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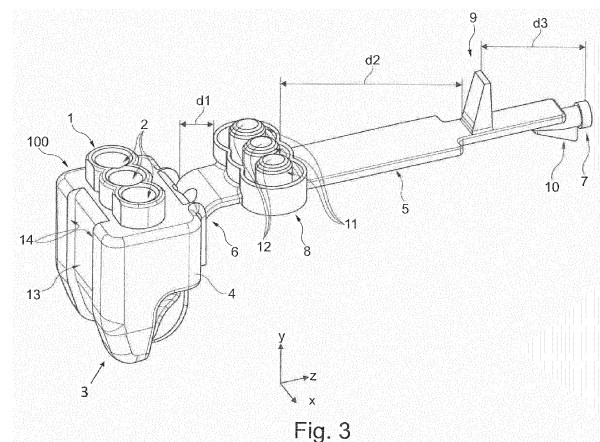
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(54) **ELECTRICAL CONNECTOR WITH SEALING**

(57) The disclosure relates to Electrical connector for electrically connecting at least two electrical cables (18) without using tools, comprising a housing (1); at least two insertion channels (2), arranged in the housing (1) on a first side, for inserting bare metal ends (19) of the electrical cables (18) into the housing (1) along an insertion direction (E); a metal clamping unit (17), arranged in the housing (1), for clamping the bare metal ends (19) inserted into the insertion channels (2) and for electrically coupling the metal ends (19) to one another; and a test channel (3), arranged in the housing (1) on a second side, for inserting a test finger; a housing cover (4) made of a pliable plastic, which is cast with the housing (1); wherein the housing cover (4) is formed in one piece with a cover strip (5), which extends from a first end (6) of the cover strip (5) to a second end (7) of the cover strip (5), wherein: the cover strip (5) merges into the housing cover (4) at the first end (6), and between the first end (6) and the second end (7) the cover strip (5) has a cap unit (8) for plugging into the insertion channels (2) and a stopper unit (9) for plugging into the test channel (3), and in an end region comprising the second end (7) the cover strip (5) has a hook unit (10) for hooking the cover strip (5) onto an associated hook counterpart (16) of the electrical connector in a sealing position, wherein in the sealing position the cap unit (8) is plugged into the insertion channels (2) and the stopper unit (9) is plugged into the test channel (3) in order to reliably seal electrical connections between two or more electrical cables (18) with little effort, even in accordance with high IP protection classes, and especially against water or moisture.



Description

Field of the invention

[0001] The disclosure relates to an electrical connector for electrically connecting, coupling, at least two electrical cables without using tools, comprising a housing, at least two insertion channels, arranged in the housing on a first side, for inserting bare metal ends of the electrical cables into the housing along an insertion direction, a metal clamping unit, arranged in the interior of the housing, for automatically clamping the bare metal ends inserted into the insertion channels and for electrically coupling the metal ends to one another, and a test channel, arranged in the housing on a second side of the housing, for inserting a mechanical test finger in order to test an electrical state of the clamping unit.

Background

[0002] An incalculably large number of electrical connectors exist for electrically connecting, that is to say electrically coupling, two or more electrical cables. In many fields of application, sealed electrical connections that have a high level of protection are desired, for example protection according to the IP67 or IP68 standard, according to the IP code, the International Protection Code. The IP code is preferably based on DIN EN 60529 or ISO 20653 in the respectively valid version, for example September 2021.

[0003] For example, EP 2 795 737 A1 discloses a connector with a sealing protective cap. US 10 777 934 B2 also discloses a connector that can be sealed in different ways. Furthermore, there are many connectors that can be sealed by pushing sealing soft parts onto the cables in question prior to connection and then pulling the respective soft parts over the connection. For high protection requirements, additional housings are also known, which are placed around the connection points, closed, and filled with a gel in order to seal the connection point, especially against water.

[0004] In summary, the solutions available for sealing electrical connections are time-consuming and laborious.

Summary

[0005] The problem addressed is therefore that of being able to reliably seal electrical connections between two or more electrical cables with little effort, even in accordance with high IP protection classes, and especially against water or moisture.

[0006] This problem is solved by the independent claim. Advantageous embodiments will become apparent from the dependent claims, the description and the figures.

[0007] One aspect relates to an electrical connector for electrically connecting, that is to say for electrically

coupling, at least two cables, that is to say two or more cables, preferably exactly three electrical cables, without using tools. The electrical connector comprises a housing, which is preferably made of plastic. The housing may in particular be a housing composed of a plurality of housing parts, for example of a plurality of housing parts which are latched to one another by means of a latching connection. The plastic of the housing and/or the housing parts may, for example be or comprises a polycarbonate (PC). In the housing, at least two, that is to say a plurality of, preferably exactly three insertion channels are arranged on a first side of the housing, a front side, said insertion channels in particular being arranged in a row. The insertion channels serve for inserting into the housing, that is to say into an interior of the housing, along an insertion or plug-in direction, bare metal ends of the electrical cables to be connected. In particular, the insertion direction here is specified identically for all the metal ends, so that the insertion channels extend in parallel.

[0008] Arranged in the interior of the housing, that is to say in the housing, is a metal clamping unit, which is protected against an environment surrounding the electrical connector by the housing as contact protection in the sense of electrical insulation. The metal clamping unit serves to automatically clamp the bare metal ends inserted into the insertion channels and to automatically and permanently electrically couple the clamped metal ends to one another. Arranged on a second side of the housing, a rear side, is a test channel for inserting a mechanical test finger, for example a phase tester or other electrical test device, along a further insertion direction. Preferably, the insertion direction and the further insertion direction are anti-parallel. The test channel thus serves to temporarily electrically couple the test finger or test device to the metal clamping unit.

[0009] The electrical connector comprises a housing cover made of a pliable plastic, that is to say a flexible plastic, which is cast with the housing and seals the housing at the region(s) of the housing around which or over which it is cast. The plastic of the housing cover is thus in particular more supple than the plastic of the housing. The plastic of the housing cover may, for example, be or comprise a thermoplastic elastomer, TPE, and/or a thermoplastic vulcanisate, TPV. In the case of a housing composed of multiple parts, any gaps between different housing parts can also be sealed by the housing cover. The housing cover is formed in one piece with a cover strip, which is thus likewise cast with the housing and the housing cover. The cover strip extends along a main extension direction, a length, of the cover strip from a first end of the cover strip to a second end of the cover strip. The cover strip merges into the housing cover at the first end. Between the first end and the second end the cover strip has a cap unit for plugging into the insertion channels and thereby automatically sealing the insertion channels, and a stopper unit for plugging into the test channel and thereby automatically sealing the test channel. In an end region comprising the second end, in particular at the

second end, the cover strip has a hook unit for hooking the cover strip onto an associated hook counterpart of the electrical connector in a sealing position. The hook counterpart may be formed on the housing or, preferably, on the housing cover, so that in the sealing position the cover strip is fastened at both ends to the housing cover. In the sealing position of the cover strip, the cap unit is plugged into the insertion channels and the stopper unit is plugged into the test channel.

[0010] Firstly, the one-piece design of the described sealable electrical connector has the advantage that, during the electrical connection and sealing, it is not necessary to handle a plurality of different parts, which prevents any loss of such parts and makes handling easier. Furthermore, production is also simplified and, due to the pliable plastic for example, the housing is also better protected against impacts, which reduces the risk of the housing breaking open and thus the sealing effect being lost. By virtue of the hook unit at the end of the cover strip, as will be further explained below, the cover strip can be brought into the sealing position and secured in this position with a single operating action, that is to say both the cap unit and the stopper unit can be secured in their position by a single hook unit. This ensures particularly reliable sealing. At the same time, also after assembly, after establishing the electrical connection without using tools, the hook unit can be unhooked without using tools and the stopper unit can be removed from the test channel in order to check, through the test channel, an electrical state of the electrical cables and/or of the metal clamping unit, for example whether a voltage is present at the metal ends of the cables. After checking, the electrical connector can be sealed again, without impairing the quality of the seal. The hook unit can thus ensure a pressing force of the cap unit and of the stopper unit into the insertion channels and the test channel, respectively, and thus the sealing reliability can be further increased. Overall, it has been found that the described configuration enables a sealing according to IP68, that is to say the electrical connection can be achieved in a dustproof manner with complete protection against touching, but especially also in a waterproof manner against permanent immersion up to at least 1 m water depth.

[0011] In one advantageous embodiment, it is provided that the cap unit has a plurality of closure elements, which are each assigned to an insertion channel. The closure elements may be individual closure elements, the cross-section of which is preferably round in a plane perpendicular to the insertion direction when the cap unit is plugged in, which improves the sealing of the individual insertion channels. In particular, the closure elements have a respective closure element bottom, the thickness of which in the insertion direction is thin enough to be pierced by the respective bare metal end of the cable upon manual insertion of the bare metal end into the respective associated insertion channel in the insertion direction when the cap unit is plugged into the insertion

channels, and thus when the cover strip is in the sealing position. This has the advantage that unused insertion channels remain reliably sealed, that the cover strip can be brought into the sealing position prior to assembling the electrical connector, and that a fitter need only plug the electrical cables into the corresponding insertion channels, without using tools, in order to achieve a sealed electrical connection, as is customary from known electrical connectors even without sealing functionality.

[0012] In another advantageous embodiment, it is provided that the respective closure elements in turn have a respective closure element insertion channel for inserting the bare metal ends of the electrical cables into the insertion channels of the housing along the insertion direction when the cover strip is in the sealing position. When the cover strip is in the sealing position, the closure element insertion channels taper conically in the insertion direction towards the respective closure element bottom. This has the advantage that, without modifying the closure element insertion channels, even electrical cables of different cross-sections can be reliably sealed.

[0013] In one particularly advantageous embodiment, it is provided that along the cover strip the cap unit is arranged between the first end and the stopper unit, and/or the stopper unit is arranged between the second end and the cap unit. In particular, the distance between the cap unit and the first end and/or the distance between the stopper unit and the second end is smaller than the distance between the cap unit and the stopper unit. This has the advantage that the distances between the two units and the respective ends are short compared to the distances between the units. Therefore, on the one hand a positioning of the two units relative to the ends of the cover strip is improved, and on the other hand, as will be described below with regard to the elasticity, a large amount of elasticity can be maintained between the two units, so that the retaining force (described below) brought about by the elasticity of the cover strip is increased. Furthermore, the cover strip may be designed to be long enough to wrap around the entire housing.

[0014] In another advantageous embodiment, it is accordingly provided that a first distance between the cap unit and the first end of the cover strip along or on the cover strip is selected in such a way that the cover strip must be stretched in order to plug the cap unit into the insertion channels, and in particular is selected in such a way that, in the sealing position, a cover strip portion between the cap unit and the first end exerts on the cap unit a first tensile force, a first spring force, acting in the direction of the first end and brought about by the elasticity of the cover strip. Therefore, a length of the cover strip may thus be greater when the cap unit is plugged in and also, as described below, when the stopper unit is plugged in and/or the hook unit is hooked on, therefore overall in the sealing position, than in a neutral position in which, without the action of any external forces, the cover strip is in contact with the housing cover only at its first end.

[0015] As an alternative or in addition, it may be provided that a second distance between the cap unit and the stopper unit along or on the cover strip is selected in such a way that the cover strip must be stretched in order to plug the stopper unit into the test channel when the cap unit is already plugged into the insertion channels. In particular, the distance is selected in such a way that, in the sealing position, a cover strip portion between the cap unit and the stopper unit exerts on the stopper unit a second tensile force, a second spring force, acting in the direction of the cap unit and brought about by the elasticity of the cover strip, and vice versa. As an alternative or in addition, it may also accordingly be provided that a third distance between the stopper unit and the hook unit along or on the cover strip is selected in such a way that a cover strip portion between the stopper unit and the hook unit must be stretched in order to hook on the hook unit when the stopper unit is already plugged into the test channel. In particular, the third distance may be selected in such a way that, in the sealing position, a cover strip portion between the stopper unit and the hook unit exerts on the hook unit a third tensile force, a third spring force, acting in the direction of the stopper unit and brought about by the elasticity of the cover strip.

[0016] The distances thus selected, in each case alone and in combination, yield the advantage that in the sealing position a loose cover strip is avoided, which may potentially hook onto objects in an environment surrounding the electrical connector and thus may easily become inadvertently detached, and in addition a sealing effect of the cap unit and/or stopper unit is increased since not only does the usual clamping force, as known from stoppers, contribute to the sealing, but also a tensile force determined by elasticity and distance, which can be adjusted independently of the existing clamping force. The sealing forces can thus also be increased without affecting other properties of the electrical connector, for example a force required when inserting the bare metal ends into the (closure element) insertion channels. An electrical connector that can be particularly well sealed is thus also achieved as a result.

[0017] In another advantageous embodiment, it is provided that at least on one side, in particular the second side and/or the side provided with the first end, a third side, and/or a fourth side located opposite the third side, the housing cover has a guide groove or guide structure for receiving and guiding the cover strip arranged in the sealing position along its main extension direction. The guide groove may be designed in the form of a depression in the housing cover, which fully accommodates the cover strip in the sealing position. Accordingly, the guide groove may be designed as a guide channel with lateral guide cheeks and a guide bottom. Preferably, when the cover strip is fastened in the sealing position, the cover strip and the housing cover merge into one another in a planar manner on an outer side of the housing cover and the cover strip. With particular preference, the guide groove is a circumferential guide groove, which extends

at least over parts of all sides. This has the advantage that slipping of the cover strip is prevented, and in addition friction forces between the housing cover and the cover strip along the direction of tension of the cover strip are increased, which especially in conjunction with the design options mentioned in the last paragraph leads to an advantageous distribution of the occurring forces and thus an improvement in the sealing effect.

[0018] In another advantageous embodiment, it is provided that the cover strip has at its first end and/or the housing cover has on the side of the first end of the cover strip, the third side, an undercut as a hook counterpart or as part of the hook counterpart, and in the sealing position of the cover strip the hook unit is designed to engage in the undercut and thus to secure or keep the cover strip hooked in the sealing position. The cover strip in the sealing position may thus be arranged to extend once around the housing cover in a plane extending parallel to the insertion direction. This has the advantage that the cover strip in the sealing position is secured in a manner wrapped around the housing and thus can be particularly reliably kept in the sealing position. Also, the respective elasticity-induced forces between the first end and the cap unit, the cap unit and the stopper unit, and the stopper unit and the hook unit, as described above, can be selected to be particularly large, which contributes to particularly tight and reliable sealing.

[0019] Particularly advantageously, the first and the second side of the housing are diametrically opposite sides, and in particular with the insertion direction anti-parallel to the further insertion direction in which the stopper unit can be plugged into the test channel. In particular, the third side of the housing cover extends transversely to the first and the second side. Accordingly, the third and the fourth side of the electrical connector and thus of the housing and/or housing cover may preferably be diametrically opposite sides. This has the advantage that the forces occurring in each case particularly advantageously interact, so that the sealing effect in the sealing position of the cover strip is further increased.

[0020] A further aspect relates to a method for establishing a sealed electrical connection between at least two electrical cables using an electrical connector according to any one of the described embodiments, comprising a series of method steps. A first step comprises plugging the cap unit into the insertion channels, which is followed by the second method step of plugging the bare ends of the electrical cables into the insertion channels, the bare ends thereby piercing the cap unit. Further steps of the method comprise plugging the stopper unit into the test channel and hooking the hook unit onto the hook counterpart, it being possible for these two method steps to be carried out before or after, but preferably before, the second method step, plugging the bare ends of the electrical cables into the insertion channels, thereby piercing the cap unit. The same advantages as in the case of the corresponding electrical connectors can thus be achieved.

[0021] Another aspect relates to a method for producing an electrical connector according to any one of the described embodiments, comprising a series of method steps. One method step comprises creating the housing with the internal metal clamping unit, in particular by latching at least two housing parts to one another. A further method step comprises holding the created housing in a first region of the housing, adjoining the insertion channels, and in a second region different from the first region, which second region adjoins the test channel but does not merge into the first region. A further method step then comprises overmolding the held housing with a plastic as a housing cover, in particular thereby sealing one or more gaps, in particular all gaps, between the at least two housing parts by means of the housing cover. In one piece with the housing cover, a cover strip is also injection-molded onto the housing. This has the advantage that the electrical connector is produced in a particularly efficient manner, in particular the housing itself does not have to meet any particular sealing requirements since not only does the housing cover provide the sealing cap unit and stopper unit, but also the housing itself can be sealed, including any gaps.

[0022] The features and combinations of features mentioned above in the description, including in the introductory part, as well as the features and combinations of features mentioned below in the description of the figures and/or shown in the figures can be used not only in the respectively specified combination, but also in other combinations without departing from the scope of the invention. Thus, embodiments which are not explicitly shown in the figures and explained but which emerge from the explained embodiments by separate combinations of features, and which can be produced, are also to be regarded as included and disclosed by the invention. Embodiments and combinations of features which therefore do not contain all the features of an originally formulated independent claim are also to be regarded as disclosed. In addition, embodiments and combinations of features which go beyond or deviate from the combinations of features set out in the dependencies of the claims are to be regarded as disclosed, in particular by the embodiments discussed above.

Detailed description

[0023] The subject matter according to the invention will be explained in greater detail with reference to the schematic drawings shown in the following figures, but without being limited to the specific embodiments shown here.

[0024] In the drawings:

- Fig. 1 shows a perspective view of a conventional electrical connector;
- Fig. 2 shows a further perspective view of the electrical connector of Fig. 1;

Fig. 3 shows a perspective view of an exemplary embodiment of an electrical connector according to an embodiment of the present disclosure with a housing cover made of pliable plastic;

Fig. 4 shows the exemplary embodiment of the electrical connector of Fig. 3 in a sealing configuration, from a first perspective view;

Fig. 5 shows the connector of Fig. 4 in a further exemplary view;

Fig. 6 shows the connector of Figs. 4 and 5 in a first sectional illustration;

Fig. 7 shows the connector of Figs. 4 to 6 in a further sectional illustration; and

Fig. 8 shows the sectional illustration from Fig. 7 with two connected electrical cables.

[0025] In the figures, identical and functionally identical elements are provided with the same reference signs.

[0026] Fig. 1 shows a conventional electrical connector, which is suitable for electrically connecting at least two, in the present case three, electrical cables without using tools. The electrical connector comprises a housing 1, in the present case composed of two housing parts 1a and 1b, and at least two, here three, insertion channels 2 for inserting bare metal ends 19 (Fig. 8) of electrical cables 18 (Fig. 8) into the housing 1 along an insertion direction E, said insertion channels being arranged on a first side in the housing 1, here an upper side in the positive y-direction. For the purpose of electrically connecting the cables, but not shown here, a metal clamping unit 17 (Fig. 7) for automatically clamping the bare metal ends inserted into the insertion channels 2 and thus for electrically connecting the electrical cables is arranged in the housing 1. As shown in Fig. 2, arranged on a second side of the housing 1, an underside of the housing 1 in the negative y-direction, is a test channel 3 for inserting a test finger, for example a phase tester, here in a further insertion direction T opposite to the insertion direction E.

[0027] Fig. 3 now shows an exemplary electrical connector 100 according to an embodiment of the present disclosure, which in the present case, in addition to the features explained with reference to Figs. 1 and 2, also has a housing cover 4 made of a pliable plastic, which is cast with the housing 1. The housing cover 4 is thus made of a plastic that is supple in comparison to the housing 1. The housing cover 4 is formed in one piece with a cover strip 5, which extends here from a first end 6 close to the housing to a second end 7 remote from the housing. The cover strip 5 merges into the housing cover 4 at the first end 6. Between the first end 6 and the second end 7, the cover strip 5 has a cap unit 8 for plugging into the insertion channels 2 and a stopper unit 9 for plugging into the test channel 3. In an end region comprising the

second end 7, in the present case at the second end 7, the cover strip 5 has a hook unit 10 for hooking the cover strip 5 onto an associated hook counterpart 16 (Fig. 5) of the electrical connector 100 in a sealing position of the cover strip 5. In the sealing position of the cover strip 5, the electrical connector 100 is configured to seal the electrical connection between the electrical cables, and is thus in a sealing configuration in which the cap unit 8 is plugged into the insertion channels 2 and the stopper unit 9 is plugged into the test channel 3.

[0028] In the example shown, the cap unit 8 has a plurality of individual closure elements 11, which are each assigned to an insertion channel 2 and have a respective closure element bottom 12, the thickness of which is thin enough for the closure element bottom 12 to be pierced by the respective bare metal end upon insertion of the metal end of the electrical cable into the respective insertion channel 4 when the cap unit 8 is plugged into the insertion channels two. Starting from the first end 6, first the cap unit 8 is arranged on the cover strip 4, then the stopper unit 9, and finally the hook unit 10. The distance d2 between the cap unit 8 and the stopper unit 9 along the cover strip 5 is longer than the distance d1 between the first end 6 and the cap unit 8 and the distance d3 between the stopper unit 9 and the second end 7. The distances d1, d2 and d3 thus correspond to respective distances between the insertion channels 2, the test channel 3 and the hook counterpart 16 along the outer side of the housing cover 4, the distances d1, d2, d3 being selected here in such a way that the cover strip 5 must be stretched somewhat in order to plug the cap unit 8 onto the insertion channels 2, to push the stopper unit 9 into the test channel 3, and to hook the hook unit 10 onto the corresponding counterpart. This ensures that the cover strip 5 is wound taut around the housing cover 4 in the sealing position, and thus improves a sealing effect. The first end 6 of the cover strip 5 merges into the housing cover 4 on a third side, here a rear side in the positive z-direction. Here, a guide groove 13 with lateral guide walls 14 is arranged on the diametrically opposite fourth side, here a front side in the negative z-direction, which further stabilizes the cover strip 5 in the sealing position, as demonstrated below.

[0029] Fig. 4 shows the exemplary connector 100 of Fig. 3 in the sealing configuration, with the cover strip 5 in the sealing position. Here, the cap unit 8 is plugged into the insertion channels 3, and the cover strip 5 is sunk into the guide groove 13 and held therein. In the region of the guide groove 13, the cover strip 5 extends with its surface planar with the housing cover 4. A compact, ready-to-use electrical connector is thus shown, in which, in order to connect the cables in a sealed manner, said cables need only be inserted with their bare metal ends into the closure element insertion channels 15 associated with the respective insertion channels 2, thereby piercing the closure element bottoms, in order to establish a sealed connection of the cables. The connector 100 can thus advantageously be pre-assembled in the sealing

configuration. The thickness of the closure element bottoms 12 (here measured in the y-direction) is selected to be thin enough that the piercing can take place without tools, that is to say by the force of an operator.

[0030] Fig. 5 shows the electrical connector of Fig. 4 from the rear side thereof. In order to keep the cover strip 5 in the sealing position, the hook unit 10 is hooked onto the corresponding counterpart 16, which in the present case is designed in the form of an undercut in the housing cover 4. In the present case, the guide groove already shown in Fig. 4 also extends along the illustrated fourth side in order to better secure the cover strip 5 in the sealing position.

[0031] Fig. 6 now shows a sectional view of the electrical connector of Figs. 3 to 5 in a section plane that extends perpendicular to the upper side, underside, front side and rear side. Accordingly, the cover strip 5 in the sealing position is now wrapped once around the housing cover 4, that is to say through more than 330°, here almost 360°. The cap unit 8 and the stopper unit 9 are thus securely held in the sealing position by the hook unit 10.

[0032] Fig. 7, in which the described exemplary embodiment of the electrical connector is shown in a sectional view, with a section plane perpendicular to the section plane of Fig. 6, shows that the closure element insertion channels 15, in the present case unlike the insertion channels 2 of the housing 1, taper conically towards the respective closure element bottom 12. As can be seen from Fig. 8, a reliable sealing of the cap unit 8 can thus be achieved even for different diameters d4 of the cables 18 provided with external insulation 22 and an internal metal core 23, the stripped bare metal ends 19 of which cables have pierced the respective bottoms 12. The configuration described here results in both external sealing surfaces 20 and internal sealing surfaces 21 for the cap unit 8, which further improves the sealing behaviour. This particularly applies to the internal sealing surfaces 21, which are pressed against the housing 1 by the plugged-in cables 18.

Claims

1. Electrical connector for electrically connecting at least two electrical cables (18) without using tools, comprising
 - a housing (1);
 - at least two insertion channels (2), arranged in the housing (1) on a first side, for inserting bare metal ends (19) of the electrical cables (18) into the housing (1) along an insertion direction (E);
 - a metal clamping unit (17), arranged in the housing (1), for clamping the bare metal ends (19) inserted into the insertion channels (2) and for electrically coupling the metal ends (19) to one another; and
 - a test channel (3), arranged in the housing (1)

on a second side, for inserting a test finger;

characterized by

- a housing cover (4) made of a pliable plastic, which is cast with the housing (1);
 - wherein the housing cover (4) is formed in one piece with a cover strip (5), which extends from a first end (6) of the cover strip (5) to a second end (7) of the cover strip (5), wherein:
 - the cover strip (5) merges into the housing cover (4) at the first end (6), and
 - between the first end (6) and the second end (7) the cover strip (5) has a cap unit (8) for plugging into the insertion channels (2) and a stopper unit (9) for plugging into the test channel (3), and
 - in an end region comprising the second end (7) the cover strip (5) has a hook unit (10) for hooking the cover strip (5) onto an associated hook counterpart (16) of the electrical connector in a sealing position, wherein in the sealing position the cap unit (8) is plugged into the insertion channels (2) and the stopper unit (9) is plugged into the test channel (3).
2. Electrical connector according to the preceding claim,
characterized in that
 the cap unit (8) has a plurality of closure elements (11), which are each assigned to an insertion channel (2) and have in particular a respective closure element bottom (12), the thickness of which in the insertion direction (E) is thin enough for the closure element bottom (12) to be pierced by the respective bare metal end (19) upon insertion of the bare metal end (19) into the associated insertion channel (2) in the insertion direction (E) when the cap unit (8) is plugged into the insertion channels (2).
3. Electrical connector according to the preceding claim,
characterized in that
 the respective closure elements (11) have a respective closure element insertion channel (15) for inserting the bare metal ends (19) along the insertion direction (E) when the cover strip (5) is in the sealing position, wherein the closure element insertion channels (2) taper conically in the insertion direction (E) towards the respective closure element bottom (12).
4. Electrical connector according to any one of the preceding claims,
characterized in that
 along the cover strip (5) the cap unit (8) is arranged between the first end (6) and the stopper unit (9), and/or the stopper unit (9) between the second end (7) and the cap unit (8); wherein in particular a first distance (d1) between the cap unit (8) and the first

end (6) and/or a third distance (d3) between the stopper unit (9) and the second end (7) is smaller than a second distance (d2) between the cap unit (8) and the stopper unit (9).

5. Electrical connector according to any one of the preceding claims,

characterized in that

- the first distance (d1) between the cap unit (8) and the first end (6) of the cover strip (5) along the cover strip (5) is selected in such a way that the cover strip (5) must be stretched in order to plug the cap unit (8) into the insertion channels (2), and in particular is selected in such a way that, in the sealing position, a cover strip portion between the cap unit (8) and the first end (6) exerts on the cap unit (8) a first force acting in the direction of the first end (6); and/or
- the second distance (d2) between the cap unit (8) and the stopper unit (9) along the cover strip (5) is selected in such a way that the cover strip (5) must be stretched in order to plug the stopper unit (9) into the test channel (3) when the cap unit (8) is already plugged into the insertion channels (2), and in particular is selected in such a way that, in the sealing position, a cover strip portion between the cap unit (8) and the stopper unit (9) exerts on the stopper unit (9) a second force acting in the direction of the cap unit (8); and/or
- the third distance (d3) between the stopper unit (9) and the hook unit (10) along the cover strip (5) is selected in such a way that a cover strip portion between the stopper unit (9) and the hook unit (10) must be stretched in order to hook on the hook unit (10) when the stopper unit (9) is already plugged into the test channel (3), and in particular is selected in such a way that, in the sealing position, a cover strip portion between the stopper unit (9) and the hook unit (10) exerts on the hook unit (10) a third force acting in the direction of the stopper unit (9).

6. Electrical connector according to any one of the preceding claims,

characterized in that

at least on one side, in particular the second side and/or the side provided with the first end (6), a third side, and/or a fourth side located opposite the third side, the housing cover (4) has a guide groove (13) for guiding the cover strip (5).

7. Electrical connector according to any one of the preceding claims,

characterized in that

the cover strip (5) has at its first end (6) and/or the housing cover (4) has on the side of the first end (6)

of the cover strip (5), the third side, an undercut as a hook counterpart (16) or as part of the hook counterpart (16), and in the sealing position of the cover strip (5) the hook unit (10) is designed to engage in the undercut and thus to secure the cover strip (5) in the sealing position. 5

8. Electrical connector according to any one of the preceding claims,
characterized in that 10
the first and the second side are opposite sides, in particular with the insertion direction (E) anti-parallel to a further insertion direction in which the stopper unit (9) can be plugged into the test channel (3), and in particular the third side extends transversely to the first and the second side. 15

9. Electrical connector according to any one of the preceding claims,
characterized in that 20
in the sealing position the cover strip (5) extends once around the housing cover (4) in a plane extending parallel to the insertion direction (E).

10. Electrical connector according to any one of the preceding claims,
characterized in that 25
the housing (1) is a housing (1) composed of a plurality of housing parts (1a, 1b), in particular of a plurality of housing parts (1a, 1b) which are latched to one another. 30

11. Method for producing an electrical connector, comprising the method steps: 35
 - Creating a housing (1) with at least two insertion channels (2) for inserting bare metal ends (19) of electrical cables (18) into the housing (1) and with an internal metal clamping unit (17) for clamping the bare metal ends (19) inserted into the insertion channels (2) and for electrically coupling the metal ends (19) to one another; 40
 - Holding the created housing (1) in a first region of the housing (1), adjoining an insertion channel (2), and in a second region different from the first region, which second region adjoins a test channel (3) for inserting a test finger but does not merge into the first region; 45
 - Overmolding the held housing (1) with a plastic as a housing cover (4), where, in one piece with the housing cover (4), a cover strip (5) is also injection-molded onto the housing (1). 50

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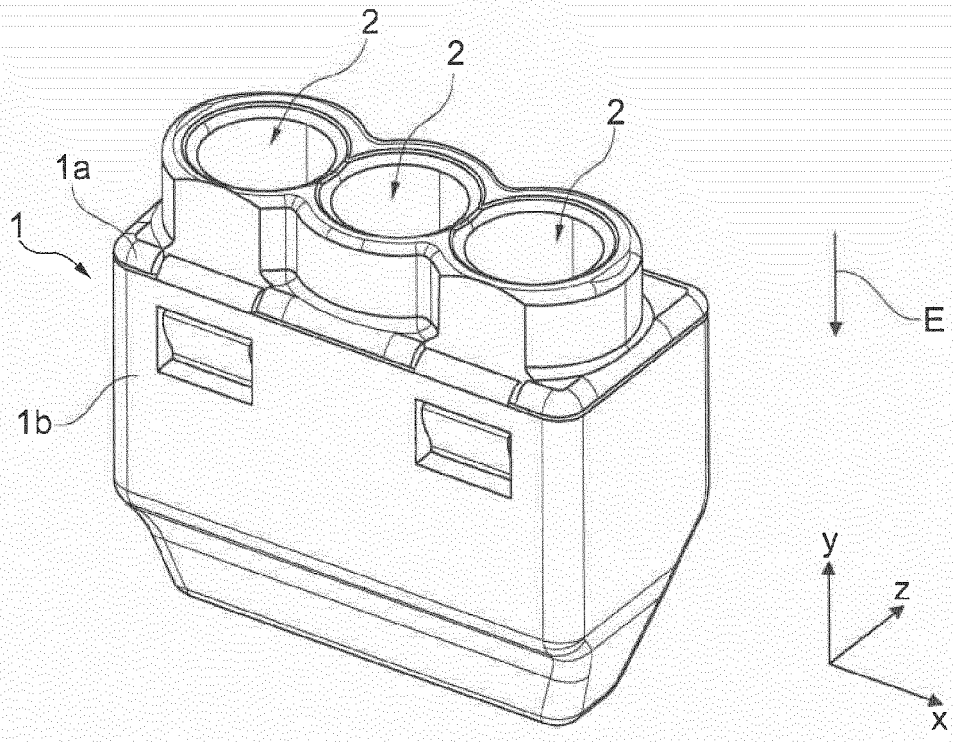


Fig. 1

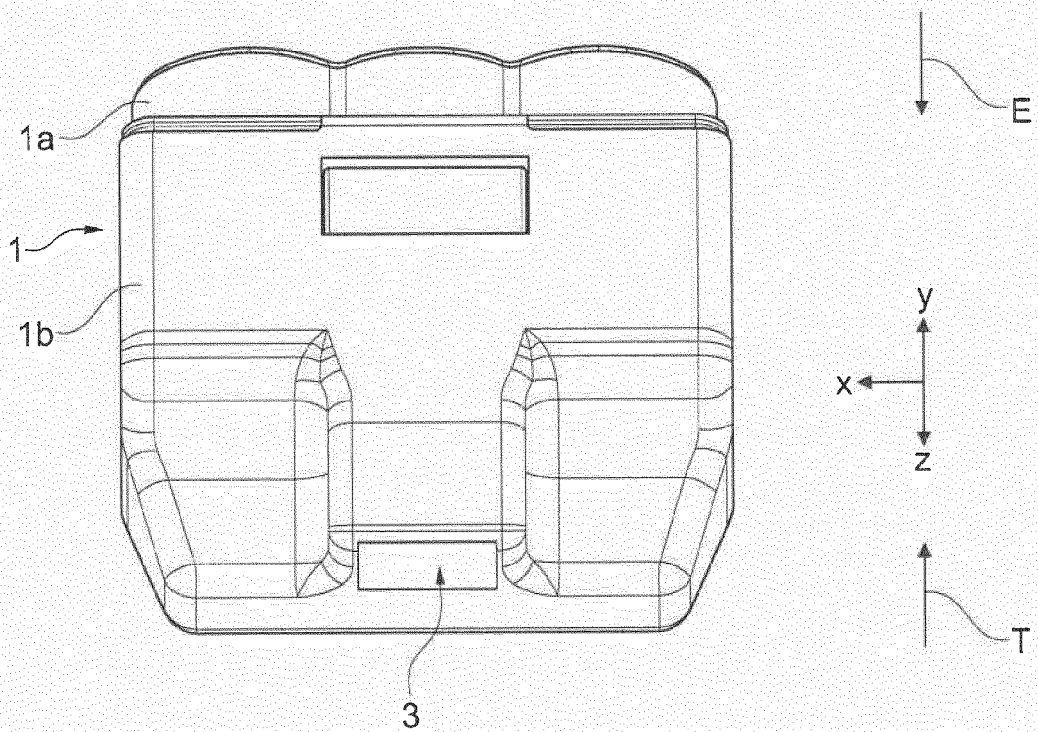


Fig. 2

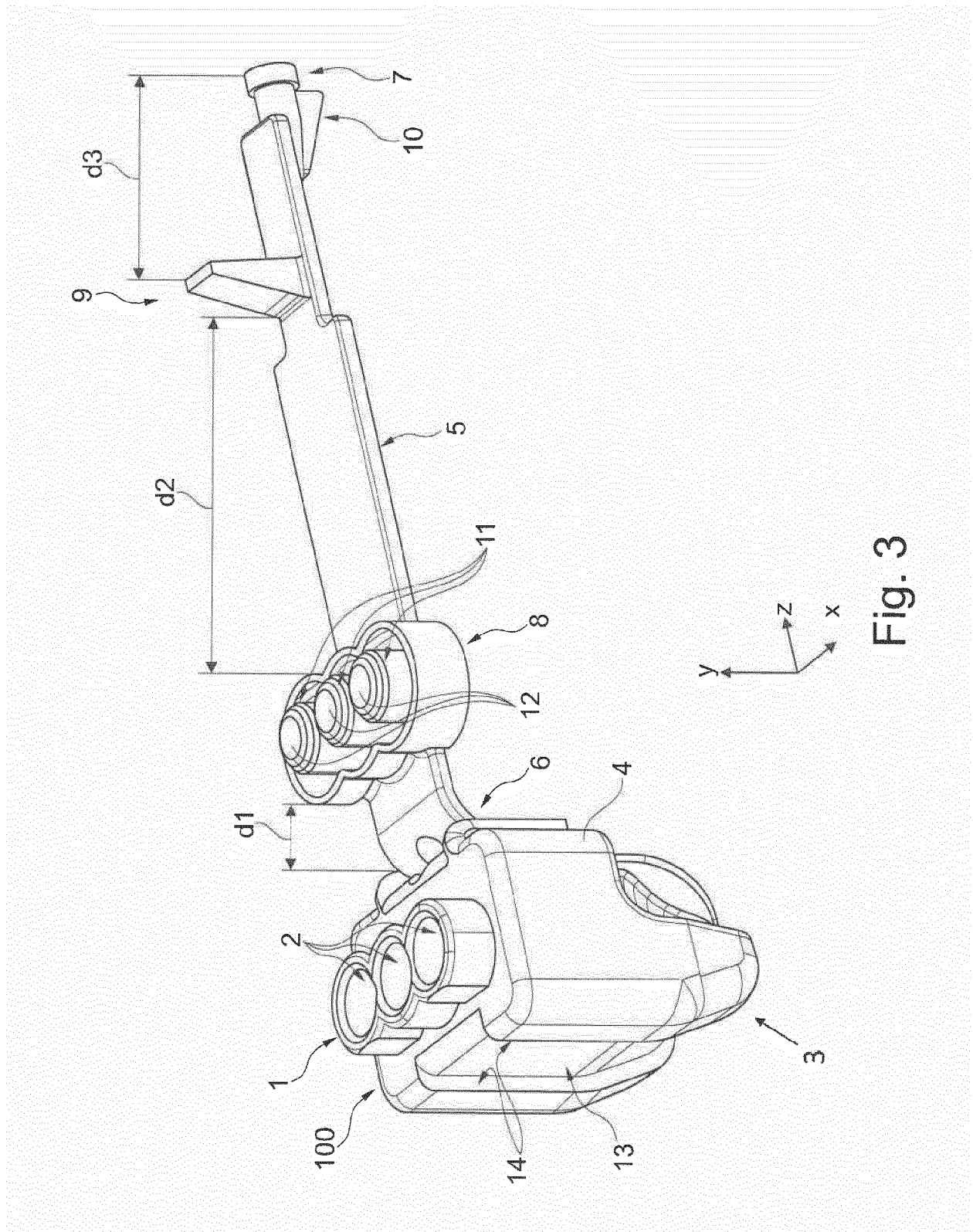


Fig. 3

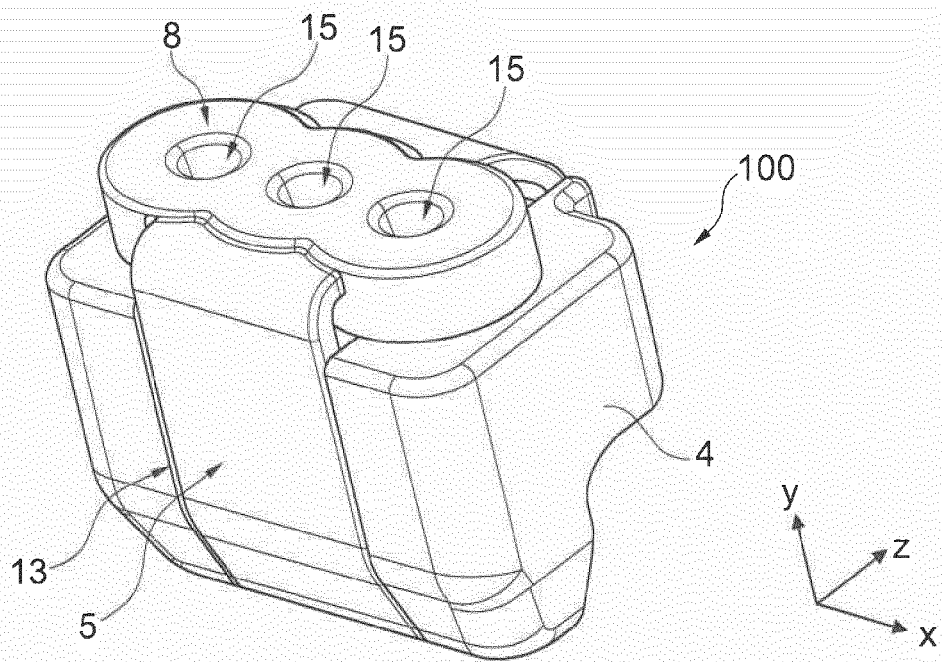


Fig. 4

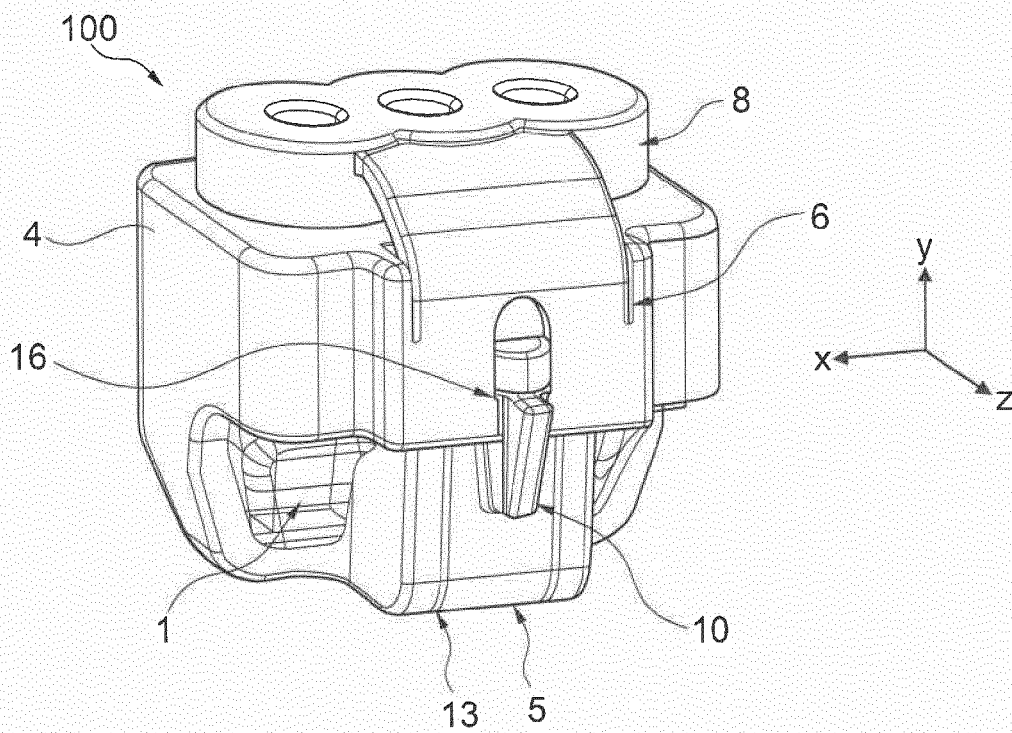
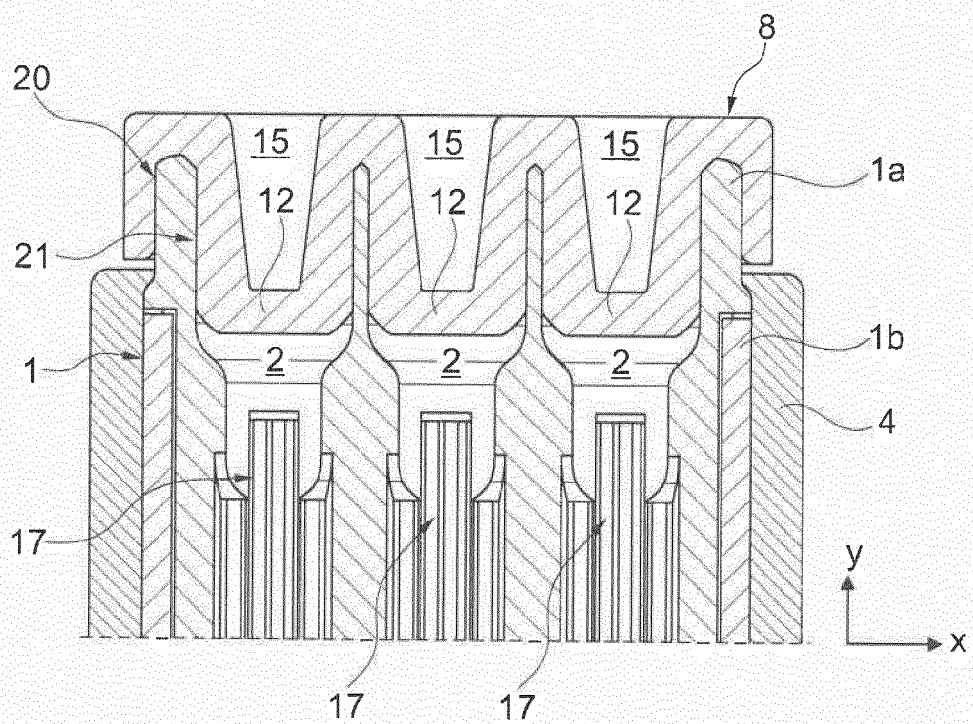
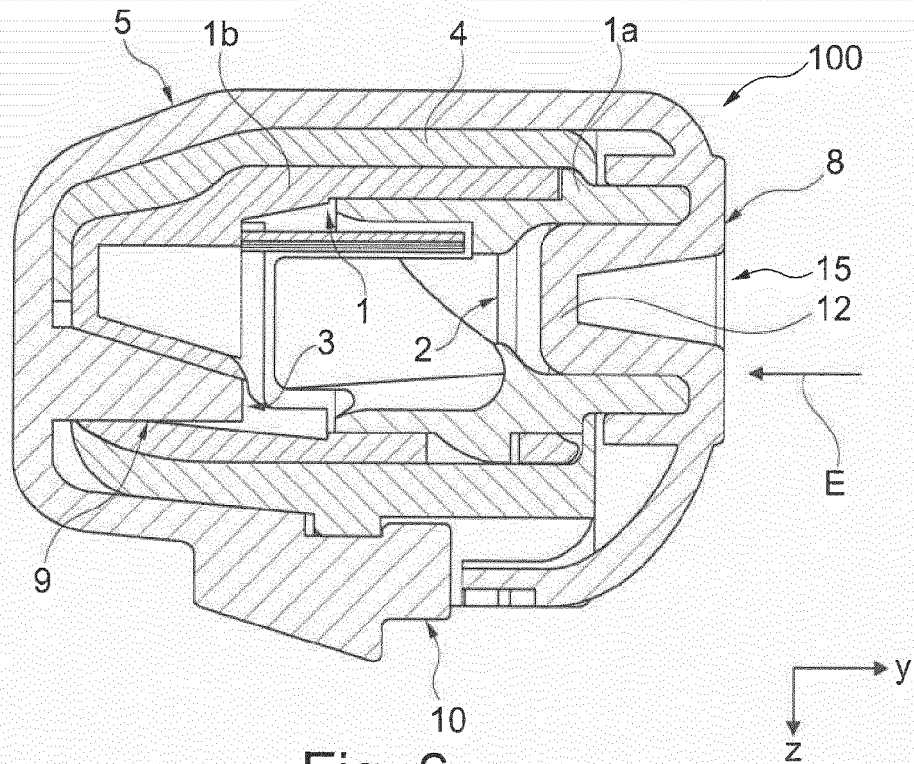


Fig. 5



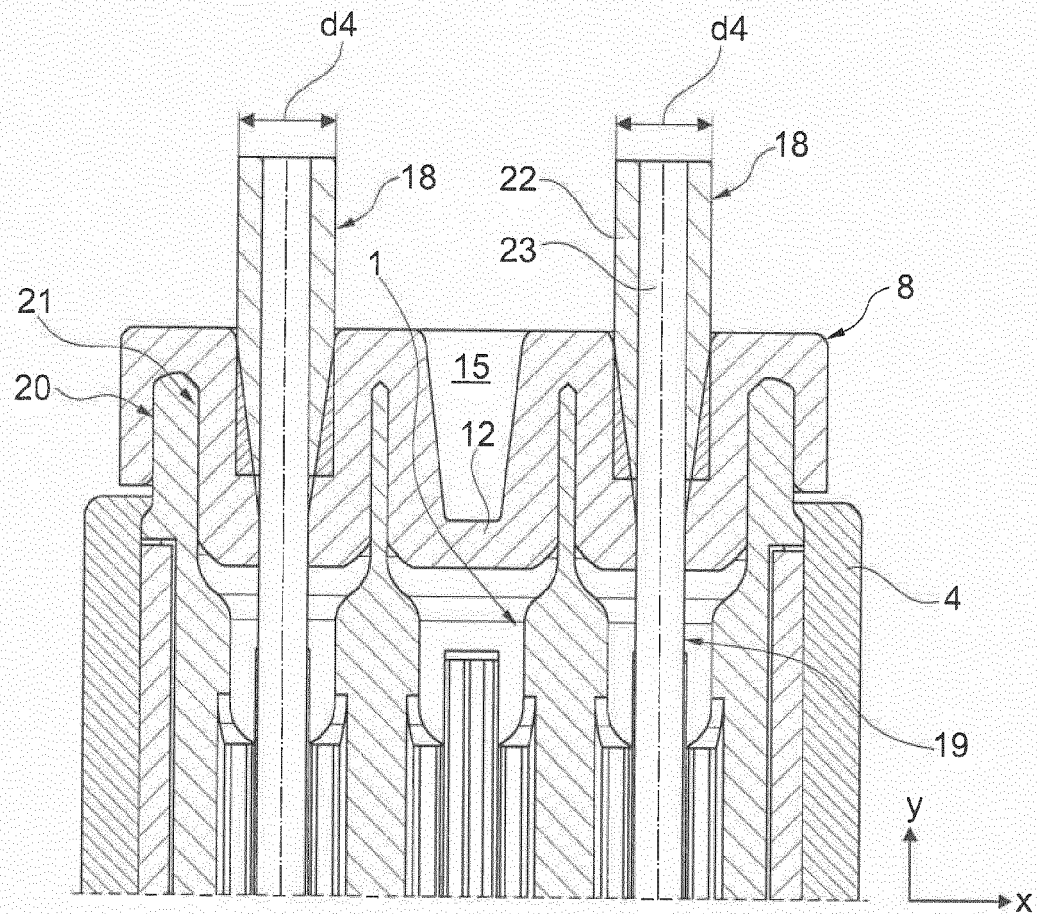


Fig. 8



EUROPEAN SEARCH REPORT

Application Number

EP 22 19 7049

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 2007/281538 A1 (ELLIOTT KENNETH C [US] ET AL) 6 December 2007 (2007-12-06)	1-4, 6-11	INV. H01R4/22
A	* paragraph [0002] - paragraph [00041]; figures 1, 3, 4, 6, 7 *	5	H01R4/70
A	US 6 854 996 B2 (TYCO ELECTRONICS CORP [US]) 15 February 2005 (2005-02-15) * abstract; figure 2 *	1, 11	ADD. H01R13/52
A	US 2019/356064 A1 (FU XIAOZHI [CN] ET AL) 21 November 2019 (2019-11-21) * abstract; figure 2 *	6	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			H01R
Place of search			Examiner
The Hague			Mateo Segura, C
Date of completion of the search			
30 January 2023			
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ON EUROPEAN PATENT APPLICATION NO.**

EP 22 19 7049

5

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2007281538 A1	06-12-2007	AT 476769 T	15-08-2010
		BR PI0711492 A2	14-02-2012
		BR PI0711497 A2	20-12-2011
		CA 2654597 A1	13-12-2007
		CA 2654602 A1	13-12-2007
		EP 2030287 A2	04-03-2009
		EP 2030288 A2	04-03-2009
		RU 2008151377 A	20-07-2010
		RU 2008151378 A	20-07-2010
		TW 200812179 A	01-03-2008
		TW 200818637 A	16-04-2008
		US 2007281538 A1	06-12-2007
		US 2007281556 A1	06-12-2007
US 6854996 B2	15-02-2005	WO 2007143601 A2	13-12-2007
		WO 2007143603 A2	13-12-2007
		AR 042641 A1	29-06-2005
		CA 2735331 A1	02-09-2004
		CL 2003002673 A1	28-01-2005
		NZ 556185 A	31-03-2009
US 2019356064 A1	21-11-2019	PE 20040632 A1	05-11-2004
		US 2004121639 A1	24-06-2004
		US 2004157488 A1	12-08-2004
		CN 208782091 U	23-04-2019
US 2019356064 A1	21-11-2019	DE 102019207041 A1	21-11-2019
		US 2019356064 A1	21-11-2019

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 2795737 A1 [0003]
- US 10777934 B2 [0003]