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(54) **MAT SEALING JOINT, ELECTRICAL CONNECTOR, AND METHOD OF MANUFACTURE**

KOMPRIMIERBARE DICHTUNGSFUGE, ELEKTRISCHER STECKVERBINDER UND HERSTELLUNGSVERFAHREN

JOINT D'ÉTANCHÉITÉ COMPRESSIBLE, CONNECTEUR ÉLECTRIQUE ET PROCÉDÉ DE FABRICATION

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Description

FIELD OF THE INVENTION

[0001] The instant invention relates to an electrical connector having a mat sealing joint, for instance electrical, optical or electro-optical connectors, and methods of manufacturing such mat sealing joints.

BACKGROUND OF THE INVENTION

[0002] Connectors are notably used for connecting an electrical, optical or electro-optical apparatus to another, and can be found in any kind of electrical, optical or electro-optical devices. Such connectors can for example be of the type comprising an electrically insulative housing in which electrical wires or optical fiber are inserted. In this document, electrical connectors are taken as examples, but the one skilled in the art will easily transpose these examples into connectors for optical or electro-optical applications.

[0003] Since it is undesirable that foreign bodies, such as dust and liquids, penetrate the inside of the connectors, it is preferable to seal the connectors against such foreign bodies. A given class of connectors therefore comprise a so-called mat sealing joint disposed between a housing body (main part of the housing) and a rear grid (rear part of the housing). Sealing is performed peripherally, for example by the sealing joint being compressed on the housing. Further, the sealing joint exerts sealing on each wire.

[0004] WO 2006/108,609 already describes such a mat sealing joint, which performs satisfactorily.

[0005] Mat sealing joints often comprise silicone which is an expensive material. Recently, one has striven to reduce the cost of such mat sealing joints. One way would be to remove material where its presence is not crucial, while still complying with the sealing requirements. This led to investigate shapes for mat sealing joints which are not totally symmetrical with respect to a plane transverse to the longitudinal axis of insertion of the wires. Such asymmetrical shapes are essentially counter-intuitive because the joint has to withstand sealing requirements both on insertion and removal of wires.

[0006] However, in turn, non-symmetrical shapes caused problems to manufacture with the high throughput required for this kind of products.

[0007] The instant invention has notably for object to provide a cheap mat sealing joint which would be easily manufactured at high operating speed, while still providing high sealing efficiency.

SUMMARY OF THE INVENTION

[0008] To this aim, it is provided an electrical connector comprising a mat sealing joint, according to claim 1, and a method of manufacturing a mat sealing joint for a connector, according to claim 7.

[0009] The joint according to the invention is made of a soft (which can be easily deformed) material (for instance a silicone). It has a main portion or central portion which defines at least one passageway extending in a longitudinal direction X. A wire, a cable or a fibre may be threaded through the passageway. Preferentially, it is designed to tightly receive and seal the wire, cable or fibre. Such a passageway may be closed or not by a membrane.

[0010] The joint according to the invention comprises at least one retaining structure extending at least partially in a plane substantially transverse to the longitudinal direction. Such a retaining structure may be a recess or a rib on an outer surface extending substantially parallel to the longitudinal direction X.

[0011] Indeed, the main function of the retaining structure is to receive, or to be received in, a back draft of the mould during the manufacture process, whereby the joint is retained on the back draft during unmolding.

[0012] When one uses a soft material, such as a silicone, for optimizing the sealing properties, and when the joint itself is "spineless" because the quantity of material is reduced for reducing the price of the joint, it becomes difficult to unmold it properly, reproducibly and reliably. That is the reason why, it is proposed according to the invention at least one maintaining structure for maintaining the joint in the mould while the mould is opened and before the joint is pushed out of the mould.

[0013] Usually, a joint has two main faces extending substantially transverse to the longitudinal (passageway) direction and the mould is opened by separating two parts of the mould along that longitudinal direction. Then according to the invention, one provides a maintaining structure extending at least partially transverse to that direction.

[0014] The maintaining structure also allows to reliably keep the joint always on the part of the mould comprising the back draft and to avoid adhesion of the joint to another part when the mould is opened.

[0015] This is particularly advantageous when the joint comprises at least one peripheral portion designed for improving the sealing properties. Such a peripheral portion usually comprises one peripheral protrusion extending substantially normal to the longitudinal direction, with two opposed surfaces extending substantially transverse to the longitudinal direction so as to be compressed along the longitudinal direction between two housing parts for providing axial sealing between the joint and these housing parts. For instance, the opposed surfaces extend parallel to each other. For moulding such a peripheral protrusion, a part of the mould may have a rib extending along the longitudinal direction which may draw the joint along while it is moved away from the joint along the longitudinal direction. Consequently, the invention provides a solution according to which at least one part of the mould is free to move without pulling the joint, while another is not.

[0016] According to the invention, the retaining struc-

ture is a recess so as to use even less material. According to the invention, such a recess is formed on a portion of the outer surface. The recess also comprises two surfaces substantially transverse to the longitudinal direction X, at least partially facing each other. According to the invention, the recess is located under the peripheral protrusion, so as to form a kind of hook that improves holding up the joint in the mould without interfering with the radial sealing properties of the peripheral portion.

[0017] In some embodiments, one might also use one or more of the features as defined in the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] Other characteristics and advantages of the invention will readily appear from the following description of five of its embodiments, provided as non-limitative examples, and of the accompanying drawings.

[0019] On the drawings :

- Fig. 1 is an exploded perspective view of a connector according to a first embodiment,
- Fig. 2 is a sectional view along line II-II of Fig. 1, of a connector with a terminal crimped on a wire,
- Fig. 3 is a partial enlarged view of Fig. 2,
- Fig. 4 is a sectional view taken along lines IV-IV of Fig. 6, of a mat sealing joint according to a second embodiment,
- Fig. 5 is a sectional view taken along lines V-V of Fig. 6, of the mat sealing joint according to the second embodiment,
- Fig. 6 is a sectional view taken along lines VI-VI of Fig. 5, of the mat sealing joint according to the second embodiment,
- Fig. 7 is a bottom perspective view of the mat sealing joint of the second embodiment,
- Fig. 8 is a top view of the mat sealing joint of the second embodiment,
- Fig. 9 is a bottom view of the mat sealing joint of the second embodiment,
- Fig. 10 is a schematic sectional view of a first step of manufacture of a mat sealing joint according to the second embodiment, seen in the same plane as Fig. 5,
- Fig. 11 is a view similar to Fig. 10 of a second step of manufacture of a mat sealing joint,
- Fig. 12 is a view similar to Fig. 7 of a third embodiment of a mat sealing joint,
- Fig. 13 is a view similar to Fig. 6 of the third embodiment of a mat sealing joint,
- Fig. 14 is a view similar to Fig. 7 of a fourth embodiment of a mat sealing joint, and
- Fig 15 is a side view of a fifth embodiment of a mat sealing joint.

[0020] On the different Figures, the same reference signs designate like or similar elements.

DETAILED DESCRIPTION

[0021] Fig. 1 shows an electrical connector 1 to be connected to a mating connector (not shown). A joint 3 of any suitable shape and material is mounted in the connector, to be interposed between the connector 1 and the mating connector for sealing this connection.

[0022] The electrical connector 1 comprises a housing comprising a housing body 4, a front grid 2 and a rear grid 15, all made of a dielectric thermoplastic material. The front grid 2 is locked to the front mating end of the housing body before assembly to the mating connector. The housing body 4 comprises a front connection portion 5 and a back portion 6. The connection portion comprises a plurality of pathways 7 (visible on Fig. 2) extending along a longitudinal direction X between a front face 8, which is a mating face with the mating connector, and a back face 9. The pathways are shaped to receive electrical terminals 13 which will be described in more details below.

[0023] The back portion 6 partly encloses a receiving space 10 (Fig. 1) for a mat sealing joint 20 to be described in more details later. For example, the receiving space 10 is defined by four lateral walls 12 all extending along the longitudinal direction. The walls 12 may further comprise locking features 11 such as through slots formed in two of the walls 12, for cooperation with complementary locking features 14 of the rear grid 15 (to be described below). The receiving space 10 may further comprise guiding features 16 such as, for example, longitudinal grooves extending along the longitudinal direction in the walls 12, for cooperation with complementary guiding features 17 of the rear grid 15 to be described in more details below.

[0024] The back portion 6 further comprises a lower edge 18 extending along the periphery of the back portion 6 and above the back face 9, and facing upward. Alignment parts 41 can project upwardly from the lower edge 18 at suitable locations of the housing, laterally offset inwardly with respect to the lower edge 18.

[0025] The back portion further comprises a sealing portion 19 located upward and laterally offset outwardly with respect to the lower edge 18. The geometry and use of the sealing portion 19 will be described in more details below.

[0026] The connector 1 further comprises a mat sealing joint 20, which will now be described in more detail in relation to the following Figures. Such a mat sealing joint is made of a material suitable for sealing the connector against water and/or dust such as, for example an elastically deformable elastomeric polymer material, such as some suitable silicones.

[0027] The mat sealing joint of Fig. 1 has one row of five pathways 22. However, the number of pathways is irrelevant for the present invention, and the mat sealing joint can have any suitable number of a*b pathways, such as, for example, 1*2 pathways as shown in the second embodiment of Figs. 4 to 9.

[0028] As shown on Fig.2, the mat sealing joint 20 comprises, seen from the side, a central portion 21 which comprises a plurality of pathways 22 extending along the longitudinal direction X, from an upper surface 22a to a lower surface 22b. For example, the thickness of the joint is about 4.8 mm, measured between the upper and lower surfaces 22a, 22b. Each of the pathways 22 corresponds to a pathway 7 of the housing body, for receiving an electrical terminal 13. As it is visible for example on Fig. 2, the pathways 22 have an internal cross-sectional shape designed for sealing around wires of the electrical terminals 13, comprising for example two ribs 23 of reduced diameter and of suitable geometry, and possibly an internal membrane to be torn upon insertion of the electrical terminal 13.

[0029] An outer portion 24 of the mat sealing joint extends outward from the central portion. A protrusion 29 of the mat sealing joint extends in the peripheral portion 124 in the upper region 38 of the mat sealing joint 20. The outer portion 24 defines a sensibly parallelepipedic ring having an upper surface 24a and a lower surface 24b.

[0030] As shown on Fig. 3, a protrusion 29 of the peripheral portion 124 of the mat sealing joint has a T-shaped cross-section. The T-shape comprises a foot 36 extending in a plane transverse to the longitudinal direction and a head 37 extending along the longitudinal direction. The foot 36 has upper 36a and lower 36b surfaces normal to the longitudinal direction.

[0031] The head 37 comprises an external surface 37a facing toward the internal face of the housing, and two opposite inwardly-facing abutting faces 37b, 37c.

[0032] The sealing portion 19 has a surface normal to the longitudinal direction and facing upward, facing the lower surface 36b of the foot 36. The housing body further comprises a lateral abutting surface 52 facing the abutting face 37b of the joint.

[0033] Seen from the side (Fig. 2), the central portion 21 is mechanically connected to (integral with) the outer portion 24 by way of an uncoupling portion 28. According to the first embodiment, the uncoupling portion 28 comprises a central peripheral rib 27 and flexible ribs extending in recesses 26 of the joint. Upper flexible ribs 25 are visible on Fig. 1. Such flexible ribs 25 may extend, along the longitudinal direction, from the central rib 27 to the upper or lower surface of the joint and, in a transverse direction, from an internal face of the outer portion 24 to an external face 21b of the central portion 21.

[0034] The uncoupling portion 28 is designed to allow a play between the central portion 21 and the outer portion 24. It should be noted that, in the described embodiment, the upper surface 22a of the central portion project upward with respect to the upper surface 24a of the outer portion 24. Hence, the ribs 25 can extend sensibly upward from the upper surface 24a of the external portion to the upper surface 22a of the central portion 21. Further, the ribs may be angled (not orthogonal, for example by 20°-70°) with respect to the internal faces of these portions, so as to adjust the way to bring into play the flexibility of the ribs.

[0035] The ribs 25 may be oriented to be close to the central vertical plane (XZ) of the central portion, and close to the corner of the peripheral portion. The recesses 26 enable to manufacture a mat sealing joint with less material and thus ultimately cheaper.

[0036] As can be seen on Figs. 2 and 3, a recess 35 is provided on an outer surface of the joint, in the outer surface 24c of the peripheral portion 124, below the protrusion 29. The recess hence is provided below the broadest portion of the joint. The recess 35 comprises a top-facing face 35a and an opposed bottom-facing face 35b which respectively face along and opposite the longitudinal direction X. According to other variations, these faces could face only partly along and opposite this direction (the normal to these faces each forming an angle of for example at least 20° with respect to this direction). According to this embodiment, the recess 35 could be a groove provided in the outer surface all along the periphery of the joint.

[0037] Referring back to Fig. 1, the housing 1 further comprises the grid 15 which has been already partially described above. The grid 15 comprises a plurality of pathways 30, which extend along the longitudinal direction X between an upper face 15a and an opposite lower face 15b (Fig. 2), and each corresponds to a corresponding pathway 22 of the mat sealing joint 20 and a corresponding pathway 7 of the housing body 4.

[0038] The grid 15 may further comprise guiding features 17 (Fig. 1) such as ribs complementary to the grooves 16 of the housing.

[0039] The grid 15 may further comprise locking features 14 such as elastic tongues complementary to the openings 11 of the housing body 4 and adapted to be deformed upon insertion of the grid in the housing body, and to spring back into the openings 11 to lock the grid to the housing body.

[0040] The bottom portion of the grid further comprises a sealing portion 50 (Fig. 2) projecting downward from the lower face. The geometry and use of the sealing portion will be described in more details below.

[0041] The connector 1 is shaped to receive electrical terminals 13 which are classically comprised of an electrical terminal member 32 connected to, for example by crimping, a wire 33 (Fig. 1). Only one such terminal is shown on Fig. 1. In the assembled state, the electrical terminal member 32 is located in a corresponding pathway 7 of the housing, while the wire 33 extends through the corresponding pathway 22 of the mat sealing joint 20 and through the corresponding pathway 30 of the grid. The longitudinal direction X referred to above and below is defined as the longitudinal direction of extension of the wire 33 at least in the mat sealing joint 20, from the grid side to the housing body side. The expressions upward, downward, upper, lower, transverse, etc. are defined with respect to this longitudinal direction X, unless it is obvious from the description that these terms locally have another

meaning.

[0042] When the electrical terminal 13 is introduced into the connector 1, the sealing ribs 23 are compressed onto the external surface of the wire 33 so as to achieve efficient sealing of the wire 33 (Fig. 2).

[0043] In the assembled state of the connector 1, as shown in particular on Figure 2, the lower face 22b of the central body of the mat sealing joint 20 rests on the lower edge 18 of the housing body. Two alignment lances 41 of the housing body are introduced in corresponding recesses 26 of the mat sealing joint, however without applying much transverse compression (in particular no transverse compression usable to attain the sealing requirements) to the material of the mat sealing joint. The transverse compression is the compression exerted in a plane transverse to the longitudinal direction X. A play along the longitudinal direction between the connection portion 5 of the housing body and the mat sealing joint 20 is defined by a gap 34 between the upper face 9 of the connection portion 5 of the housing and the lower face 22b of the joint.

[0044] The grid is mechanically connected to the housing body by way of the cooperation of the locking features 14 of the grid and the locking features 11 of the housing body. Locating lances, projecting from the bottom face of the grid, may be introduced in corresponding recesses 26 of the mat sealing joint, however without applying much transverse compression to the material of the mat sealing joint (Fig. 1). A play along the longitudinal direction between the grid and the mat sealing joint 20 is defined by a gap 42 between the lower face 15b of the grid and the upper face 22a of the joint (Fig. 2).

[0045] Thanks to the gaps 34,42 no compression of the central portion 21 along the longitudinal axis X occurs. Such a compression would lead to transverse compression, this one would be partially transferred through the uncoupling portion 28 to the outer portion 24 and transverse compression would be exerted on the mat sealing joint by the internal faces 12a of the housing. Instead in an embodiment as per fig. 2 a mere contact exists here.

[0046] Thanks to the gaps 34 or 42, free space is available allowing the lips 23 to bent forward or rearward along X axis without being stressed when a terminal member 32 is introduced or withdrawn through the joint. This decreases the risk of damaging the lips.

[0047] The sealing between the grid 15 and the housing body 4 can be performed peripherally as detailed below in relation to Figure 3.

[0048] Locally, the grid comprises a sealing portion 50 which has a surface normal to the longitudinal direction and facing downward, facing the upper surface 36a of the foot 36. The grid further comprises a lateral abutting surface 53 facing the abutting face 37c of the joint.

[0049] When the grid is mechanically connected to the housing, the mat sealing joint is pressed between the housing and the grid. More specifically, the foot 36 of the T-shape is pressed between the sealing portion 19 of the housing and the sealing portion 50 of the grid all along the periphery of the joint. The pressing surfaces of these sealing portions compress the foot 36 sensibly along a direction parallel to the longitudinal direction (so-called "longitudinal peripheral sealing"), so as to achieve the desired degree of sealing. For example, the degree of compression of the foot 36 is at least 20%, preferably at least 25%. No transverse sealing compression is required by the housing on the external surface 37a of the joint. Indeed, the terms "compression" or "sealing compression" are used here to designate a compression of the material sufficient to achieve the sealing requirements. The mere fact that a face of the joint is in contact with a face of the housing, is not considered as "compression".

[0050] Alternatively the head 37 can be tight fitted inside the housing in such a way that the transverse compression is performed between the housing and the external surface 37a of the joint, adding a second sealing point for better efficiency.

[0051] When an electrical terminal 13 is inserted into the assembled connector 1 along the longitudinal direction, a certain degree of freedom is allowed in the central portion, without adversely affecting the peripheral sealing, thanks to the above described uncoupling portion 28 and gaps 34, 42. The alignment lances of the housing body and the grid participate to maintaining the mat sealing joint in place during insertion. If, however, the insertion effort is so intense that it tends to cause a transverse movement inward of the peripheral portion, the abutting surfaces 37b and 37c will abut on the facing abutting surfaces respectively, of the housing body and grid, so as to maintain the peripheral sealing portion of the joint in place. The same applies to extraction efforts and bending efforts of the electrical members.

[0052] When submitted to thermal tests (for example heating at 175 °C for 240 hours), the recesses 26 in the mat sealing joint, and the gaps 34, 42 between the mat sealing joint and the housing body or the grid, allow the mat sealing joint to expand more than the housing body and the grid without deforming them.

[0053] Turning now to Figs. 4 to 8, a second embodiment will be described.

[0054] The second embodiment is described with reference to the first embodiment. According to the invention, the joint 20 has a globally truncated shape.

[0055] By truncated shape, it is meant that, without considering the recess, the surface defined by the outer perimeter of the joint, in cross-section transverse to the longitudinal axis, will decrease (or locally remain constant) all along the longitudinal axis, from a broad portion to a narrow portion.

[0056] Seen from the side, the peripheral portion 124 and the uncoupling portion 28 extend only in the upper region 38 of the mat sealing joint 20.

[0057] Hence, in the lower region, the outer surface 21a of the central portion 21 forms the outer surface of the mat sealing joint 20. Overall, the mat sealing joint appears to have a three-stepped truncated shape. In the

upper region 38, the mat sealing joint comprises all of the central, uncoupling and peripheral portions, and is therefore broader than in the lower region 39, where the mat sealing joint comprises only the central portion. In a region 138, intermediate between the upper and lower regions, the peripheral portion does not comprise the protrusion 29. There, the joint is broader than in the lower portion, but narrower than in the upper portion.

[0058] Locating lances 51 of the grid are visible on Fig. 4 for the second embodiment.

[0059] Turning to Fig. 7, ribs 31 may be provided in the lower region 39 of the mat sealing joint. Such ribs 31 may extend from the peripheral rib 27 downward and toward the outer surface of the central portion 21. For example, they exhibit a triangular cross-section as shown on Fig. 7. In a fashion similar to the ribs 25, the ribs 31 may be disposed:

- along the length direction Y of the joint 20: one rib 31 on each side of a pathway 22, the two ribs forming an imaginary line passing through the centre of a pathway,
- along the width direction Z of the joint 20: two ribs per pathway. The two ribs may for example be symmetrical with respect to an imaginary line passing through the centres of the pathways, and half-way between this imaginary line and the corner of the pathway.

[0060] Turning to Fig. 8, the ribs 25 of the upper portion of the joint are described. For example, two neighbour ribs 25 joining one face of the central portion to the corresponding face of the peripheral portion together form a V-shape, possibly truncated, with the edge of the V closer to the surface of the central portion.

[0061] Compared to the first embodiment, the housing body is also modified in that the lower edge 18 and discrete locating lances 41 are removed, and are replaced by shoulders 141 (Fig. 4) which project upwardly from the back face 9 at suitable locations of the housing body, and are separated from each other by grooves.

[0062] The ribs 31 and these grooves are shaped to allow insertion of the ribs 31 in respective grooves.

[0063] The recess 35 may be provided continuously around the periphery of the joint as in the first embodiment, as shown on Fig. 12. However, according to this second embodiment, as shown on Fig. 7, a recess 35 is provided at each corner region of the mat sealing joint 20. As shown on Fig. 6, the recess 35 has a shape corresponding to that of the facing recess 26. The recess 35 is separated from the corresponding facing recess 26 of the uncoupling portion by a sufficient thickness t of material.

[0064] As above explained, there are two main modifications of the second embodiment with respect to the first embodiment: The 3-stepped truncated shape of the joint and the discontinuous recess 35. These two modifications are unrelated, and additional embodiments where only one of these modifications is implemented may be encompassed in the present description.

[0065] Turning now to Figs. 10 and 11, a method of manufacture of a mat sealing joint according to the second embodiment is described. A manufacturing apparatus is provided. The manufacturing apparatus comprises a mold 43. The mold may for example consist of at least 3 parts together defining a cavity 44. These three parts are a central plate 45 shaped to define at least the recess(es) 35 and advantageously a portion of the outer surface of the joint at this level, a top part 46 formed as a half-cavity shaped to define the shape of the joint on one side of this central plate, and a bottom part 47 formed as a half-cavity shaped to define the shape of the joint on the other side of this central plate.

[0066] During a first step, the deformable joint-forming plastic material is introduced to fill the cavity and to take the shape imparted by the mold 43. Then, both the top part 46 and the bottom part 47 are moved out of place, as illustrated by the arrows on Fig. 10. Since the material is deformable, it easily deforms out of the top part 46 and the bottom part 47.

[0067] As shown on Fig. 10, at this stage, the joint 20 is efficiently retained within the central plate 45 thanks to the recesses 35. Hence, opposed top and bottom faces 45a and 45b of the central plate 45 each correspond with a respective top and bottom face 35a, 35b of the recess 35. The central plate 45 ensures that, during the previous unmolding step, the asymmetrical joint will not remain stuck to one of the top part 46 and the bottom part 47. Hence, reproducibility of the unmolding step is enhanced, and the apparatus can operate at high speed.

[0068] As shown on Fig. 11, the joint 20 is then removed from the central plate 45 by any suitable automated means. For example, an ejector plate 48 is moved along the arrow of Fig. 11, and imparts pressure onto the joint until it detaches from the central plate 45. Ejector plate 48 has advantageously a large surface so as to prevent any high stresses to be imparted on the joint. After the formed joint is removed from the central plate 45, the process can start anew.

[0069] This process of course could be implemented in parallel, to manufacture many joints simultaneously. A similar process could be implemented to manufacture the joint according to the first embodiment, or to any one of the embodiments described here.

[0070] As shown on Fig. 13, according to another embodiment, it is provided a mat sealing joint where the recess 35 has a similar cross-sectional profile as the one of the second embodiment but however extends as a groove all over the periphery of the mat sealing joint.

[0071] As shown on Fig. 15, according to yet another embodiment (having 1*4 pathways), the recess 35 does not have a similar cross-section, but the face 35a forms an angle with the longitudinal direction, for example of 20° as shown or more, preferably of 45° or more, i.e. forms a slanted surface with respect to the rest of the outer face of the joint. The other face 35b may for example

retain its orientation normal to the longitudinal direction. Such recess 35 may be provided on all or part of the periphery of the joint.

[0072] As shown on Fig. 14, according to yet another embodiment, a plurality of individual recesses 35, at least one on each lateral side of the mat sealing joint. For example, each recess 35 is provided in correspondence with a respective rib 25 (not visible) and/or, as shown, with a respective rib 31.

[0073] The location around the periphery of the joint, the length and the cross-section of the recess/recesses 35 are defined in each case in order that the retaining of joint in the central plate 45 is strong enough, but nevertheless that the rigidity of the joint remain sufficient to keep the tightness notwithstanding the external constraints, e.g differential pressure between upper and lower surfaces 22a, 22b of the joint.

[0074] As it will be apparent to the person skilled in the art, the above embodiments may be combined, when appropriate.

Claims

1. An electrical connector (1) comprising a housing body (3), a rear grid (15) and a mat sealing joint (20), said mat sealing joint (20) adapted to be disposed between the housing body (4) and the rear grid (15), said mat sealing joint (20) being made of a deformable material and having a central portion (21) defining at least one passageway (22), extending along a longitudinal direction (X) and adapted to sealingly receive a wire, fibre or cable (13),
wherein the mat sealing joint (20) comprises

- an outer surface (24c)
- at least one peripheral portion (124), comprising one peripheral protrusion (29) extending essentially normal to the longitudinal direction (X), and having two opposed parallel faces (36a, 36b) each extending transverse to the longitudinal direction (X), at least one retaining structure (35) extending at least partially in a plane substantially transverse to the longitudinal direction (X) wherein the retaining structure is a recess (35), and
- the recess (35) formed in the outer surface (24c) of the peripheral portion (124), **characterized in that** said recess (35) comprises a top-facing face (35a) and an opposed bottom-facing face (35b) substantially transverse to the longitudinal direction (X) which respectively face at least partly along and opposite said longitudinal direction (X),and wherein the peripheral protrusion (29)is adapted to be compressed along the longitudinal direction (X) to provide sealing with the housing (4, 15) of the electrical connector wherein the mat sealing joint (20) has a globally truncated shape, in which the outer surface decreases all along the longitudinal axis (X) from a broad portion to a narrow portion, wherein the recess (35) is located below the protrusion (29) below a broadest point of the mat sealing joint (20) with respect to the longitudinal direction (X).

2. An electrical connector (1) according to claim 1, wherein the recess (35) comprises a groove extending all along the periphery of the mat sealing joint (20).

3. An electrical connector (1) according to claim 1, wherein the recess (35) is provided adjacent the peripheral protrusion (29).

4. An electrical connector (1) according to any of claims 1 to 3, wherein the mat sealing joint (20)has a polygonal cross-section normal to the longitudinal direction, and wherein the mat sealing joint has a plurality of recesses, and
the recesses (35) are formed in the outer surface (24c), adjacent the peripheral protrusion (29), at corners of said cross-section.

5. An electrical connector (1) according to any of claims 1 to 4, further comprising an uncoupling portion (28), located between the central portion (21) and a peripheral portion (124), and comprising at least one groove (26) adapted to prevent movement of the central portion to propagate to the peripheral portion.

6. An electrical connector (1) according to claim 5, the mat sealing joint comprising, seen from above:

- a central portion (12) comprising at least a passageway (22), said passageway extending along a longitudinal direction (X) and being adapted to sealingly receive a wire, cable or fibre (13),
- the peripheral portion (124), to be placed in sealing engagement with a housing (4, 15) of the electrical connector,
- the uncoupling portion (28), located between the central (21) and the peripheral portion (124), and comprising at least one groove (26) adapted to prevent movement of the central portion (21) to propagate to the peripheral portion (124), the mat sealing joint

comprising, seen from a side:

- a broad first portion (38) comprising said peripheral portion (124) and said uncoupling portion (28),
- a narrow second portion (39)

wherein an outer surface (21a) of the central portion

(21) forms the outer surface (24c) of the mat sealing joint (20).

7. A method of manufacturing a mat sealing joint (20) for a connector, said mat sealing joint (20) being adapted to be disposed between a housing body (4) and a rear grid (15), said mat sealing joint (20) being made of a deformable plastic material, the method comprising the following steps:

- providing a mold (43) having a central retention device (45) and two half cavities (46, 47) placed on both sides of said retention device (45), the central retention device (45) and the two half cavities (46, 47) together defining a cavity (44),
- introducing matter so as to form in the cavity a mat sealing joint (20) having:

  - a central portion (21) defining at least one passageway (22), extending along a longitudinal direction (X) and adapted to sealingly receive a wire, cable of fibre (13),
  - an outer surface (24c), and
  - at least one peripheral portion (124), comprising one peripheral protrusion (29) extending essentially normal to the longitudinal direction (X), and having two opposed parallel faces (36a, 36b) each extending transverse to the longitudinal direction (X), and adapted to be compressed along the longitudinal direction (X) to provide sealing with a housing (4, 15) of an electrical connector
  - at least one retaining structure (35) extending at least partially in a plane substantially transverse to the longitudinal direction wherein the retaining structure is a recess,
  - the recess (35) formed in the outer surface (24c) of the peripheral portion (124), said recess (35) comprising a top-facing face (35a) and an opposed bottom-facing face (35b) substantially transverse to the longitudinal direction (X) which respectively face at least partly along and opposite said longitudinal direction (X), the recess (35) located below the protrusion (29) below a broadest point of the mat sealing joint (20) with respect to the longitudinal direction (X), and
  - a globally truncated shape, in which the outer surface decreases all along the longitudinal axis from a broad portion to a narrow portion,

- withdrawing the two half-cavities (46, 47), whereby the mat sealing joint (20) is retained on the central retention device (45) by cooperation of the central retention device (45) with said retaining structure (35).

8. Method according to claim 7, further comprising deforming the mat sealing joint (20) out of the central retention device (45).

Patentansprüche

1. Ein elektrischer Verbinder (1), der einen Gehäusekörper (3), ein hinteres Gitter (15) und eine Mattendichtungsverbindung (20) aufweist, wobei die Mattendichtungsverbindung (20) ausgebildet ist, zwischen dem Gehäusekörper (3) und dem hinteren Gitter (15) angeordnet zu sein, wobei die Mattendichtungsverbindung (20) aus einem verformbaren Material besteht und einen zentralen Teil (21) hat, der zumindest einen Durchlass (22) definiert, der sich entlang einer Längsrichtung (X) erstreckt und ausgebildet ist zum abdichtenden Aufnehmen eines Drahts, einer Faser oder eines Kabels (13), wobei die Mattendichtungsverbindung (20) aufweist

- eine äußere Oberfläche (24c),
- zumindest einen peripheren Teil (124), der einen peripheren Vorsprung (29) aufweist, der sich im Wesentlichen senkrecht zu der Längsrichtung (X) erstreckt, und zwei gegenüberliegende parallele Flächen (36a, 36b) hat, die sich jeweils quer zu der Längsrichtung (X) erstrecken, zumindest eine Haltestruktur (35), die sich zumindest teilweise in einer Ebene im Wesentlichen quer zu der Längsrichtung (X) erstreckt, wobei die Haltestruktur eine Aussparung (35) ist, und
- die Aussparung (35), die in der äußeren Oberfläche (24c) des peripheren Teils (124) gebildet ist, **dadurch gekennzeichnet, dass** die Aussparung (35) eine nach oben gewandte Fläche (35a) und eine gegenüberliegende nach unten gewandte Fläche (35b) im Wesentlichen quer zu der Längsrichtung (X) aufweist, mit der jeweiligen Fläche zumindest teilweise entlang und gegenüber der Längsrichtung (X), und wobei der periphere Vorsprung (29) ausgebildet ist, entlang der Längsrichtung (X) komprimiert zu werden, um eine Abdichtung mit dem Gehäuse (4, 15) des elektrischen Verbinders vorzusehen, wobei die Mattendichtungsverbindung (20) eine global kegelstumpfartige Form hat, wobei die äußere Oberfläche entlang der Längsachse (X) von einem breiten Teil zu einem schmalen Teil abnimmt, wobei sich die Aussparung (35) unter dem Vorsprung (29) unter einem breitesten Punkt der Mattendichtungsverbindung (20) in Bezug auf die Längsrichtung (X) befindet.

2. Ein elektrischer Verbinder (1) gemäß Anspruch 1, wobei die Aussparung (35) eine Nut aufweist, die sich entlang der Peripherie der Mattendichtungsver-

bindung (20) erstreckt.

3. Ein elektrischer Verbinder (1) gemäß Anspruch 1, wobei die Aussparung (35) angrenzend an den peripheren Vorsprung (29) vorgesehen ist.

4. Ein elektrischer Verbinder (1) gemäß einem der Ansprüche 1 bis 3, wobei die Mattendichtungsverbindung (20) einen polygonalen Querschnitt senkrecht zu der Längsrichtung hat und wobei die Mattendichtungsverbindung eine Vielzahl von Aussparungen hat und die Aussparungen (35) in der äußeren Oberfläche (24c) angrenzend an den peripheren Vorsprung (29) an Ecken des Querschnitts gebildet sind.

5. Ein elektrischer Verbinder (1) gemäß einem der Ansprüche 1 bis 4, der weiter einen Entkopplungsteil (28) aufweist, der sich zwischen dem zentralen Teil (21) und einem peripheren Teil (124) befindet und zumindest eine Nut (26) aufweist, die ausgebildet ist zum Verhindern, dass sich eine Bewegung des zentralen Teils zu dem peripheren Teil ausbreitet.

6. Ein elektrischer Verbinder (1) gemäß Anspruch 5, wobei die Mattendichtungsverbindung aufweist, von oben betrachtet:

- einen zentralen Teil (12), der zumindest einen Durchlass (22) aufweist, wobei sich der Durchlass entlang einer Längsrichtung (X) erstreckt und ausgebildet ist zum abdichtenden Aufnehmen eines Drahts, eines Kabels oder einer Faser (13),
- den peripheren Teil (124) zum Platzieren in einem Dichtungskontakt mit einem Gehäuse (4, 15) des elektrischen Verbinders,
- den Entkopplungsteil (28), der sich zwischen dem zentralen (21) und dem peripheren Teil (124) befindet und zumindest eine Nut (26) aufweist, die ausgebildet ist zum Verhindern, dass sich eine Bewegung des zentralen Teils (21) zu dem peripheren Teil (124) ausbreitet,

wobei die Mattendichtungsverbindung aufweist, von einer Seite betrachtet:

- einen breiten ersten Teil (38), der den peripheren Teil (124) und den Entkopplungsteil (28) aufweist,
- einen schmalen zweiten Teil (39),

wobei eine äußere Oberfläche (21a) des zentralen Teils (21) die äußere Oberfläche (24c) der Mattendichtungsverbindung (20) bildet.

7. Ein Verfahren zur Herstellung einer Mattendichtungsverbindung (20) für einen Verbinder, wobei die Mattendichtungsverbindung (20) ausgebildet ist, zwischen einem Gehäusekörper (4) und einem hinteren Gitter (15) angeordnet zu sein, wobei die Mattendichtungsverbindung (20) aus einem verformbaren Kunststoffmaterial besteht, wobei das Verfahren die folgenden Schritte aufweist:

- Vorsehen einer Form (43) mit einer zentralen Haltevorrichtung (45) und zwei Halbhohlräumen (46, 47), die an beiden Seiten der Haltevorrichtung (45) angeordnet sind, wobei die zentrale Haltevorrichtung (45) und die zwei Halbhohlräume (46, 47) zusammen einen Hohlraum (44) definieren,
- Zuführen von Material, um in dem Hohlraum eine Mattendichtungsverbindung (20) zu bilden, die umfasst:

  - einen zentralen Teil (21), der zumindest einen Durchlass (22) definiert, der sich entlang einer Längsrichtung (X) erstreckt und ausgebildet ist zum abdichtenden Aufnehmen eines Drahts, eines Kabels oder einer Faser (13),
  - eine äußere Oberfläche (24c), und
  - zumindest einen peripheren Teil (124), der einen peripheren Vorsprung (29) aufweist, der sich im Wesentlichen senkrecht zu der Längsrichtung (X) erstreckt und zwei gegenüberliegende parallele Flächen (36a, 36b) hat, die sich jeweils quer zu der Längsrichtung (X) erstrecken, und ausgebildet ist, entlang der Längsrichtung (X) komprimiert zu werden, um eine Abdichtung mit einem Gehäuse (4, 15) eines elektrischen Verbinders vorzusehen,
  - zumindest eine Haltestruktur (35), die sich zumindest teilweise in einer Ebene im Wesentlichen quer zu der Längsrichtung erstreckt, wobei die Haltestruktur eine Aussparung ist,
  - die Aussparung (35), die in der äußeren Oberfläche (24c) des peripheren Teils (124) gebildet ist, wobei die Aussparung (35) eine nach oben gewandte Fläche (35a) und eine gegenüberliegende nach unten gewandte Fläche (35b) im Wesentlichen quer zu der Längsrichtung (X) aufweist, mit der jeweiligen Fläche zumindest teilweise entlang und gegenüber der Längsrichtung (X), wobei sich die Aussparung (35) unter dem Vorsprung (29) unter einem breitesten Punkt der Mattendichtungsverbindung (20) in Bezug auf die Längsrichtung (X) befindet, und
  - eine global kegelstumpfartige Form, wobei die äußere Oberfläche entlang der Längsachse von einem breiten Teil zu einem schmalen Teil abnimmt,

- Entfernen der zwei Halbhohlräume (46, 47), wodurch die Mattendichtungsverbindung (20) auf der zentralen Haltevorrichtung (45) gehalten wird durch eine Kooperation der zentralen Haltevorrichtung (45) mit der Haltestruktur (35).

8. Verfahren gemäß Anspruch 7, das weiter ein Deformieren der Mattendichtungsverbindung (20) aus der zentralen Haltevorrichtung (45) aufweist.

Revendications

1. Connecteur électrique (1) comprenant un corps de boîtier (3), une grille arrière (15) et un joint d'étanchéité en forme de tapis (20), ledit joint d'étanchéité en forme de tapis (20) étant adapté à être disposé entre le corps de boîtier (4) et la grille arrière (15), ledit joint d'étanchéité en forme de tapis (20) étant réalisé en un matériau déformable et ayant une portion centrale (21) définissant au moins un passage (22), s'étendant le long d'une direction longitudinale (X) et adapté à recevoir avec étanchement un fil, une fibre ou un câble (13),
dans lequel le joint d'étanchéité en forme de tapis (20) comprend

- une surface extérieure (24c)
- au moins une portion périphérique (124), comprenant une projection périphérique (29) s'étendant essentiellement perpendiculairement à la direction longitudinale (X), et ayant deux faces parallèles opposées (36a, 36b) s'étendant chacune transversalement à la direction longitudinale (X), au moins une structure de retenue (35) s'étendant au moins partiellement dans un plan sensiblement transversal à la direction longitudinale (X), ladite structure de retenue étant un évidement (35), et
- l'évidement (35) étant formé dans la surface extérieure (24c) de la portion périphérique (124), **caractérisé en ce que** ledit évidement (35) comprend une face tournée vers le haut (35a) et une face opposée tournée vers le bas (35b) sensiblement transversalement à la direction longitudinale (X), qui font respectivement face au moins partiellement le long de et à l'opposé de ladite direction longitudinale (X), et dans lequel la projection périphérique (29) est adaptée à être comprimée le long de la direction longitudinale (X) pour assurer une étanchéité avec le boîtier (4, 5) du connecteur électrique, dans lequel le joint d'étanchéité en forme de tapis (20) a une forme globalement tronquée dans laquelle la surface extérieure diminue tout le long de l'axe longitudinal (X) depuis une portion large jusqu'à une portion étroite, dans lequel l'évidement (35) est situé au-dessous de la projection (29) au-dessous d'un point le plus large du joint d'étanchéité en forme de tapis (20) par rapport à la direction longitudinale (X).

2. Connecteur électrique (1) selon la revendication 1, dans lequel l'évidement (35) comprend une gorge qui s'étend tout le long de la périphérie du joint d'étanchéité en forme de tapis (20).

3. Connecteur électrique (1) selon la revendication 1, dans lequel l'évidement (35) est prévu adjacent à la projection périphérique (29).

4. Connecteur électrique (1) selon l'une quelconque des revendications 1 à 3, dans lequel le joint d'étanchéité en forme de tapis (20) a une section transversale polygonale perpendiculairement à la direction longitudinale, et dans lequel le joint d'étanchéité en forme de tapis présente une pluralité d'évidements, et
les évidements (35) sont formés dans la surface extérieure (24c), adjacents à la projection périphérique (29) au niveau des coins de ladite section transversale.

5. Connecteur électrique (1) selon l'une quelconque des revendications 1 à 4, comprenant en outre une portion de découplage (28), située entre la portion centrale (21) et une portion périphérique (124), et comprenant au moins une gorge (26) adaptée à empêcher qu'un mouvement de la portion centrale se propage vers la portion périphérique.

6. Connecteur électrique (1) selon la revendication 5, dans lequel le joint d'étanchéité en forme de tapis comprend, vu depuis le dessus :

- une portion centrale (12) comprenant au moins un passage (22), ledit passage s'étendant le long d'une direction longitudinale et étant adapté à recevoir avec étanchéité un fil, un câble ou une fibre (13),
- la portion périphérique (124), destinée à être placée en engagement d'étanchéité avec un boîtier (4, 15) du connecteur électrique,
- la portion de découplage (28), située entre la portion centrale (21) et la portion périphérique (124), et comprenant au moins une gorge (26) adaptée à empêcher qu'un mouvement de la portion centrale (21) se propage vers la portion périphérique (124),

le joint d'étanchéité en forme de tapis comprenant, vu depuis un côté :

- une première portion large (38) comprenant ladite portion périphérique (124) et ladite portion de découplage (28),

- une seconde portion étroite (39)

dans lequel une surface extérieure (21 a) de la portion centrale (21) forme la surface extérieure (24c) du joint d'étanchéité en forme de tapis (20).

7. Procédé de fabrication d'un joint d'étanchéité en forme de tapis (20) pour un connecteur, ledit joint d'étanchéité en forme de tapis (20) étant adapté à être disposé entre un corps de boîtier (4) et une grille arrière (15), ledit joint d'étanchéité en forme de tapis (20) étant réalisé en une matière plastique déformable, le procédé comprenant les étapes suivantes consistant à :

- fournir un moule (43) ayant un dispositif de rétention central (45) et deux demi-cavités (46, 47) placées sur les deux côtés dudit dispositif de rétention (45), le dispositif de rétention central (45) et les deux demi-cavités (46, 47) définissant ensemble une cavité (44),
- introduire un matériau de manière à former dans la cavité un joint d'étanchéité en forme de tapis ayant :
- une portion centrale définissant au moins un passage (22), s'étendant le long d'une direction longitudinale (X) et adapté à recevoir avec étanchéité un fil, un câble ou une fibre (13),
- une surface extérieure (24c), et
- au moins une portion périphérique (124) comprenant une projection périphérique (29) s'étendant essentiellement perpendiculairement à la direction longitudinale (X), et ayant deux faces parallèles opposées (36a, 36b) qui s'étendent chacune transversalement à la direction longitudinale (X), et adaptée à être comprimée le long de la direction longitudinale (X) pour assurer une étanchéité avec un boîtier (4, 15) d'un connecteur électrique
- au moins une structure de retenue (35) s'étendant au moins partiellement dans un plan sensiblement transversal à la direction longitudinale, ladite structure de retenue étant un évidement,
- l'évidement (35) étant formé dans la surface extérieure (24c) de la portion périphérique (124), ledit évidement (35) comprenant une face tournée vers le haut (35a) et une face opposée tournée vers le bas (35b) sensiblement transversalement à la direction longitudinale (X) qui font respectivement face au moins partiellement le long de et à l'opposé de ladite direction longitudinale (X), l'évidement (35) étant situé au-dessous de la projection (29) au-dessous d'un point le plus large du joint d'étanchéité en forme de tapis (20) par rapport à la direction longitudinale (X), et
- une forme globalement tronquée, dans laquelle la surface extérieure diminue tout le long de l'axe longitudinal depuis une portion large jusqu'à une portion étroite,
- retirer les deux demi-cavités (46, 47) grâce à quoi le joint d'étanchéité en forme de tapis (20) est retenu sur le dispositif de rétention central (45) par coopération du dispositif de rétention central (45) avec ladite structure de retenue (35).

8. Procédé selon la revendication 7, comprenant en outre l'étape consistant à déformer le joint d'étanchéité en forme de tapis (20) hors du dispositif de rétention central (45).

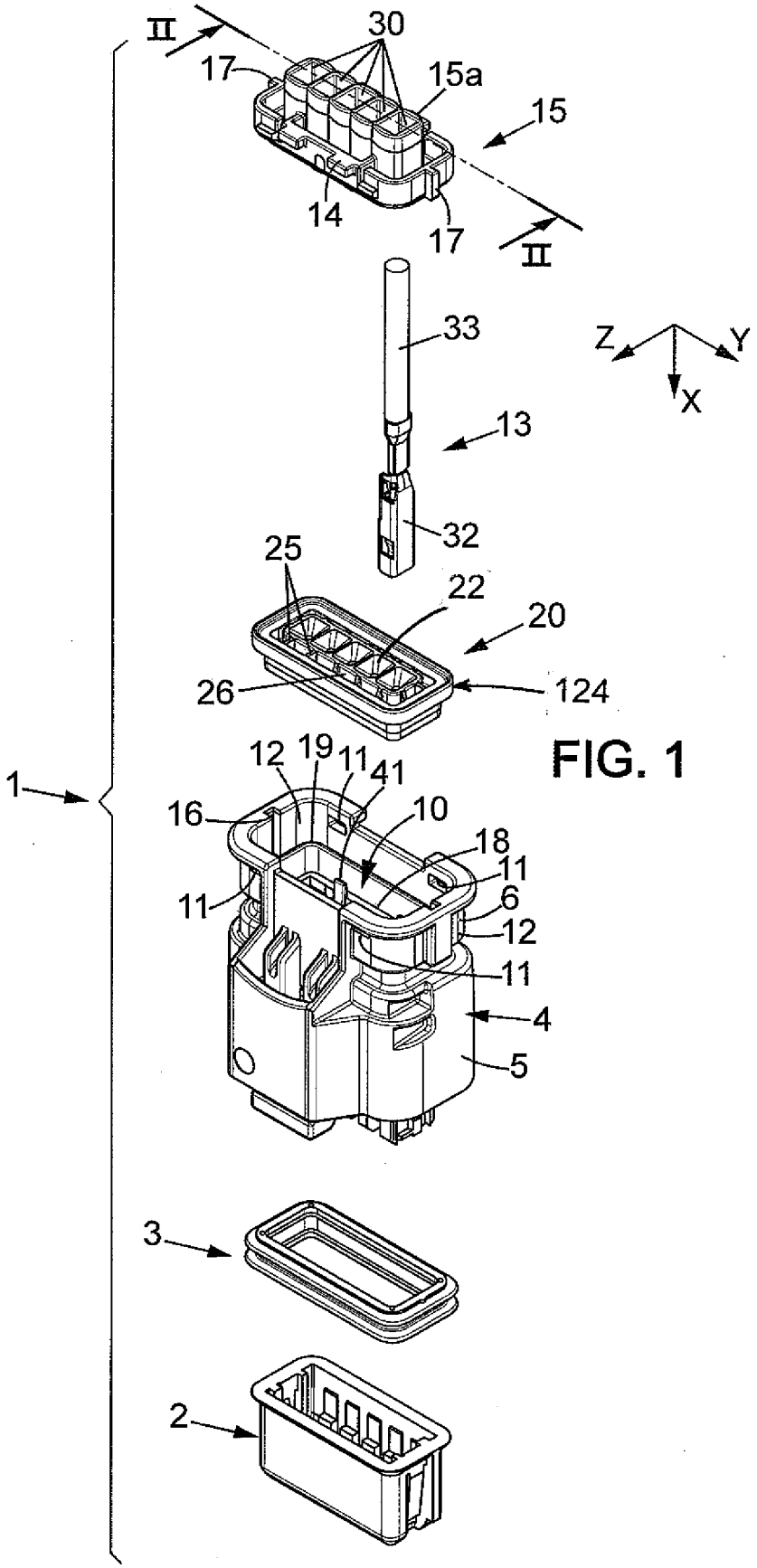
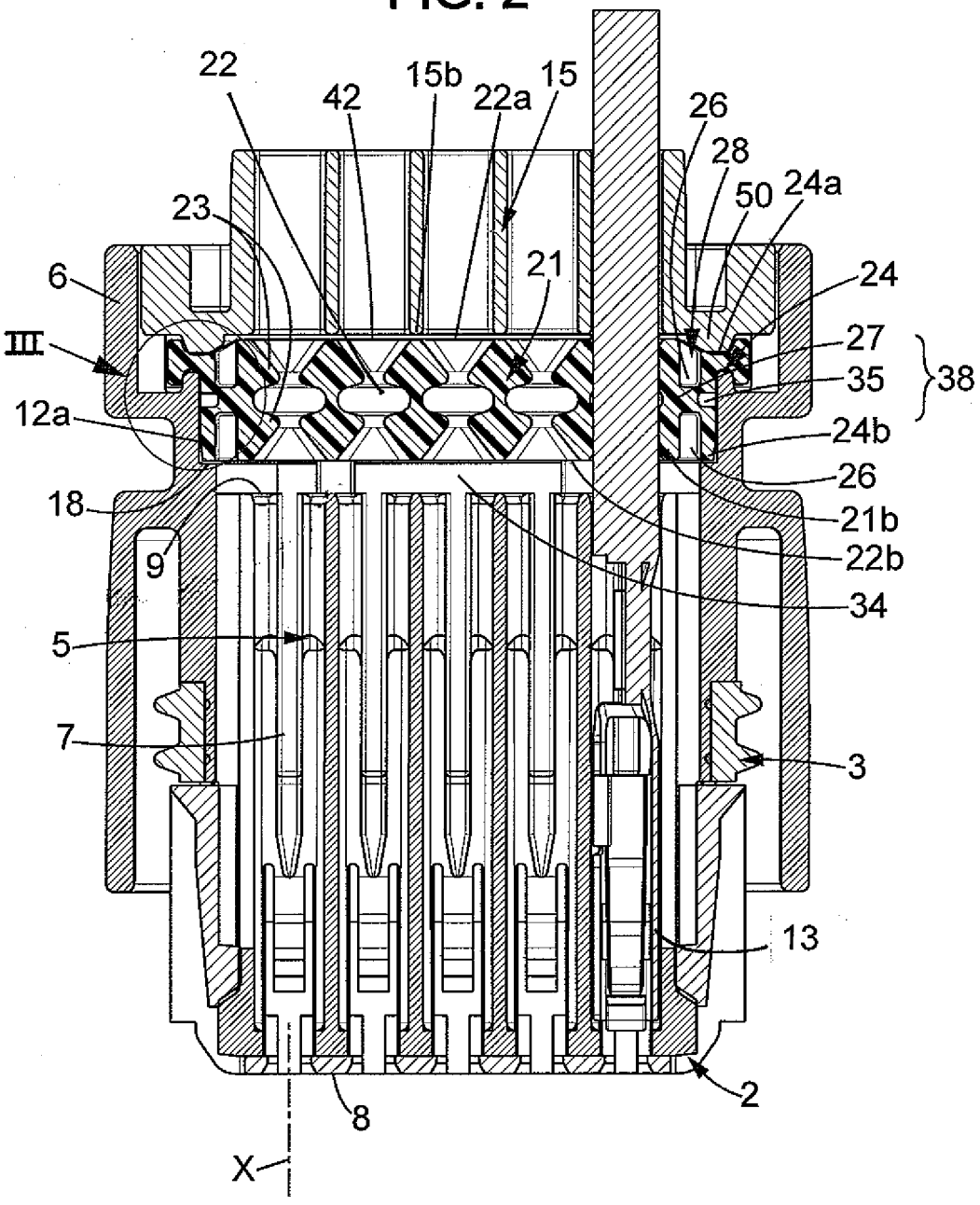

II
30
17
15a
15
14
17
II
33
Z
Y
X
13
32
25
22
20
26
124
12
19
11
41
1
16
10
18
11
11
6
12
11
4
5
3
2

FIG. 1

FIG. 2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15b
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15
26
28
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24a
23
21
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III
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7
3
13
2
8
X

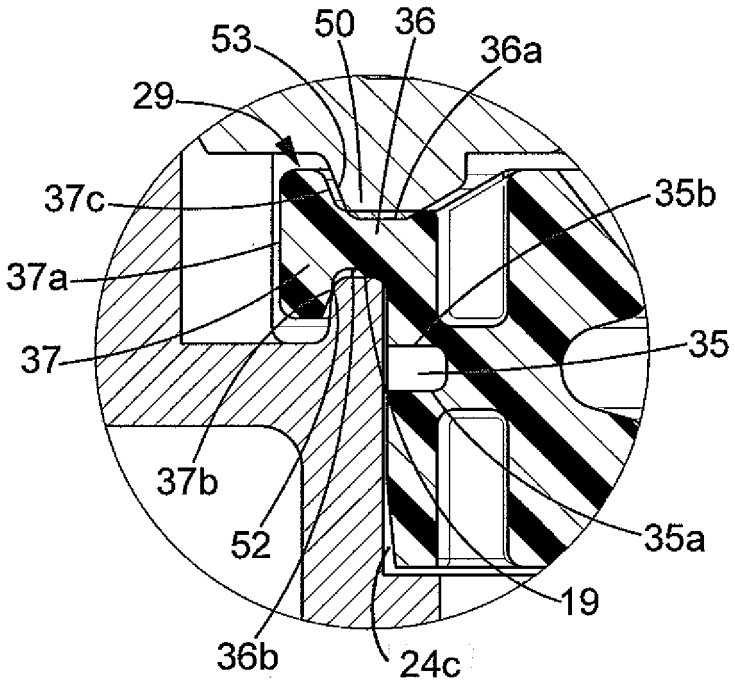

FIG. 3

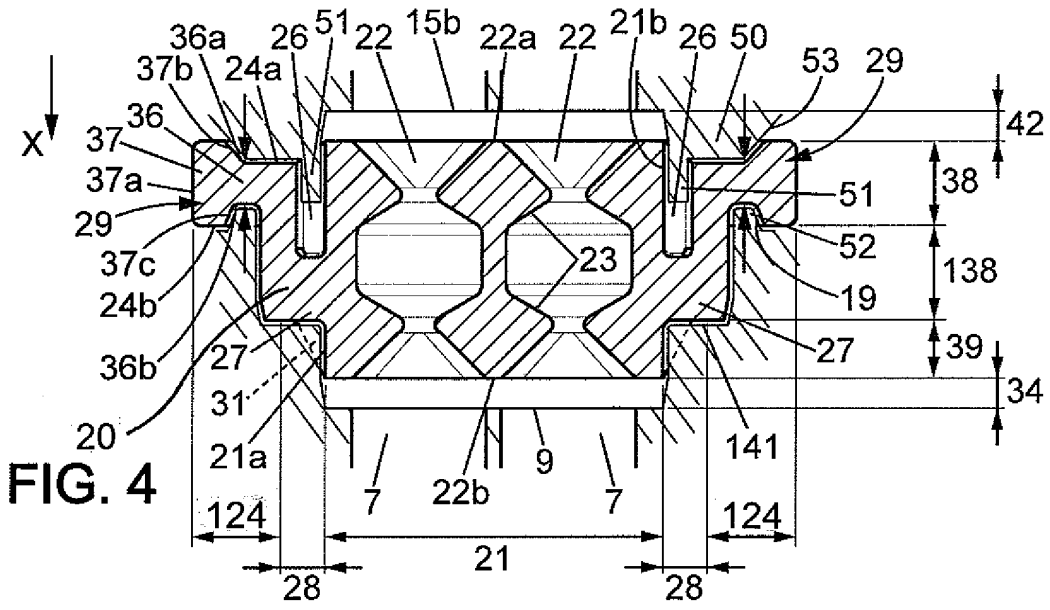

FIG. 4

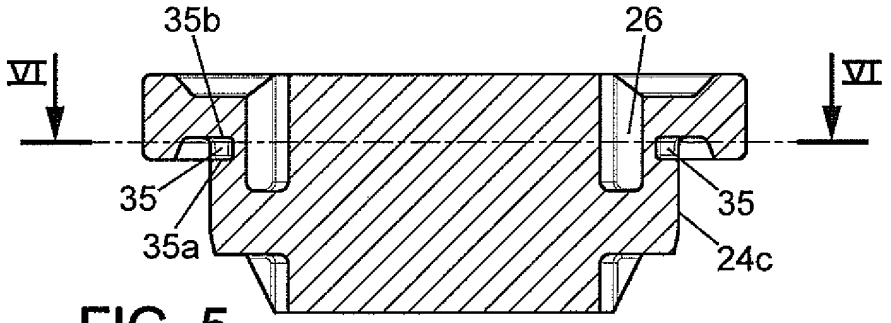

FIG. 5

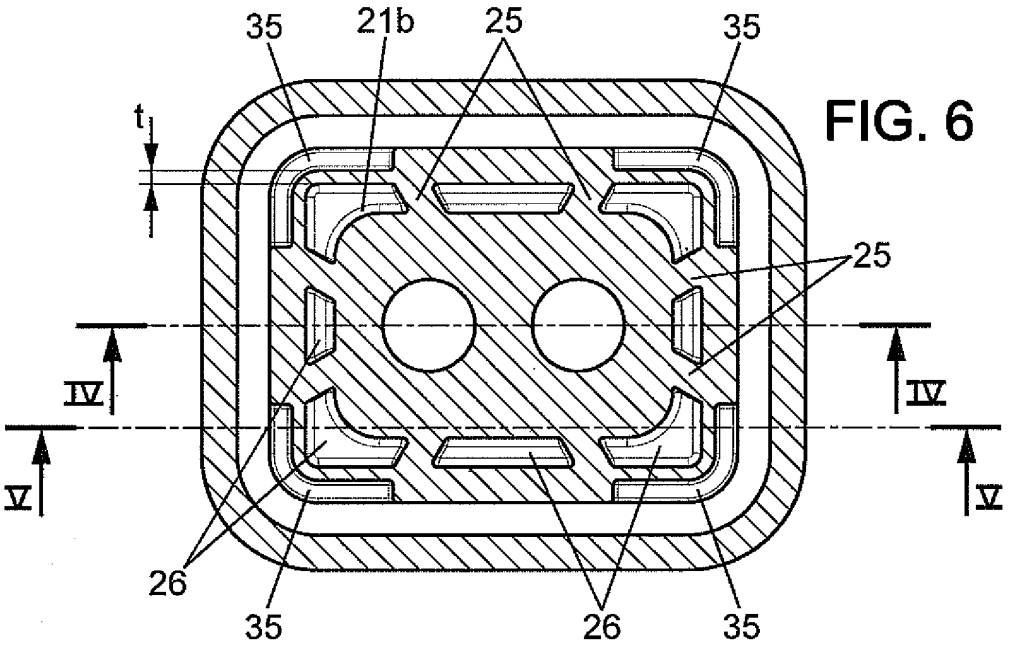

FIG. 6

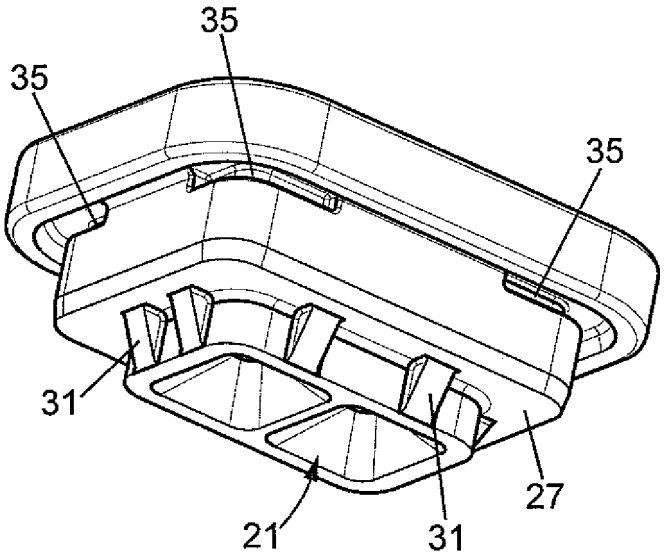

FIG. 7

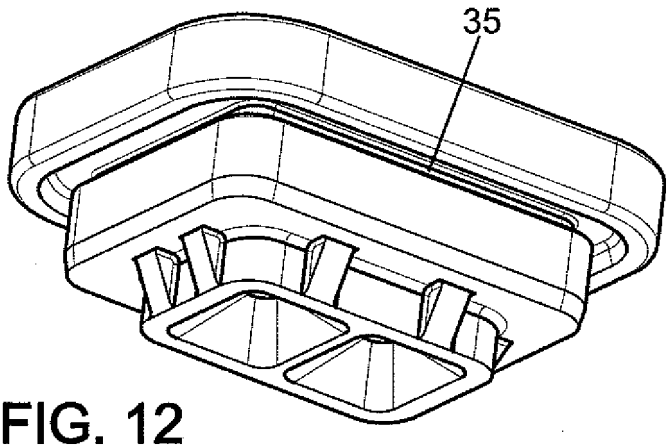

FIG. 12

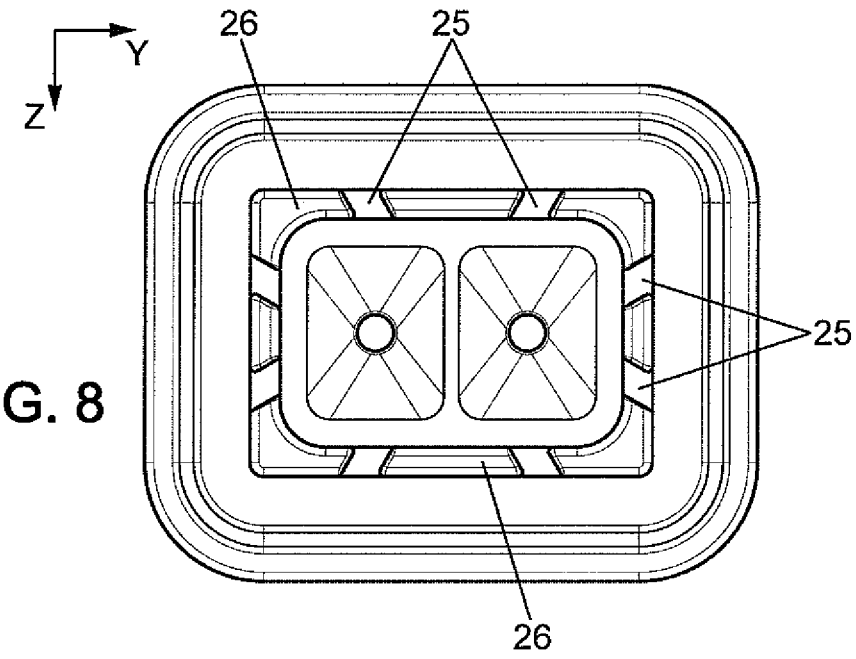

FIG. 8

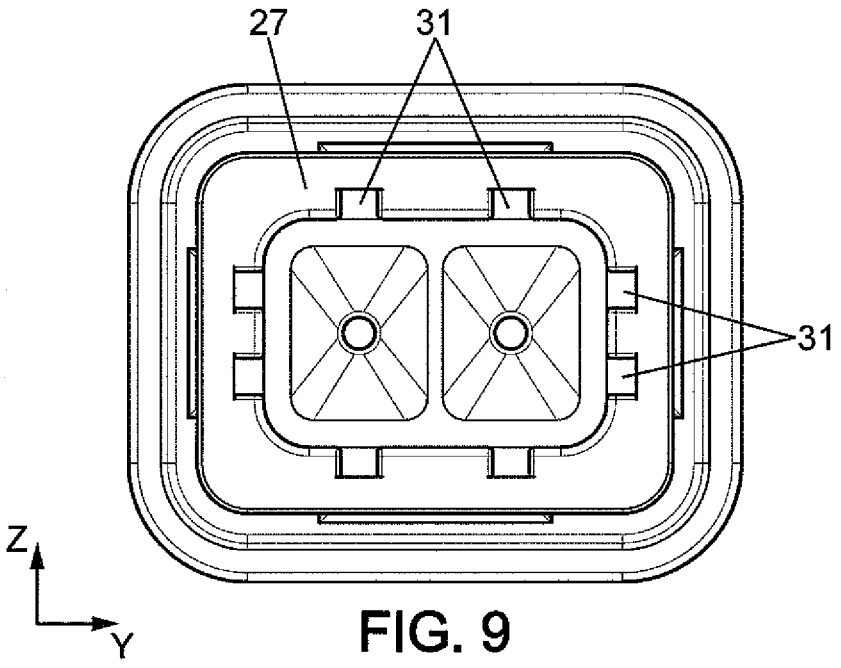

FIG. 9

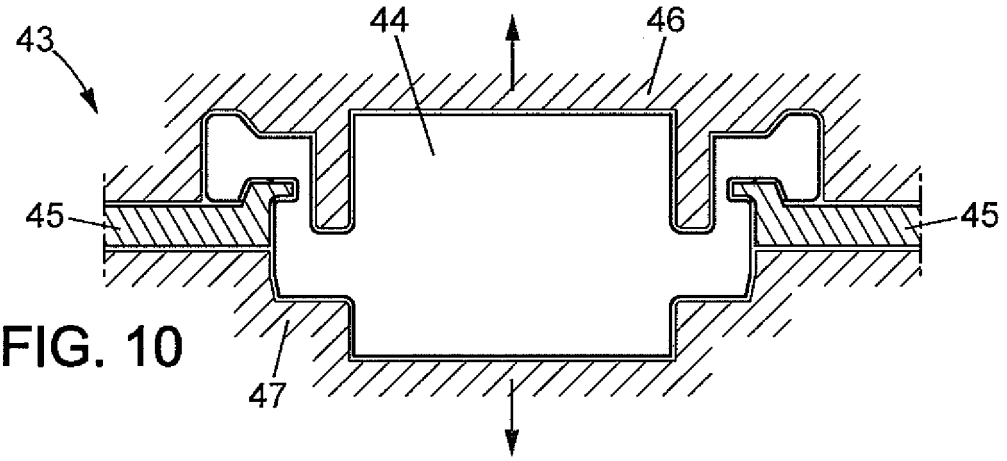

FIG. 10

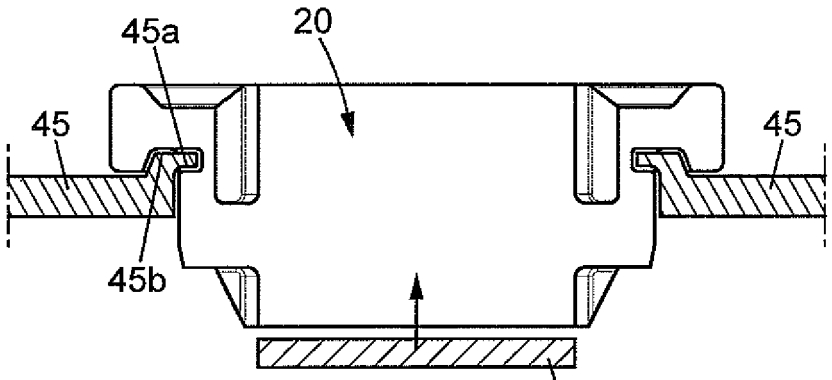

FIG. 11

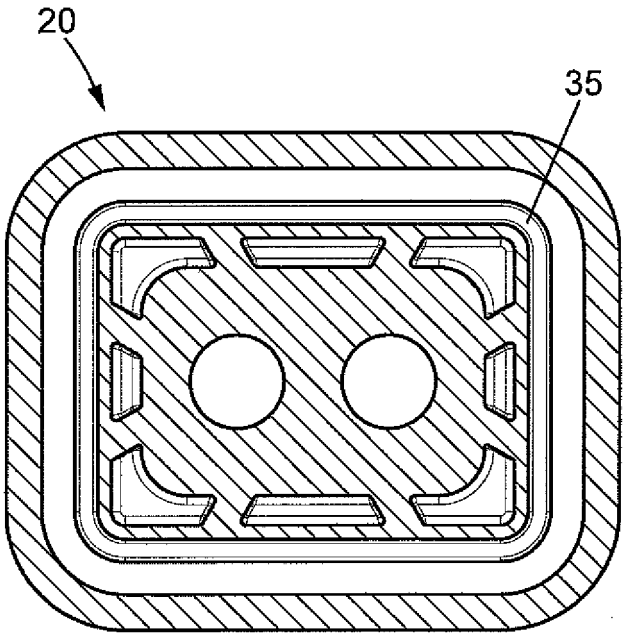

FIG. 13

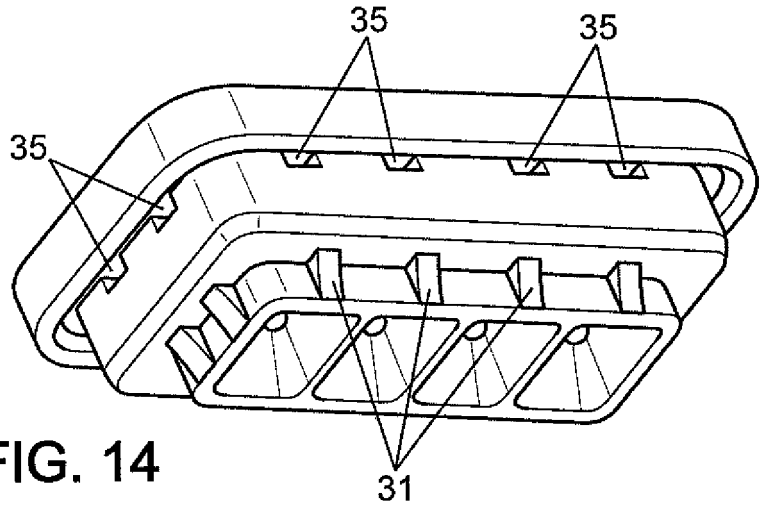

FIG. 14

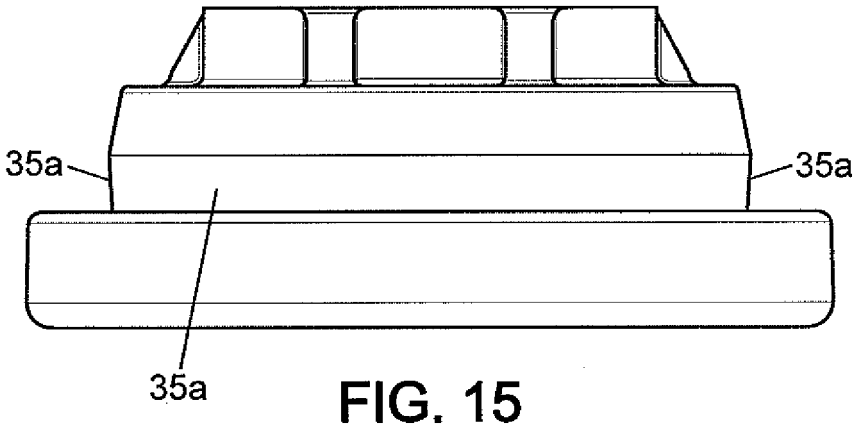

FIG. 15

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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