

(19)



(11)

EP 4 248 527 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:

31.07.2024 Bulletin 2024/31

(21) Application number: **20811303.5**

(22) Date of filing: **20.11.2020**

(51) International Patent Classification (IPC):

H01H 33/02 ^(2006.01) **H01R 11/26** ^(2006.01)

(52) Cooperative Patent Classification (CPC):

H01H 33/025; **H01R 11/26**

(86) International application number:

PCT/EP2020/082904

(87) International publication number:

WO 2022/106026 (27.05.2022 Gazette 2022/21)

(54) **ELECTRICAL CONNECTOR HAVING AN ANNULAR CONTACT**

ELEKTRISCHER VERBINDER MIT RINGFÖRMIGEM KONTAKT

CONNECTEUR ÉLECTRIQUE AYANT UN CONTACT ANNULAIRE

(84) Designated Contracting States:

AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(43) Date of publication of application:

27.09.2023 Bulletin 2023/39

(73) Proprietor: **Hitachi Energy Ltd**

8050 Zürich (CH)

(72) Inventors:

- **SAMUL, Boguslaw**
31-345 Krakow (PL)
- **OSTROWSKI, Joerg**
8048 Zürich (CH)

• **GATZSCHE, Michael**

8003 Zürich (CH)

• **SAXL, David**

8046 Zürich (CH)

(74) Representative: **Schaad, Balass, Menzl & Partner AG**

Bellerivestrasse 20

Postfach

8034 Zürich (CH)

(56) References cited:

WO-A1-2014/142799 CN-A- 107 785 727

US-A1- 2013 330 981

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Description

[0001] The present invention relates to an electrical connector for transmitting electrical current according to the preamble of claim 1 as well as a gas-insulated grounding switch and a generator circuit breaker comprising the electrical connector.

[0002] Short-time withstand current and peak current withstand capability are key requirements in particular for high-power devices to ensure that, in case of a short-circuit in a grid, no downstream components are damaged. Indeed, high current causes thermal stress in the current path, especially in parts with reduced cross sections such as contact elements in disconnectors and earthing switches.

[0003] Further, ununiform current distribution in multi-contact moving systems can lead to short time current failures due to overload of single contact elements. In some cases, thermal issues for continuous operation might also result.

[0004] Typical solution of such problems requires adding of additional contact elements in parallel to reduce current intensity per contact element. However, this leads to higher space requirements as well as higher plug-in and sliding forces for an electrical conductor that must be inserted for example in the disconnector or the earthing switch.

[0005] US 2013/0330981 discloses a high current connector for transmitting electric currents, having a housing made of electrically conductive material for mechanical and electrical connection to a cable, an open side for the insertion of a matching plug connector made of an electrically conductive material, and a contact element disposed and formed in the housing such that it produces an electrical contact with a contact surface and contact pressure between the housing and the matching plug connector inserted therein, wherein the contact element has at least one annular helical spring through which the plug connector can be inserted.

[0006] US 2006/0270277 discloses an electrical terminal system suitable for high current applications, wherein the electrical terminal system includes a female terminal body having a stamped groove for accepting a canted coil spring and an opening having a geometry configured for accepting the inserting portion of a male terminal body. Electrical communication between the male and female terminal bodies is provided by an interface between the canted coil spring and the inserting portion of the male terminal body.

[0007] DE 19718448 discloses a connector having a socket part with a substantially cylindrical chamber and a cylindrical pin part which can be inserted into the chamber. An annular sprung contact element is mounted in an annular groove formed on the wall of the chamber or pin. The contact element extends in the radial direction from the groove over the pin part or chamber wall to contact the socket part or pin part. The contact element is an annular, helical, closed spring whose spring windings are inclined with respect to the axis of the helix.

[0008] These different electrical connectors do not solve the problems described above in an optimal manner. Indeed, in each case, the problem of reducing current per contact element would involve an increase of the number of contact elements that results in increased space requirements as well as plug-in and sliding forces.

[0009] The object of the present invention is therefore to provide an electrical connector with a simple and cost-effective design that allows a reduction of current per contact element, while requiring a limited space and keeping plug-in and sliding forces low.

[0010] This object is achieved by an electrical connector according to claim 1.

[0011] Preferred embodiments are the subject-matter of dependent claims.

[0012] The present invention relates to an electrical connector for transmitting electrical current, comprising a connecting element of electrically conductive material having a receiving hole which can be formed as a blind hole, and designed for mechanical and electrical connection to an electrical conductor, wherein the receiving hole extends in a longitudinal direction defining a longitudinal axis of the connector for the insertion of the electrical conductor.

[0013] The term "electrical connector" is to be understood in the usual sense as a device used to join electrical conductors and create an electrical circuit. It can be formed as a socket in which the electrical conductor can be inserted.

[0014] The electrical conductor can be a cable. It can also be an insertion-type connector designed to be inserted in the connecting element and to be connected mechanically and electrically to the connecting element, wherein the cable is in turn electrically connected to the insertion-type connector. Concretely, the insertion-type connector could be a crimp contact, the connecting element being mechanically and electrically connected to a pin of the crimp contact in which the cable is inserted.

[0015] The connecting element can be surrounded by or embedded in a material acting as a protection material and/or as an electrically insulating material.

[0016] Further, the receiving hole has a plurality of grooves extending circumferentially about an interior wall of the receiving hole and in communication with the receiving hole. In addition, the plurality of grooves are closed in the radial direction and do not communicate with the exterior of the connecting element. Preferably, each groove extends symmetrically with respect to a plane perpendicular to the longitudinal axis L.

[0017] The electrical connector also comprises a plurality of contact elements, each contact element being housed at least partially in one of the plurality of grooves in such a way that the plurality of contact elements make electrical contact with the electrical conductor inserted in the connecting element and produces contact-making pressure between the

connecting element and the electrical conductor to allow the transmission of electrical current from the electrical conductor to the connecting element. The provision of a plurality of grooves and a plurality of a contact elements is meant to allow the split of current flowing from the electrical conductor to the electrical connector via the plurality of contact elements.

[0018] Each contact element also makes electrical contact with the connecting element in a groove contact region of the groove in which it is housed. The groove contact region can be preferably a surface, at least approximately a line or at least approximately a point depending on the relative conformation of the contact element and the groove.

[0019] Preferably, a contact element is arranged in each groove. However, it is also possible that one or more grooves are free from contact element. This can be the case for example if the maximum electrical current intensity in the electrical conductor and the electrical connector requires only a limited number of contact elements for operation. Such an embodiment has the advantage that a single connecting element comprising a plurality of grooves can be used to cover different configuration of contact elements depending on the use of the electrical connector.

[0020] According to the present invention, the connecting element comprises a control segment extending, as viewed along the longitudinal axis, between two consecutive grooves of the plurality of grooves, and side segments adjacent to the control segment, wherein the control segment has an electrical resistance different from the electrical resistance of the side segment.

[0021] The provision of a control segment according to the invention allows the control of current distribution in the connecting element, and consequently in the electrical connector, in such a way that the overload of single contact elements can be avoided. The control segment is formed such that current flowing from the contact elements of two consecutive grooves into the connecting element cross the control segment. Presently, the current distribution is controlled by the difference in the value of the electrical resistance of the control segment and the adjacent side segments. As a result of this difference in electrical resistance, the electrical current can flow with different intensities in the contact elements housed in the two consecutive grooves so that it can be distributed in a controlled manner between the contact elements and further in the connecting element.

[0022] In contrast to the alternative solution consisting of increasing the number of contact elements, the present solution does not require more space and the plug-in and sliding forces acting while inserting the electrical conductor in the electrical connector are not increased. Indeed, according to the present invention, the external conformation of the connecting element can remain the same, while its internal design provides for the control segment and the side segment, wherein the control segment and the side segments have different electrical resistance but do not require more space in the connecting element.

[0023] In a preferred embodiment, the electrical resistance of the control segment is higher than the electrical resistance of the side segments. An increase of the electrical resistance can be achieved in a simple manner, as disclosed in further embodiments, and consequently, this embodiment can be realized while keeping the design simple and production cost low.

[0024] It is also conceivable, to provide for a control segment having a lower electrical resistance than that of the side segment.

[0025] Concretely, considering two consecutive grooves, the control segment is limited in the longitudinal direction by the groove contact region of each of the two consecutive grooves. In other words, the control segment is defined as a region of the connecting element including bulk material extending between the groove contact region of each of the two consecutive grooves of the plurality of grooves.

[0026] Preferably, the control segment extends longitudinally, when viewed in a longitudinal cross section, along the shortest path between the groove contact region of each of the two consecutive grooves and radially from the interior wall of the receiving hole to an exterior wall of the connecting element, such that it includes the shortest path between the groove contact region of each of the two consecutive grooves. In this case, the control segment can be seen as a slice of the connecting element.

[0027] The side segments are defined as a region of the connecting element including bulk material and extending adjacent to the control segment, preferably directly adjacent to the control segment, on both side of the control segment.

[0028] In a preferred embodiment, the side segments are formed complementary to the control segment, i.e. the shape of the side segments match the shape of the control segment. In such an embodiment, the side segments and the control segment can be formed complementary to each other and their union forms the connecting element.

[0029] In a preferred embodiment, the control segment can be delimited longitudinally by a first plane and a second plane extending perpendicular to the longitudinal axis. The first plane crosses the groove contact region of a first of the two consecutive grooves and the second plane crosses the groove contact region of a second of the two consecutive grooves. The control segment extends between the first plane and the second plane. Radially the control segment can be delimited by the interior wall of the receiving hole and the exterior wall of the connecting element. The side segments are delimited longitudinally by the first plane and extend on the side of the first plane facing away from the second plane, and by the second plane and extend on the side of the second plane facing away from the first plane. Radially the extension of the side segments can be delimited by the interior wall of the receiving hole and the exterior wall of the connecting element. This embodiment has the advantage of a simple calculation of the electrical resistance and current

distribution and implementation.

[0030] In case the groove contact region of one or both two consecutive grooves extend over a surface, the first plane can be defined as crossing a border region of the groove contact region of the first of the two consecutive grooves. The second plane can be defined as crossing a border region of the groove contact region of the second of the two consecutive grooves. The border region extends each time on the side of the groove contact region facing in the direction of the groove contact region of the other groove of the two consecutive grooves.

[0031] In a preferred embodiment, the control segment comprises a recess extending circumferentially, opened towards the exterior of the connecting element, and closed towards the receiving hole. In other words, the recess is free from a communication with the receiving hole, including the grooves, i.e. the recess does not cut the interior surface of the receiving hole, including of the grooves. Preferably, the recess is an annular recess. Further, the recess is formed, when viewed in the longitudinal direction, between two consecutive grooves to increase the electrical resistance of the control segment extending between the two consecutive grooves.

[0032] The recess is formed in the electrically conductive material of the connecting element to increase the electrical resistance. However, it is also conceivable that the recess extends in the electrical connector outside of the connecting element, for example if the connecting element is surrounded by or embedded in a further material, e.g. a dielectric material. This embodiment has a particular simple design of the recesses enabling a simplified implementation.

[0033] The provision of a recess in the control segment according to the invention allows the control of current distribution in the connecting element, and consequently in the electrical connector, in such a way that the overload of single contact elements can be avoided. Presently, the current distribution is controlled by the increase of the electrical resistance of the control segment extending between the two consecutive grooves. This increase of resistance is caused by the modification of the segment geometry, namely by the provision of the recess in the control segment, which reduces the segment cross section available for the electrical current flow and consequently increases its electrical resistance. As a result, the current flow from the electrical conductor can be distributed in a controlled manner between the contact elements and flow through the connecting element.

[0034] In contrast to the alternative solution consisting of increasing the number of contact elements, the present solution does not require more space and the plug-in and sliding forces acting while inserting the electrical conductor in the electrical connector are not increased.

[0035] Further, the implementation of this solution is inexpensive and simple because it does not require a detailed redesigning of existing components, what is especially critical by casted connecting elements or electrical devices comprising a casted connecting element.

[0036] In a preferred embodiment, the recess extends about a whole circumference of the connecting element. In other words, the recess extends without interruption over 360° around the longitudinal direction of the connecting element. This allows the control of current distribution circumferentially in the control segment of the connecting element extending between the two consecutive grooves.

[0037] In a preferred embodiment, the recess is limited in the longitudinal direction by recess sidewalls extending perpendicular to the longitudinal direction and radially by a recess bottom wall delimiting a recess bottom. For example, the longitudinal cross section of the recess can be at least approximately rectangular. This embodiment has the advantage of a simple design and implementation of the recess in the form of a cut extending circumferentially. Preferably, each recess sidewall extends in a plane for a very simple design and implementation.

[0038] It is however conceivable that the recess has a longitudinal cross section widening in a step-like manner, when viewed in a radially outwards direction, i.e. with increasing distance from the longitudinal axis. In other words, the recess is limited radially by the recess bottom wall, and longitudinally successively by recess sidewalls extending perpendicular to the longitudinal direction and by recess sidewalls extending parallel to the longitudinal direction.

[0039] In a preferred embodiment, the longitudinal cross section of the recess is widening, preferably continually widening, when viewed in a radially outwards direction, i.e. with increasing distance from the longitudinal axis. For example, the recess can be limited in the longitudinal direction by recess sidewalls extending inclined with respect to the longitudinal direction so that the longitudinal cross section of the recess is at least approximately triangular.

[0040] In another example, the recess can be limited in the longitudinal direction by recess sidewalls curved in a concave manner with respect to the longitudinal direction. In particular, the longitudinal cross section of the recess can be at least approximately of semicircular shape. Such an embodiment has also the advantage of a simple design and implementation of the recess.

[0041] In a preferred embodiment, a radius of the connecting element measured from the recess bottom to the longitudinal axis in a plane extending perpendicular to the longitudinal axis is at least approximately constant, preferably constant, over the whole recess bottom. For example, in the case of a recess having a rectangular longitudinal cross section, the radius corresponds to the distance from the longitudinal axis to the side of the rectangle forming the recess bottom. In the case of a recess having a triangular longitudinal cross section, the radius can be measured as the distance from the longitudinal axis to the tip of the triangle forming the bottom of the triangular longitudinal cross section. In addition to the simple manufacturing taking advantage of the constant radius, the geometry of this embodiment allows

a simplification of the calculation of the resistance resulting from the provision of the recess.

[0042] In a preferred embodiment, the plurality of grooves have the same longitudinal cross section, preferably limited in the longitudinal direction by groove sidewalls extending at least approximately perpendicular to the longitudinal direction and preferably limited radially by groove bottom walls extending at least approximately parallel to the longitudinal direction. This geometry allows a simple design and manufacturing taking advantage of the same longitudinal cross section of the grooves.

[0043] In a preferred embodiment, the plurality of grooves have the same longitudinal cross section and are preferably limited in the longitudinal direction by groove sidewalls extending at least approximately perpendicular to the longitudinal direction. Further, the plurality of grooves are preferably limited radially by recess bottom walls comprising two straight wall portions projecting inclined radially outwards with respect to the longitudinal axis L, each from one of the groove sidewalls. The two straight wall portions intersect at an intersection point situated in a groove symmetry plane extending perpendicularly to the longitudinal axis L. This geometry allows an optimized contact between the contact elements housed in the grooves and the groove bottom walls inclined with respect to the longitudinal axis.

[0044] A depth of the groove is defined as the difference between the radius of the groove and the radius of the receiving hole in a region of the interior wall directly adjacent to the groove, as viewed in the longitudinal direction. The radius of the groove can be defined as the longest radius of the groove if the bottom groove is not parallel to the longitudinal axis. In the case of a cylindrical receiving hole of constant radius and centered on the longitudinal axis, the depth of the groove is the difference between the radius of the groove, as defined above, and the radius of the receiving hole.

[0045] In a preferred embodiment, the plurality of grooves have an at least approximately constant depth. This geometry allows a further simplification of the calculation of the resistance resulting from the provision of the recess in the control segment.

[0046] In a preferred embodiment, the plurality of grooves are at least approximately equally spaced apart from each other. This geometry allows a homogenous distribution of the current flowing between two successive grooves.

[0047] In a preferred embodiment, the plurality of grooves have the same longitudinal cross section and are equally spaced apart from each other. This embodiment combines the advantages of the two previous embodiments disclosed.

[0048] In a preferred embodiment, the connecting element comprises a plurality of control segments, preferably having a higher electrical resistance than the respective adjacent side segments. Each control segments of the plurality of control segments can each be formed according to any one of the embodiments disclosed previously. The provision of a plurality of control segments allows the control of the current distribution in the plurality of contact elements. As a result, the current flow from the electrical conductor can be distributed in a controlled manner between the plurality of contact elements.

[0049] It is also possible to provide a portion of the connecting element having a plurality of control segments with an increased resistance and a further portion of the connecting element having an unchanged resistance. This allows the control of the current distribution, i.e. the split of the current in a predefined manner, between the contact elements arranged in the portion and in the further portion of the connecting element.

[0050] In a preferred embodiment, the connecting element comprises a plurality of recesses, each recess being arranged in a control segment between two consecutive grooves of the plurality of grooves. Each recess of the plurality of recesses can be formed according to any one of the embodiments disclosed previously. As explained above, the electrical resistance increase of the control segment extending between two successive grooves is caused by the recess formed between the two successive grooves. The provision of a plurality of recesses allows more possibilities to configure the electrical resistance of the connecting element.

[0051] In a preferred embodiment, the plurality of recesses have the same longitudinal cross section, each recess being arranged preferably centered between two consecutive grooves. This geometry allows a homogenous distribution of the current flowing between two successive grooves and a further simplification of the calculation of the resistance resulting from the provision of the plurality of recesses.

[0052] In a more preferred embodiment, the plurality of recesses is such that a recess, preferably one recess, is provided between each two consecutive grooves of the plurality of grooves. Further, a contact element is provided in each groove of the plurality of grooves. In such an embodiment, the reduction of the overload risk of single contact elements can be optimized.

[0053] In a preferred embodiment, the radius of the connecting element measured at the recess bottom of the recess and at a further recess bottom of a further recess are different. The provision of a different radius of the connecting element results in the provision of control segments of the connecting element having different cross sections available for the electrical current flowing between two consecutive grooves. Consequently, the control segments also have different electrical resistances. Therefore, the current distribution between contact elements can be optimized locally, i.e. in portions of the connecting element.

[0054] It is also conceivable to provide a first group of recesses arranged in a first portion of the connecting element and having a first radius as well as a second group of recesses arranged in a second portion of the connecting element and having a second radius different from the first radius. In this embodiment, the electrical current flow can be controlled

in a different manner in the first and in the second portion, leading to more flexibility and reliability in the use of the electrical connector.

[0055] In a preferred embodiment, at least one control segment of the connecting element extending between two consecutive grooves is free from recess. The absence of recess in at least one control segment between two consecutive grooves result in a segment having a lower resistance than a segment comprising a recess. It results in the provision of segments having different cross sections available for the electrical current flow between two grooves and consequently having different electrical resistances. Therefore, the current distribution between contact elements can also be optimized locally in such an embodiment.

[0056] In a preferred embodiment, the recess or the plurality of recesses is filled with a material, preferably a dielectric material. Filling the recess or the plurality of recesses avoids the accumulation of undesirable particles therein and ensure more reliable operation of the electrical connector.

[0057] In a preferred embodiment, the control segment is made at least partially of a material having a higher electrical resistance than the material of the side segment. In contrast to the alternative solution consisting of increasing the number of contact elements, this solution does not require more space and the plug-in and sliding forces acting while inserting the electrical conductor in the electrical connector are not increased. Indeed, the external conformation of the connecting element can remain the same, while its internal design provides for a control segment and side segment, wherein the control segment has a higher electrical resistance than the side segments but does not require more space in the connecting element.

[0058] In a preferred embodiment, the connecting element comprises a plurality of control segments, each control segment being arranged between two consecutive grooves and made at least partially of a material having a higher electrical resistance than the material of the adjacent side segments.

[0059] In a preferred embodiment, the electrical resistance of a control segment and of a further control segment of the plurality of control segments are different, i.e. have different values. Therefore, the current distribution between contact elements can be optimized locally.

[0060] It is also conceivable to provide a first group of control segments arranged in a first portion of the connecting element and having each a first electrical resistance as well as a second group of control segments arranged in a second portion of the connecting element and having a second electrical resistance different from the first electrical resistance. In this embodiment, the electrical current flow can be controlled in a different manner in the first and in the second portion, leading to more flexibility and reliability in the use of the electrical connector.

[0061] In a preferred embodiment, the plurality of control segments comprises a group of control segments having a recess according to one of the previous embodiments and a further group of control segments made of a material having a higher electrical resistance than the material of the side segments according to one of the previous embodiments. This embodiment has the advantage that both solutions can be implemented depending on the conformation of the connecting element in different portions of the connecting element. For example, in a portion of the connecting element having a small diameter, the use of a material having a higher electrical resistance can be preferable to the use of recesses to produce the connecting element. The possibility to implement one solution of these solutions or both ensure flexibility in the production method.

[0062] In a preferred embodiment, the connecting element is formed with a cylindrical symmetry with respect to the longitudinal axis. The geometry of this embodiment allows a further simplification of the calculation of the resistance resulting from the provision of the recess.

[0063] In a preferred embodiment, each contact element is designed to surround the electrical conductor inserted in the connecting element. This configuration allows a homogeneous flow of current around the electrical conductor and consequently an optimized heat distribution in the electrical conductor.

[0064] In a preferred embodiment, the contact elements are annular helical springs arranged such that each annular helical spring surrounds the electrical conductor inserted in the connecting element. In this embodiment, each annular helical spring forms a loop, preferably closed, and is arranged in a groove. When the electrical conductor is inserted in the connecting element, it is consequently inserted in the loops formed by the annular helical springs. The provision of annular helical springs allows a reliable contacting of the electrical conductor with the contact elements, in particular in case of vibrations.

[0065] In a further aspect, the invention relates to a gas-insulated grounding switch comprising an electrical connector according to one of the previous embodiments.

[0066] In still a further aspect, the invention relates to a generator circuit breaker comprising an electrical connector according to one of the previous embodiments.

[0067] In the two previous aspects of the invention, the application of the electrical connector according to the invention is foreseen for high voltages, i.e. voltage in the range 60 kV to 110 kV. Applications in medium voltage, i.e. in the range 3 kV to 60 kV is likewise possible. Further, the electrical connector according to the invention can also be used in domestic and industrial application involving lower voltages.

Description of the figures

[0068] Preferred embodiments of the electrical connector according to the invention will now be described by way of example with reference to the accompanying drawings, in which:

Fig. 1 shows a cross-section of a gas-insulated grounding switch comprising an embodiment of the electrical connector according to the invention,

Fig. 2 shows an enlarged view of the portion marked as II in Fig. 1 comprising the electrical connector,

Fig. 3 shows a graphical representation of the resistance R_1 dependency to the radius of the connecting element at a recess bottom for the electrical connector according to Fig. 1,

Fig. 4 shows a graphical representation of the resistance R_2 dependency to the radius of the connecting element at a further recess bottom of the connecting element according to Fig. 1, and

Fig. 5 shows a further embodiment of the electrical connector according to the invention.

[0069] Gas-insulated grounding switches are well-known devices in the field of high-voltage current supply. Therefore, only aspects relevant for the understanding of the invention are described below in more details. The gas-insulated grounding switch disclosed in Fig. 1 is an exemplary application in which an electrical connector according to the invention is embodied. The principles according to the invention described herein also apply for other devices comprising an electrical connector, in particular in switching devices used in the field of high-voltage current supply.

[0070] The gas-insulated grounding switch 10 represented schematically in Fig. 1 comprises a substantially axisymmetric hollow housing 20 extending in a longitudinal direction defining a longitudinal axis L of the switch. The housing 20 delimits a cylindrical cavity 22 of radius R centered on the longitudinal axis L and designed to receive an electrical conductor which can be in the form of a cable 24. The cable 24 can be inserted into a receiving end 28 of the housing 20 along the longitudinal direction L and further into the cavity 22. On the side of the housing 20 opposed to the receiving end 28, the housing 20 is closed by a closing plate 32 fixed to the housing 20 by way of screws 36. The gas-insulated grounding switch 10 further comprises an output element 40 extending radially with respect to the longitudinal direction and arranged in a housing end region opposed to the receiving end 28, the connection element 40 being electrically connected to the housing 20.

[0071] Furthermore, the gas-insulated grounding switch 10 comprises an electrical connector 44, said electrical connector 44 comprising a connecting element 48 made of electrically conductive material and designed for mechanical and electrical connection to the cable 24. The connecting element 48 is also substantially axisymmetric in the form of a cylindrical hollow housing having a receiving hole 50, whose axis is centered on the longitudinal axis L. Further, the connecting element 48 is electrically connected to the receiving end 28 and extends the receiving end 28 along the longitudinal axis L. In the present embodiment, the housing 20 and the electrical connector 44 are formed integrally in one piece.

[0072] In the inserted position of the cable 24, an end region of the cable 24 is in contact with the connecting element 48 and current flowing through the cable flows through the connecting element 48 to the output element 40.

[0073] In the present embodiment, the electrical connector 44, the housing, the connecting element 48 and the output element 40 are made of an AlSi 1 %-alloy (99 % Aluminium, 1 % Silicon).

[0074] In Fig. 1 and Fig. 2, a protection and insulation layer designed to protect and electrically isolate the gas-insulated grounding switch and in particular the electrical connector 44 from the outside can be provided but has not been represented for the sake of clarity.

[0075] The features of the electrical connector 44 are further described below referring to Fig. 2, in which it is represented in a more detailed manner, and to Fig. 1.

[0076] In the present embodiment, the receiving hole 50 is cylindrical and has a constant radius R equal to the radius of the cylindrical cavity 22. The receiving hole 50 centered on and extending along the longitudinal axis L is designed to receive the electrical conductor, namely the cable 24, to connect the cable 24 to the gas-insulated grounding switch 10. The cable 24 can be inserted through an insertion opening 51 of the receiving hole 50 in the receiving hole 50 and further through the receiving end 28 into the housing 20, as already mentioned.

[0077] Further, the receiving hole 50 has a plurality of grooves 52 extending circumferentially about an interior wall 54 of the receiving hole 50 and in communication with the receiving hole. The grooves 52 are annular and extend about the whole circumference of the receiving hole 50. Further, the plurality of grooves 52 are closed in the radial direction and do not communicate with the exterior of the connecting element 48.

[0078] The plurality of grooves 52 have the same longitudinal cross section and are at least approximately equally

spaced apart from each other. Each groove 52 is limited in the longitudinal direction by groove sidewalls 56 extending perpendicular to the longitudinal axis L and formed symmetrically with respect to a groove symmetry plane G extending perpendicularly to the longitudinal axis L. The symmetry plane G is represented only for one groove in Fig. 2. Further, each groove 52 is limited radially by a groove bottom wall 58 comprising two straight wall portions projecting each from one of the groove sidewalls 56, radially outwards with respect to the groove sidewalls 56, i.e. inclined with respect to the longitudinal axis L, and intersecting at an intersection point P situated in the groove symmetry plane G. In other words, the radial distance from the longitudinal axis L to the groove bottom wall 58 increases, when viewed in the longitudinal direction, from the groove sidewalls 56 to the intersection point P. In the present embodiment, the plurality of grooves 52 comprises three grooves 52.

[0079] A radius K of the groove 52 measured from the longitudinal axis in a plane extending perpendicular to the longitudinal axis can be of different lengths if the bottom of the groove does not extend parallel to the longitudinal axis L. The maximum radius K is defined as the longest distance between the longitudinal axis L and the groove bottom wall 58. The depth of the groove is defined as the difference between the maximum radius K of the groove and the radius R of the receiving hole.

[0080] The electrical connector 44 also comprises a plurality of contact elements 64, each contact element 64 being housed at least partially in one of the plurality of grooves 52 in such a way that the plurality of contact elements 64 makes electrical contact with the cable 24 inserted in the connecting element 44 and produces contact-making pressure between the connecting element 48 and the cable 24. This allows the transmission of electrical current from the cable 24 to the connecting element 44. In the present embodiment, the plurality of contact elements 64 comprises three contact elements 64.

[0081] Each contact element 64 also makes electrical contact with the connecting element 48 by way of a groove contact region 66. The groove contact region 66 is formed as a surface comprising two regions, each extending circumferentially on the groove bottom wall 58 and symmetrically with respect to the groove symmetry plane G. Viewed in the longitudinal section of Fig. 2, the groove contact region 66 is represented by two line segments.

[0082] In Fig. 1 and Fig. 2, the contact elements 64 are annular helical springs arranged such that each annular helical spring surrounds the cable 24 inserted in the connecting element 48. Each annular helical spring forms a closed loop and is arranged in one of the grooves 52. When the cable 24 is inserted in the connecting element 48, it is consequently inserted in the loops formed by the annular helical springs, which produce contact-making pressure between the connecting element 48 and the cable 24.

[0083] Further, the connecting element 48 comprises a control segments 74a and a further control segment 74b, forming a plurality of control segments, having a recess 70a and a further recess 70b, respectively, extending circumferentially in an annular form, opened towards the exterior of the connecting element 48 and closed towards the receiving hole 50. Presently, when viewed in the direction of insertion of the electrical conductor 44, the recess 70a is the nearest and the further recess 70b is the second nearest to the insertion opening 51. The recess 70a and the further recess 70b extends about a whole circumference of the connecting element 48. Further, the recess 70a and the further recess 70b are formed, when viewed in the longitudinal direction, each time between two consecutive grooves 52, to increase the electrical resistance of the control segment 74a and of the further control segment 74b, respectively.

[0084] The control segment 74a and the further control segment 74b are each delimited longitudinally by the groove contact region 66 of each of the two consecutive grooves 52. In Fig. 2, the further control segment 74b is limited on each side, as viewed in the longitudinal direction, by the groove contact regions 66 adjacent to the recess 70b. Concretely, the further control segment 74b is delimited on each side by a plane L1 and L2, respectively, extending perpendicular to the longitudinal axis L and crossing a border region of each of the groove contact region 66.

[0085] The connecting element further comprises side segments 75a and 75b, adjacent to the control segment 74a, and side segments 75b and 75c, adjacent to the further control segment 74b, when viewed in the longitudinal direction. Presently, the side segments 75a, 75b and 75c have an electrical resistance different from the electrical resistance of the control segments because they do not have a recess.

[0086] The longitudinal cross section of the recess 70a and the further recess 70b is at least approximately rectangular. The recess 70a and the further recess 70b are limited in the longitudinal direction by recess sidewalls 80 extending perpendicular to the longitudinal axis L. Further, the recess 70a and the further recess 70b are limited radially by a recess bottom wall 82a defining a recess bottom 83a and a further recess bottom wall 82b defining a further recess bottom 83b, respectively. The recess bottom 83a and the further recess bottom 83b extend circumferentially at a constant distance Da and Db, respectively, from the longitudinal axis L. In other words, the radius of the connecting element 48 measured from the recess bottom 83a and the further recess bottom 83b is equal to the distance Da and Db, respectively.

[0087] In the present embodiment, the distance Da is shorter than the distance Db. Since the depth of the grooves is the same for the plurality of grooves, it results that the segment cross section available for the electrical current flow is bigger for the further control segment 74b than for the control segment 74a, and consequently, the electrical resistance of the control segment 74a is greater than the electrical resistance of the further control segment 74b.

[0088] The evolution of the electrical resistance of the control segment 74a and the further control segment 74b versus

the distance D_a and D_b , respectively, for the connecting element according to Fig. 2 is schematically represented in the Fig. 3 and Fig. 4, respectively. The X-axis represents the distance D_a and D_b expressed in mm and the Y-axis represents the electrical resistance expressed in Ohm. An increase of the electrical resistance is shown with a decrease of the distance D_a and D_b , i.e. with a decrease of the radius of the connecting element 48 measured at the bottom of the recess 70a and the further recess 70b, respectively.

[0089] The embodiment of the electrical connector 44 represented in Fig. 5 is similar to the embodiment represented in Fig. 2. Therefore, same reference signs are used in Fig. 1, Fig. 2 and Fig. 5 to denote structurally or functionally same features. Only features differing in both embodiments are described below in details.

[0090] As in Fig. 1 and 2, the electrical connector 44 of Fig. 5, comprises the connecting element 48 having the receiving hole 50 extending in the longitudinal direction and centered on the longitudinal axis L. The receiving hole 50 is designed for the insertion of the electrical conductor 24.

[0091] Further, the receiving hole 50 has a plurality of grooves 52 extending circumferentially about an interior wall 54 of the receiving hole 50 and in communication with the receiving hole. The grooves 52 are annular and extend about the whole circumference of the receiving hole 50. Further, the plurality of grooves 52 are closed in the radial direction and do not communicate with the exterior of the connecting element 48. The plurality of grooves 52 have the same longitudinal cross section and are at least approximately equally spaced apart from each other.

[0092] The electrical connector 44 also comprises a plurality of contact elements 64 each contact element 64 being housed at least partially in one of the plurality of grooves 52 in such a way that the plurality of contact elements 64 makes electrical contact with the cable 24 inserted in the connecting element 44.

[0093] Further, the connecting element 48 comprises the control segments 74a and the further control segment 74b, forming a plurality of control segments, made of a material having a higher electrical resistance than the material of the side segments 75a, 75b and 75c adjacent to the control segments 74a and the further control segment 74b. The control segment 74a and the further control segment 74b are at least approximately delimited longitudinally on one side by the plane L1 and on the other side by the plane L2, both extending perpendicular to the longitudinal axis L, similarly as in Fig.2. Radially, the extension of the control segment 74a and of the further control segment 74b is delimited by the interior wall 54 of the receiving hole 50 and an exterior wall of the connecting element 48.

List of reference signs

[0094]

gas-insulated grounding switch	10
housing	20
cylindrical cavity	22
cable	24
receiving end	28
closing plate	32
screws	36
output element	40
electrical connector	44
connecting element	48
receiving hole	50
insertion opening	51

grooves	52
interior wall	54
groove sidewalls	56
groove bottom wall	58
contact elements	64
groove contact region	66
recess, further recess	70a, 70b
control segment, further control segment	74a, 74b
side segments	75a, 75b and 75c
recess sidewalls	80

(continued)

recess bottom wall, further recess bottom wall 82a, 82b
 recess bottom, further recess bottom 83a, 83b

5

Claims

1. Electrical connector (44) for transmitting electrical current, comprising a connecting element (48) of electrically conductive material designed for mechanical and electrical connection to an electrical conductor (24), in particular a cable, the connecting element (48) having a receiving hole (50) extending longitudinally along a longitudinal axis (L) of the connector for the insertion of the electrical conductor (24), the receiving hole (50) having a plurality of grooves (52) extending circumferentially about an interior wall (54) of the receiving hole (50) and in communication with the receiving hole (50), and a plurality of contact elements (64), each contact element being housed at least partially in one of the plurality of grooves and the plurality of contact elements being designed to make electrical contact with the electrical conductor (24) inserted in the connecting element (48) and to produce contact-making pressure between the connecting element (48) and the electrical conductor (24) to allow the transmission of electrical current from the electrical conductor (24) to the connecting element (48), **characterized in that** the connecting element (48) comprises a control segment (74a) extending longitudinally between two consecutive grooves (52) of the plurality of grooves and side segments (75a, 75b) arranged adjacent to the control segment (74a) on each side of the control segment (74a), as viewed in the longitudinal direction, wherein the electrical resistance of the control segment (74a) is different from the electrical resistance of the side segments (75a, 75b).
2. Electrical connector (44) according to claim 1, **characterized in that** the electrical resistance of the control segment (74a) is higher than the electrical resistance of the side segments (75a, 75b).
3. Electrical connector (44) according to claim 1 or 2, **characterized in that** the control segment (74a) has a recess (70a) extending circumferentially, preferably extending about a whole circumference of the connecting element (48), opened towards the exterior of the connecting element (48) and closed towards the receiving hole (50), to increase the electrical resistance of the control segment (74a).
4. Electrical connector (44) according to claim 3, **characterized in that** the recess (70a) is limited in the longitudinal direction by recess sidewalls (80) extending at least approximately perpendicular to the longitudinal axis (L).
5. Electrical connector (44) according to claim 3, **characterized in that** the longitudinal cross section of the recess (70a) is widening, preferably continually widening, when viewed in a radially outwards direction with respect to the longitudinal axis (L).
6. Electrical connector (44) according to any one of claims 3 to 5, **characterized in that** the plurality of grooves (52) have the same longitudinal cross section and are at least approximately equally spaced apart from each other.
7. Electrical connector (44) according to any one of the claims 3 to 6, **characterized by** a plurality of recesses (70a, 70b), each recess being arranged between two consecutive grooves (52) of the plurality of grooves.
8. Electrical connector (44) according to claim 7, **characterized in that** the radius (Da) of the connecting element (48) measured at a recess bottom (83a) of the recess (70a) is constant over the recess bottom (83a) and the radius (Db) of the connecting element (48) measured at a further recess bottom (83b) of a further recess (70b) of the plurality of recesses is constant over the further recess bottom (83b), wherein the respective radii (Da, Db) have a length different from each other.
9. Electrical connector (44) according to any one of the claims 7 to 8, **characterized in that** at least a control segment (74a, 74b) of the connecting element (48) extending between two consecutive grooves (52) is free from recess.
10. Electrical connector (44) according to any one of the claims 3 to 9, **characterized in that** the recess (70a) or the plurality of recesses (70a, 70b) is filled with a dielectric material.
11. Electrical connector (44) according to claim 1 or 2, **characterized in that** the control segment (74a) is made at least partially of a material having a higher electrical resistance than the material of the side segments.

12. Electrical connector (44) according to any one of the claims 1 to 11, **characterized by** a plurality of control segments (74a, 74b), each control segment (74a, 74b) being arranged between two consecutive grooves (52) of the plurality of grooves.
13. Electrical connector (44) according to any one of the claims 1 to 12, **characterized in that** each contact element (64), preferably in the form of an annular helical spring, is designed to surround the electrical conductor (24) inserted in the connecting element (48).
14. Gas-insulated grounding switch (10) comprising an electrical connector (44) according to any one of claims 1 to 13.
15. Generator circuit breaker comprising an electrical connector (44) according to any one of claims 1 to 13.

Patentansprüche

1. Elektrischer Verbinder (44) zur Übertragung von elektrischem Strom, umfassend ein Verbindungselement (48) aus elektrisch leitendem Material, das zur mechanischen und elektrischen Verbindung mit einem elektrischen Leiter (24), insbesondere einem Kabel, ausgelegt ist, wobei das Verbindungselement (48) einen Aufnahmehohlraum (50) aufweist, der sich in Längsrichtung entlang einer Längsachse (L) des Verbinders erstreckt und zum Einführen des elektrischen Leiters (24) ausgebildet ist, wobei der Aufnahmehohlraum (50) eine Mehrzahl von Nuten (52) aufweist, die sich umlaufend um eine Innenwand (54) des Aufnahmehohlraums (50) erstrecken und mit dem Aufnahmehohlraum (50) in Verbindung stehen, und eine Mehrzahl von Kontaktelementen (64), wobei jedes Kontaktelement zumindest teilweise in einer der Mehrzahl von Nuten untergebracht ist und die Mehrzahl von Kontaktelementen dazu ausgelegt ist, elektrischen Kontakt mit dem in das Verbindungselement (48) eingeführten elektrischen Leiter (24) herzustellen und Druckkontakt zwischen dem Verbindungselement (48) und dem elektrischen Leiter (24) zu erzeugen, um die Übertragung von elektrischem Strom vom elektrischen Leiter (24) zum Verbindungselement (48) zu ermöglichen,
dadurch gekennzeichnet, dass das Verbindungselement (48) ein Steuersegment (74a), das sich in Längsrichtung zwischen zwei aufeinanderfolgenden Nuten (52) der Mehrzahl von Nuten erstreckt, und Seitensegmente (75a, 75b) umfasst, die neben dem Steuersegment (74a) auf jeder Seite des Steuersegments (74a), in Längsrichtung gesehen, angeordnet sind, wobei der elektrische Widerstand des Steuersegments (74a) von dem elektrischen Widerstand der Seitensegmente (75a, 75b) verschieden ist.
2. Elektrischer Verbinder (44) gemäß Anspruch 1, **dadurch gekennzeichnet, dass** der elektrische Widerstand des Steuersegments (74a) höher ist als der elektrische Widerstand der Seitensegmente (75a, 75b).
3. Elektrischer Verbinder (44) gemäß Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** das Steuersegment (74a) eine sich umlaufend erstreckende Aussparung (70a) aufweist, die sich vorzugsweise über den gesamten Umfang des Verbindungselements (48) erstreckt, zur Außenseite des Verbindungselements (48) geöffnet und zum Aufnahmehohlraum (50) geschlossen ist, um den elektrischen Widerstand des Steuersegments (74a) zu erhöhen.
4. Elektrischer Verbinder (44) gemäß Anspruch 3, **dadurch gekennzeichnet, dass** die Aussparung (70a) in Längsrichtung durch sich zumindest annähernd senkrecht zur Längsachse (L) erstreckende Aussparungsseitenwände (80) begrenzt ist.
5. Elektrischer Verbinder (44) gemäß Anspruch 3, **dadurch gekennzeichnet, dass** der Längsschnitt der Aussparung (70a) sich, in radialer Auswärtsrichtung zur Längsachse (L) gesehen, aufweitet, vorzugsweise kontinuierlich aufweitet.
6. Elektrischer Verbinder (44) gemäß einem der Ansprüche 3 bis 5, **dadurch gekennzeichnet, dass** die Mehrzahl der Nuten (52) den gleichen Längsschnitt aufweisen und mindestens annähernd gleichmäßig voneinander beabstandet sind.
7. Elektrischer Verbinder (44) gemäß einem der Ansprüche 3 bis 6, **gekennzeichnet durch** eine Mehrzahl von Aussparungen (70a, 70b), wobei jede Aussparung zwischen zwei aufeinanderfolgenden Nuten (52) der Mehrzahl von Nuten angeordnet ist.
8. Elektrischer Verbinder (44) gemäß Anspruch 7, **dadurch gekennzeichnet, dass** der Radius (Da) des Verbindungs-

elements (48) gemessen an einem Aussparungsboden (83a) der Aussparung (70a) über den Aussparungsboden (83a) konstant ist und der Radius (Db) des Verbindungselements (48) gemessen an einem weiteren Aussparungsboden (83b) einer weiteren Aussparung (70b) der Mehrzahl von Aussparungen über den weiteren Aussparungsboden (83b) konstant ist, wobei die jeweiligen Radien (Da, Db) voneinander abweichende Längen haben.

9. Elektrischer Verbinder (44) gemäß einem der Ansprüche 7 bis 8, **dadurch gekennzeichnet, dass** zumindest ein Steuersegment (74a, 74b) des Verbindungselements (48), das sich zwischen zwei aufeinanderfolgenden Nuten (52) erstreckt, aussparungsfrei ist.
10. Elektrischer Verbinder (44) gemäß einem der Ansprüche 3 bis 9, **dadurch gekennzeichnet, dass** die Aussparung (70a) oder die Mehrzahl von Aussparungen (70a, 70b) mit einem dielektrischen Material gefüllt ist.
11. Elektrischer Verbinder (44) gemäß Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** das Steuersegment (74a) zumindest teilweise aus einem Material hergestellt ist, das einen höheren elektrischen Widerstand als das Material der Seitensegmente hat.
12. Elektrischer Verbinder (44) gemäß einem der Ansprüche 1 bis 11, **gekennzeichnet durch** eine Mehrzahl von Steuersegmenten (74a, 74b), wobei jedes Steuersegment (74a, 74b) zwischen zwei aufeinanderfolgenden Nuten (52) der Mehrzahl von Nuten angeordnet ist.
13. Elektrischer Verbinder (44) gemäß einem der Ansprüche 1 bis 12, **dadurch gekennzeichnet, dass** jedes Kontaktelement (64), vorzugsweise in Form einer ringförmigen Spiralfeder, dazu ausgebildet ist, den in das Verbindungselement (48) eingeführten elektrischen Leiter (24) zu umgeben.
14. Gasisolierte Erdungsschaltung (10) umfassend einen elektrischen Verbinder (44) gemäß einem der Ansprüche 1 bis 13.
15. Generator-Schutzschalter aufweisend einen elektrischen Verbinder (44) gemäß einem der Ansprüche 1 bis 13.

Revendications

1. Connecteur électrique (44) pour la transmission du courant électrique, comprenant un élément de connexion (48) en matériau électriquement conducteur conçu pour une connexion mécanique et électrique à un conducteur électrique (24), en particulier un câble, l'élément de connexion (48) ayant un trou de réception (50) s'étendant longitudinalement le long d'un axe longitudinal (L) du connecteur pour l'insertion du conducteur électrique (24), le trou de réception (50) ayant une pluralité de rainures (52) s'étendant circonférentiellement autour d'une paroi intérieure (54) du trou de réception (50) et en communication avec le trou de réception (50), et une pluralité d'éléments de contact (64), chaque élément de contact étant logé au moins partiellement dans l'une de la pluralité de rainures et la pluralité d'éléments de contact étant conçus pour établir un contact électrique avec le conducteur électrique (24) inséré dans l'élément de connexion (48) et pour produire une pression de mise en contact entre l'élément de connexion (48) et le conducteur électrique (24) afin de permettre la transmission du courant électrique du conducteur électrique (24) à l'élément de connexion (48),
caractérisé en ce que l'élément de connexion (48) comprend un segment de contrôle (74a) s'étendant longitudinalement entre deux rainures consécutives (52) de la pluralité de rainures et des segments latéraux (75a, 75b) disposés à côté du segment de contrôle (74a) de chaque côté du segment de contrôle (74a), vu dans la direction longitudinale, dans lequel la résistance électrique du segment de contrôle (74a) est différente de la résistance électrique des segments latéraux (75a, 75b).
2. Connecteur électrique (44) selon la revendication 1, **caractérisé en ce que** la résistance électrique du segment de contrôle (74a) est supérieure à la résistance électrique des segments latéraux (75a, 75b).
3. Connecteur électrique (44) selon la revendication 1 ou 2, **caractérisé en ce que** le segment de contrôle (74a) présente un évidement (70a) s'étendant circonférentiellement, de préférence sur toute la circonférence de l'élément de connexion (48), ouvert vers l'extérieur de l'élément de connexion (48) et fermé vers le trou de réception (50), afin d'augmenter la résistance électrique du segment de contrôle (74a).
4. Connecteur électrique (44) selon la revendication 3, **caractérisé en ce que** l'évidement (70a) est limité dans la

direction longitudinale par des parois latérales (80) de l'évidement s'étendant au moins approximativement perpendiculairement à l'axe longitudinal (L).

- 5 5. Connecteur électrique (44) selon la revendication 3, **caractérisé en ce que** la section transversale longitudinale de l'évidement (70a) s'élargit, de préférence de façon continue, lorsqu'elle est observée dans une direction radiale vers l'extérieur par rapport à l'axe longitudinal (L).
- 10 6. Connecteur électrique (44) selon l'une quelconque des revendications 3 à 5, **caractérisé en ce que** la pluralité de rainures (52) ont la même section transversale longitudinale et sont au moins approximativement également espacées les unes des autres.
- 15 7. Connecteur électrique (44) selon l'une quelconque des revendications 3 à 6, **caractérisé par** une pluralité d'évidements (70a, 70b), chaque évidement étant disposé entre deux rainures (52) consécutives de la pluralité de rainures.
- 20 8. Connecteur électrique (44) selon la revendication 7, **caractérisé en ce que** le rayon (Da) de l'élément de connexion (48) mesuré à un fond d'évidement (83a) de l'évidement (70a) est constant sur le fond d'évidement (83a) et le rayon (Db) de l'élément de connexion (48) mesuré à un autre fond d'évidement (83b) d'un autre évidement (70b) de la pluralité d'évidements est constant sur l'autre fond d'évidement (83b), dans lequel les rayons respectifs (Da, Db) ont une longueur différente l'un de l'autre.
- 25 9. Connecteur électrique (44) selon l'une quelconque des revendications 7 à 8, **caractérisé en ce qu'**au moins un segment de contrôle (74a, 74b) de l'élément de connexion (48) s'étendant entre deux rainures consécutives (52) est exempt d'évidement.
- 30 10. Connecteur électrique (44) selon l'une quelconque des revendications 3 à 9, **caractérisé en ce que** l'évidement (70a) ou la pluralité d'évidements (70a, 70b) est rempli d'un matériau diélectrique.
- 35 11. Connecteur électrique (44) selon la revendication 1 ou 2, **caractérisé en ce que** le segment de contrôle (74a) est constitué au moins partiellement d'un matériau ayant une résistance électrique plus élevée que le matériau des segments latéraux.
- 40 12. Connecteur électrique (44) selon l'une quelconque des revendications 1 à 11, **caractérisé par** une pluralité de segments de contrôle (74a, 74b), chaque segment de contrôle (74a, 74b) étant disposé entre deux rainures (52) consécutives de la pluralité de rainures.
- 45 13. Connecteur électrique (44) selon l'une quelconque des revendications 1 à 12, **caractérisé en ce que** chaque élément de contact (64), de préférence sous la forme d'un ressort hélicoïdal annulaire, est destiné à entourer le conducteur électrique (24) inséré dans l'élément de connexion (48).
- 50 14. Interrupteur de mise à la terre (10) isolé au gaz comprenant un connecteur électrique (44) selon l'une quelconque des revendications 1 à 13.
- 55 15. Disjoncteur de générateur comportant un connecteur électrique (44) selon l'une quelconque des revendications 1 à 13.

Fig. 1

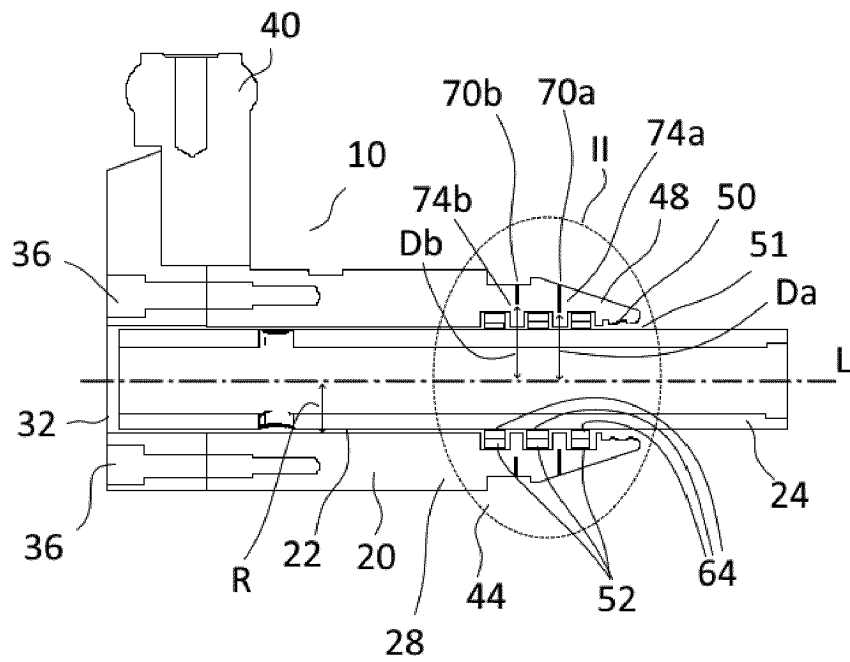


Fig. 2

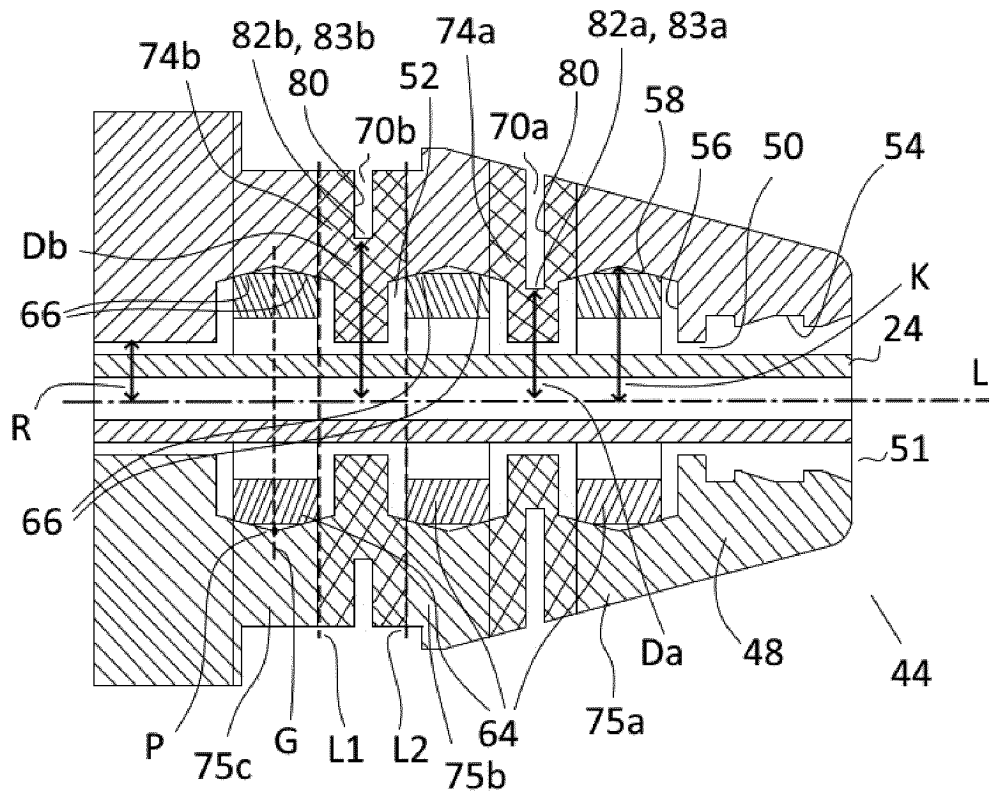


Fig. 3

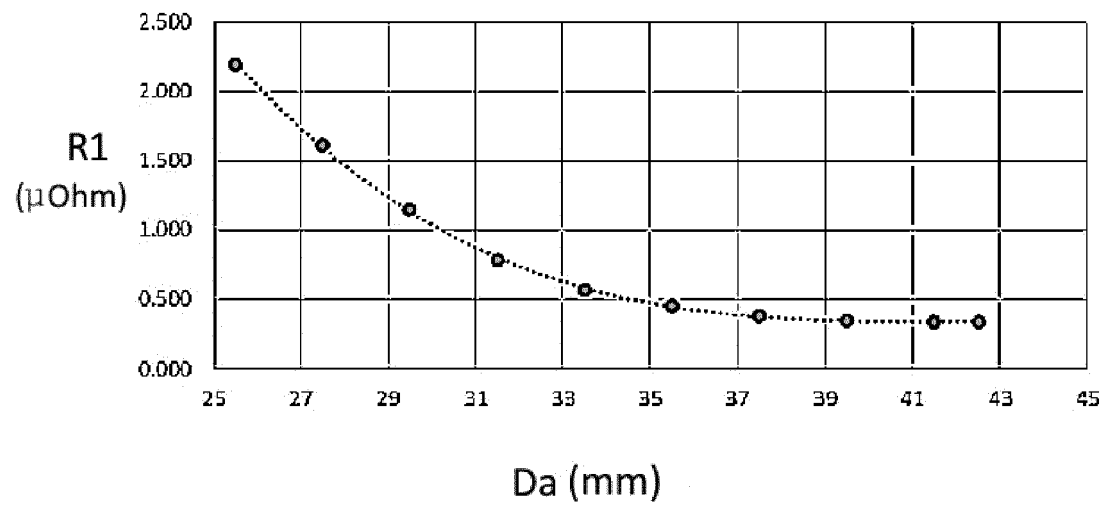


Fig. 4

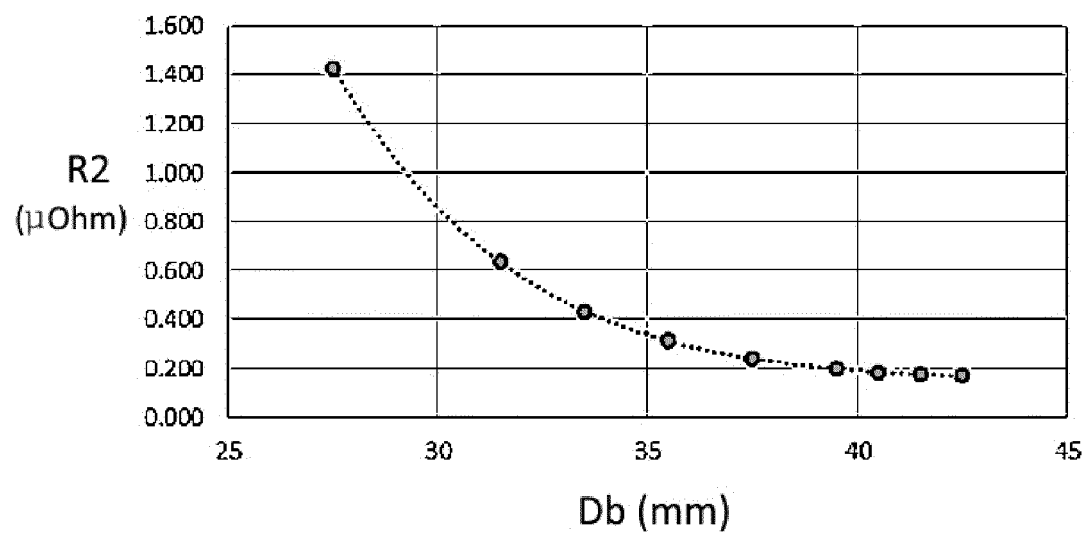
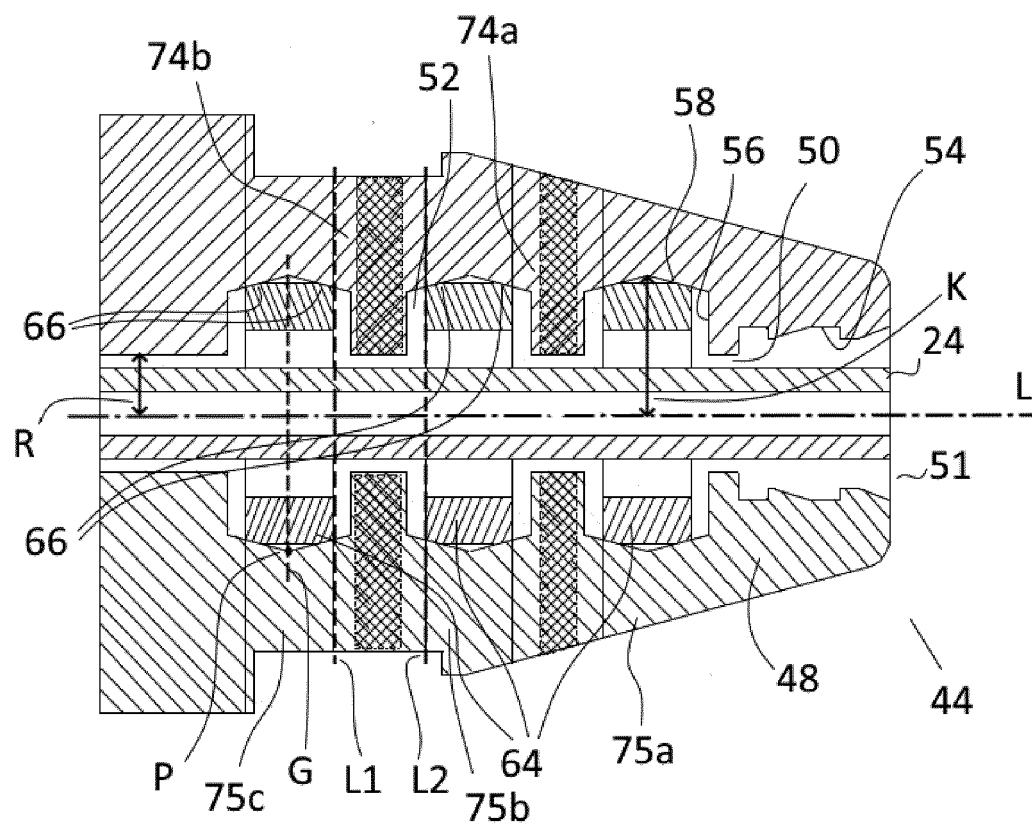


Fig. 5



REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- US 20130330981 A [0005]
- US 20060270277 A [0006]
- DE 19718448 [0007]