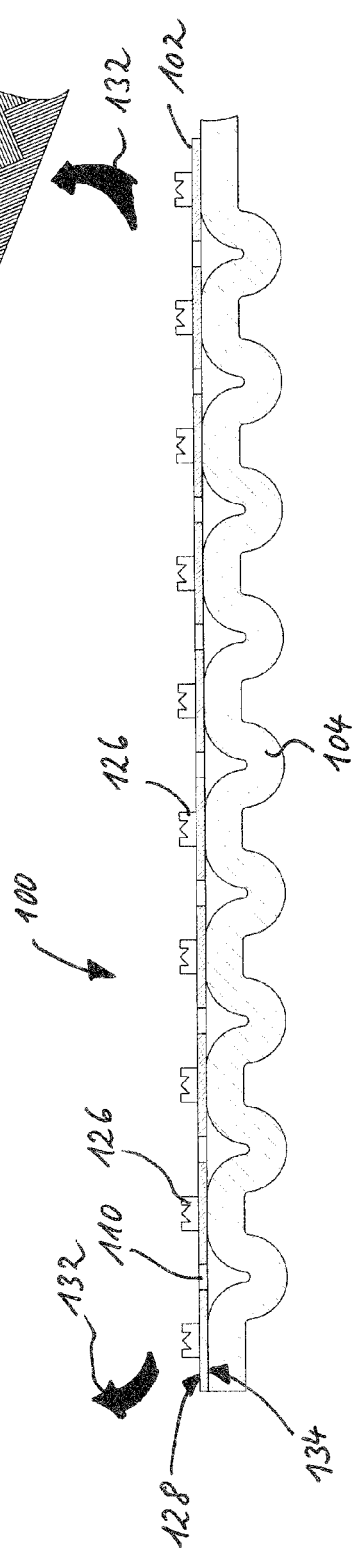


Figure 8

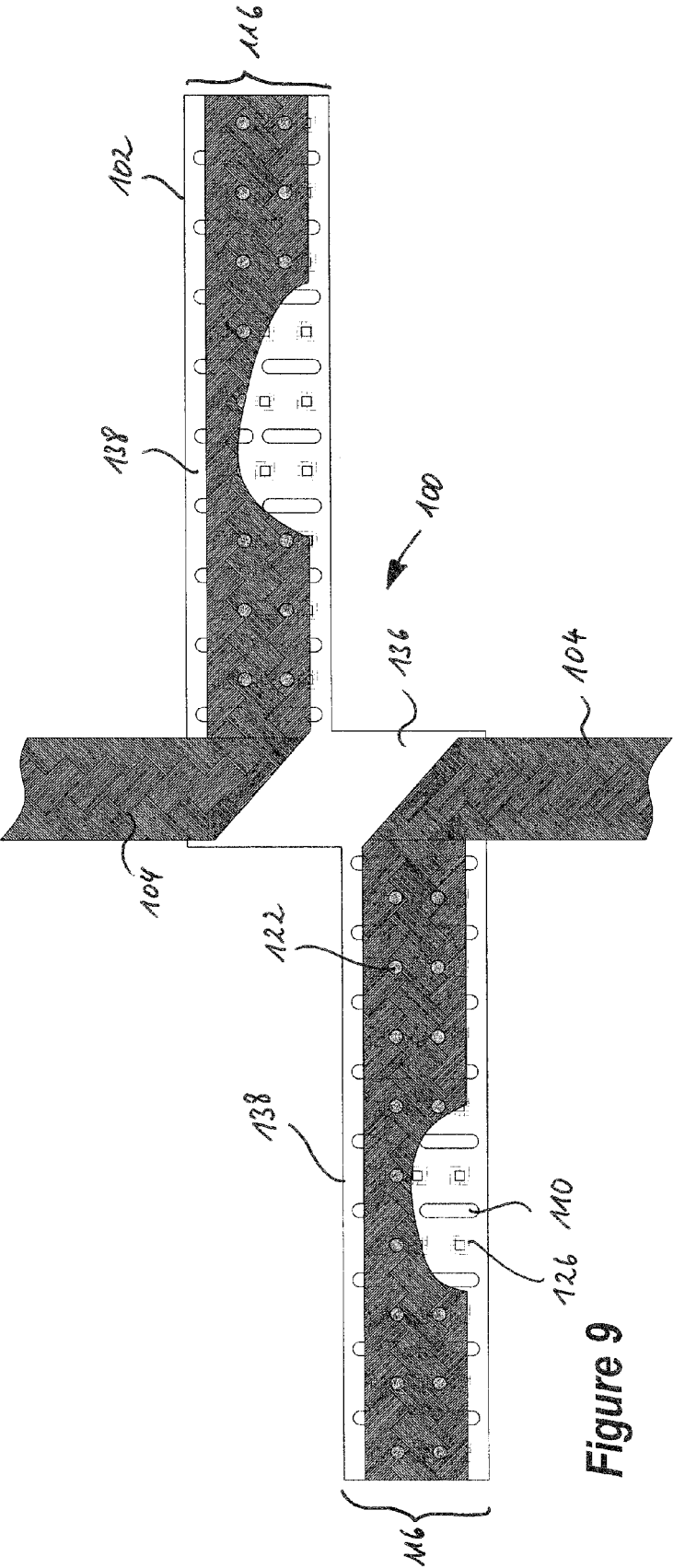


Figure 9

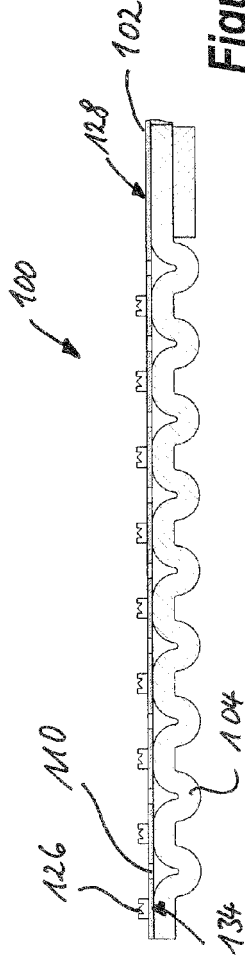


Figure 10

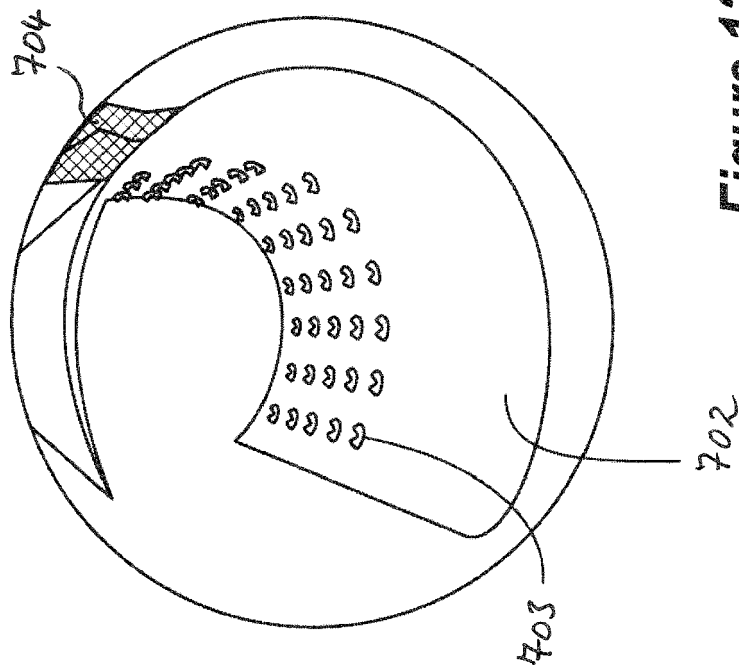


Figure 12

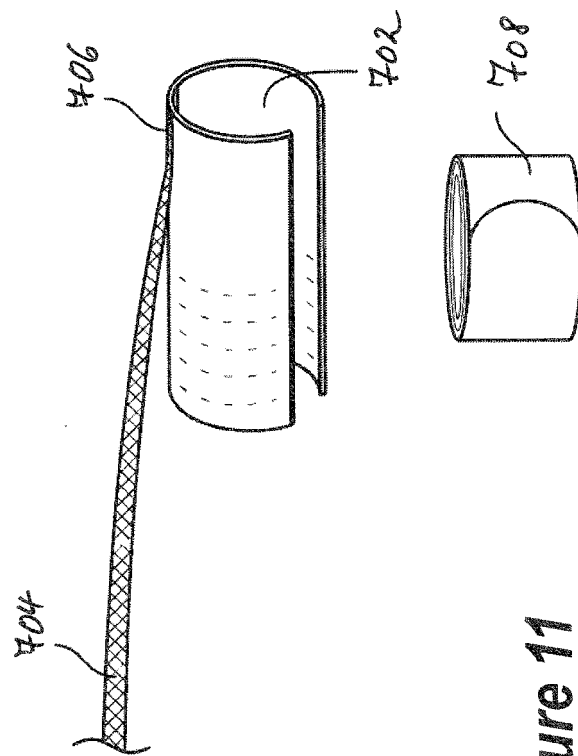


Figure 11



EUROPEAN SEARCH REPORT

Application Number
EP 14 19 5222

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 3 109 052 A (DUMIRE LEO G ET AL) 29 October 1963 (1963-10-29)	1-4,11, 12	INV. H01R4/64
Y	* figure 8 *	13	H01R4/26

X	US 2 250 280 A (STARBIRD MAURICE M) 22 July 1941 (1941-07-22)	1-3	
	* figures 7-9 *		

X	FR 2 271 688 A1 (CABLES DE LYON GEOFFROY DELORE [FR]) 12 December 1975 (1975-12-12)	1-6,8	
	* figures 1,2,4 *		

Y	FR 2 387 540 A1 (SCAL GP CONDIT ALUMINIUM [FR] SCAL GP CONDIT ALUMINIUM) 10 November 1978 (1978-11-10)	13	
	* figure 3 *		

			TECHNICAL FIELDS SEARCHED (IPC)
			H01R H02G
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		28 May 2015	Corrales, Daniel
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

1

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 14 19 5222

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

28-05-2015

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3109052	A	29-10-1963	NONE
US 2250280	A	22-07-1941	NONE
FR 2271688	A1	12-12-1975	NONE
FR 2387540	A1	10-11-1978	NONE

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- WO 2014072258 A1 [0008]