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(71) Applicant *(for all designated States except US)*: **NEWFREY LLC** [US/US]; 1207 Drummond Plaza, Newark, Delaware, 19711 (US).

(72) Inventors; and
(71) Applicants *(for US only)*: **HAIN, Jochen** [DE/DE]; STANLEY Engineered Fastening, Tucker GmbH, Max-Eyth-Strasse 1, 35394 Giessen (DE). **OPPER, Reinhold** [DE/DE]; STANLEY Engineered Fastening, Tucker GmbH, Max-Eyth-Strasse 1, 35394 Giessen (DE).

(74) Agent: **WITTE, WELLER & PARTNERPATENTANWÄLTE MBB**; Postfach 10 54 62, 70047 Stuttgart (DE).

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(54) **Title**: CONTACTING DEVICE FOR AN ELECTRICAL CONTACT ARRANGEMENT, AND ALSO METHOD FOR PRODUCTION THEREOF

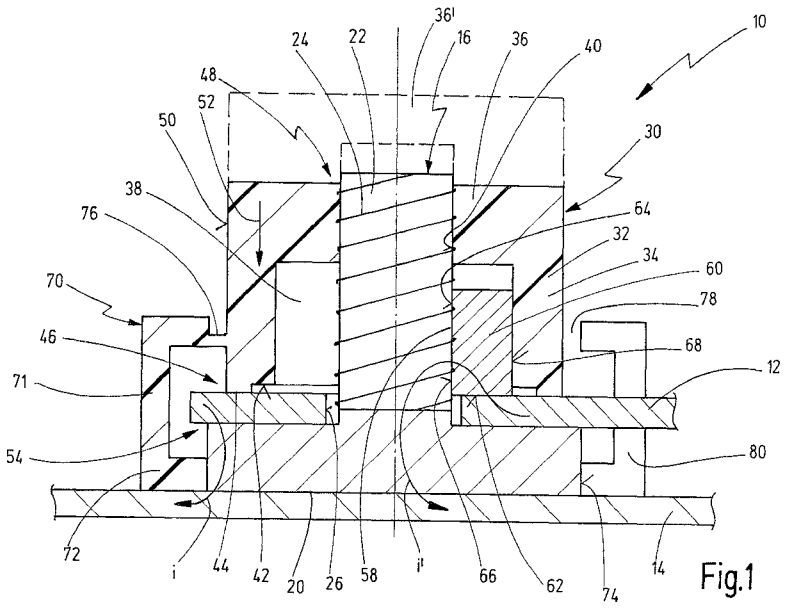

Fig.1

(57) **Abstract**: An earth contact arrangement, comprising a covering cap (32), which is produced from an electrically non-conductive material by moulding, which comprises an interior (38) for receiving an electrical contact element (60), and which, at an end face (42) of the cap, comprises a sealing collar (44) for forming a first fluid seal (46) with a counterelement (12), wherein an annular contact element (60) is provided, which is produced from an electrically conductive material, which comprises a central contact element opening (58) for receiving and for electrically contacting a stud (16), and the contact element (60) is moulded into the interior (38) of the covering cap (32), such that the contact element (60) and the covering cap (32) form a one- piece contacting device (30).

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Contacting device for an electrical contact arrangement, and also method for production thereof

[0001] The present invention relates to a contacting device for an electrical contact arrangement, in particular for an earth contact arrangement, comprising a covering cap, which is produced from an electrically non-conductive material by moulding, which comprises an interior for receiving an electrical contact element, and which, on a cap end face, comprises a sealing collar for forming a first fluid seal with a counterelement.

[0002] The present invention also relates to a contact arrangement comprising a threaded stud and comprising such a contacting device, and also to a method for producing a contacting device and also a contact arrangement.

[0003] In the field of earth contact arrangements, it is known within vehicle construction to weld a metal stud onto a body sheet with access from one side. Cable lugs can then be slid onto the stud, wherein a nut is then screwed onto the stud in order to complete the earth contact arrangement.

[0004] This method generally has the disadvantage that the individual nuts have to be kept ready during the vehicle assembly process. In the case of production of earth contact arrangements having a plurality of cable lugs, it cannot be ruled out in this case that a cable lug will be forgotten. Furthermore, it may be that a nut becomes lost

and, for example trapped in a cavity of the vehicle body, causes noise during subsequent operation.

[0005] The electrical contacting is also difficult for the case in which the body sheet is painted with the stud already welded thereon.

[0006] It is known from document DE 10 2006 034 501 A1 to provide a groove in the nut for paint abrasion.

[0007] It is also known, for example from document DE 10 2006 056 065 A1, on a stud welded onto a body sheet, said stud possibly having an outer or an inner thread, to apply a cover part, before painting, to a threaded portion such that the threaded portion is not wetted with paint during the painting process. With this variant, it is not necessary to provide a paint abrasion groove on the nut. The surface in the region of the thread is therefore attacked to a lesser extent and is consequently less susceptible to corrosion.

[0008] It is known from document DE 10 2007 027 104 A1 to connect a cable lug undetachably to a nut, more specifically so as to be rotatable via a flange connection.

[0009] An earth contact arrangement, wherein a preliminary protective coating formed from Nycote is applied to the thread before the application of a coat of paint to the body sheet and stud, is known from document DE 10 2008 051 712 A1.

[0010] If a plurality of cable lugs are to be connected to a stud, it is known to slide an antitwist protection element over the stud before sliding on the cable lugs. In this case, the flange of the stud for example has an antitwist protection portion (for example a hexagon) on the outer periphery, and the antitwist protection element has a corresponding receptacle for the flange portion and also upright webs, between which radial openings are provided. The individual cable lugs in this case can be fastened in a star-shaped manner via the radial openings in a manner secured against rotation (EP 0 533 421 A2). It is also known to form an antitwist protection element of this type in two parts, in such a way that the cable lugs are received beforehand in the antitwist protection element, before

they are slid together with the antitwist protection element over the stud (DE 10 2004 054 782 B3).

[0011] A retaining arrangement for a plurality of cable lugs is known from document WO 2009/100887 A1, wherein the retaining device comprises a base part and a cover part, which are interconnected via a hinge (living hinge) in such a way that the retaining device can be formed in one piece. The retaining device further comprises centering means, which engage on the outer periphery of the cable lug. An antitwist protection means for bearing against an outer periphery of a flange may also be formed on the retaining device.

[0012] It is also known in the prior art to protect screw connections against corrosion by means of covering caps. Here, the covering caps can be slid or pressed axially onto a screw connection, wherein an annular end face of the covering cap comprises a sealing collar or a sealing lip, which bears against a flange of the screw connection. Covering caps of this type may also comprise radial webs on the inner periphery, which engage on an end of a threaded stud protruding with respect to a nut and consequently are screwed onto the screw connection (what are known as screw caps).

[0013] In the earth contact arrangements mentioned in the introduction, the installed metal components (studs, electrical connection members such as cable lugs, nuts etc.) can be very far apart in terms of the electrochemical series (installation of noble and ignoble materials). Since, for the production of an earth connection, it is necessary to destroy the corrosion protection applied here previously (by scratching off the coat of paint), corrosion may easily occur in the region of the earth contact arrangement.

[0014] In the contacting device mentioned in the introduction, a covering cap comprises an interior and a sealing collar on an end face of the cap in order to seal the interior. Covering caps of this type often cannot be assembled retrospectively however in the case of the earth contact arrangements mentioned in the introduction. In addition, this would be associated with an increased assembly effort and with the further problem that a separate part is to be kept ready during the final assembly of the motor vehicle.

[0015] On this basis, the object of the invention is to specify an improved contacting device, an improved contact arrangement, and also improved methods for production thereof.

[0016] The above object is achieved in the contacting device mentioned in the introduction in that the contacting device comprises an annular contact element, which is produced from an electrically conductive material and which comprises a central contact element opening for receiving and for electrically contacting a stud, the contact element being moulded into the interior of the covering cap such that the contact element and the covering cap form a one-part contacting device.

[0017] In this embodiment, electrical contacting can be achieved via an electrical contact between the contact element and the stud. Further, this electrical contact in the interior of the covering cap can be sealed via the sealing collar, such that the likelihood of the occurrence of corrosion is at least considerably reduced.

[0018] The contacting device is further formed in one part such that it is not necessary to keep ready a plurality of individual assembly components during the final assembly process.

[0019] The above object is also achieved by a contact arrangement comprising a threaded stud and a contacting device of the type according to the invention, wherein at least one electrical connection member is arranged between the contacting device and a flange of the threaded stud and forms a counterelement, wherein an interior of the covering cap is sealed in a fluid-tight manner with respect to the surrounding environment.

[0020] With this contact arrangement, the sealing flange in the finished assembled contact arrangement can bear in an annular manner against an upper face of the electrical connection member and can consequently seal the interior.

[0021] The above object is also achieved by a method for producing a contacting device according to the invention comprising the following step: producing the cover-

ing cap in a moulding step, such as an injection moulding step, wherein the contact element is integrally moulded into the covering cap during the moulding step.

[0022] Lastly, the above object is achieved by a method for producing a contact arrangement of the type according to the invention, said method comprising the following steps: fitting the contacting device onto a threaded stud and screwing the contacting device onto the threaded stud until the sealing collar of the covering cap forms a first fluid seal with an electrical connection member, which is arranged between the contacting device and a flange of the threaded stud.

[0023] The above advantages are also achieved with the contact arrangement according to the invention and the methods according to the invention.

[0024] The object is thus achieved fully.

[0025] In accordance with a particularly preferred embodiment, a first inner peripheral portion of the contact element is formed as a smooth contact portion that can be grooved by a thread of the stud.

[0026] Here, the contact element is produced, at least in the region of the contact portion, from a material that is softer or more resilient than the stud or the thread thereof. Whereas the stud is preferably produced from a steel, the contact element can be produced from copper for example.

[0027] As the contacting device is screwed onto the stud, the thread of the stud consequently digs into the contact element itself. On the one hand, excellent electrical contacting is thus achieved between the stud and contact element. On the other hand, a self-locking effect can thus be achieved, such that, even in the event of vibrations such as those that occur in motor vehicles, the contact element does not "loosen" again.

[0028] It is generally also possible however to provide the contact element with a thread on the inner periphery.

[0029] In accordance with a further preferred embodiment, a second inner peripheral portion of the contact element is formed as a scratching portion, by means of which a coat of paint on the stud can be removed at least in part.

[0030] Here, the scratching portion is preferably arranged closer to the end face of the cap, as viewed in the longitudinal direction, such that, when screwed onto a stud, the scratching portion first comes into contact with the stud or with the thread thereof, and therefore paint can be scratched off from the stud before the thread is screwed into the contact portion.

[0031] Here, it is generally possible to form the scratching portion on the contact element such that the contacting device can be produced with few component parts.

[0032] In accordance with a further preferred alternative embodiment, the contacting device further includes a separate scratching element however, which is moulded into the interior of the covering cap adjacently to the contact element in the axial direction.

[0033] In this case, it is possible to produce the scratching element from a different material compared to the contact element, in particular a harder material, whereby the scratching effect can be increased.

[0034] The contact element and, where applicable, the scratching element are produced from electrically conductive, in particular metal, material. If the separate scratching element is provided, this is integrally moulded into the covering cap such that it forms a good electrical contact with the contact element.

[0035] The contact element and, where applicable, the scratching element can be integrated here into the covering cap such that they can move axially to a minimal extent in order to compensate for tolerances. Here, the covering cap comprises preferably a radially oriented shoulder, which can ensure that the contact element (and where applicable the scratching element) can be pressed in the axial direction with a high axial force onto a counterelement, such as an electrical connection member.

[0036] Before the assembly of the contacting device, it is preferable if at least part of the sealing collar of the end face of the covering cap protrudes axially in the axial direction with respect to a corresponding contact element end face or scratching element end face, but can be compressed so far axially in the axial direction in the assembled state that a planar contact between the contact element end face or scratching element end face and the counterelement (for example an electrical connection member such as a cable lug) and therefore good electrical contacting between the counterelement and the contact element/scratching element can be ensured.

[0037] The contact element generally constitutes a type of "nut", even if the contact element has no previously formed threaded portion, but a threadeable portion that can be grooved, wherein this "nut" is insert moulded with a non-conductive material, which forms the covering cap.

[0038] On the whole, it is also advantageous if a tool engagement portion for rotating the covering cap is formed on the covering cap, the contact element being moulded into the covering cap such that the contact element is connected to the covering cap in a rotationally secured manner.

[0039] In this embodiment, the contacting device is consequently rotated when screwed onto a stud since a tool engages on the tool engagement portion and is rotated. Here, the tool engagement portion may comprise a polygon profile for example, similarly to a nut.

[0040] Since the force for screwing the contacting device onto a stud is consequently applied via the covering cap, it goes without saying that the covering cap is preferably produced from a relatively firm non-conductive material, such as a hard plastic. The material of the covering cap may also be a fibre-reinforced plastic where necessary.

[0041] Here, the contact element (and where applicable the scratching element) can be formed on the outer periphery, preferably likewise with a polygon profile, in such a way that the contact element and, where applicable, the scratching element can be

surrounded at the outer periphery by the covering cap with a largely uniform thickness. Furthermore, it can thus be ensured that the contact element (and where applicable the scratching element) are received in the finished covering cap in a manner secured against rotation.

[0042] In accordance with a further preferred embodiment, which in conjunction with the preamble of Claim 1 constitutes a separate invention, the covering cap comprises a cylindrical stud-receiving portion, into which a threaded stud can be screwed in such a way that a second fluid seal can be formed between the threaded stud and the covering cap and/or that an axial force is produced in order to form the first fluid seal.

[0043] In some earth contact arrangements, the threaded stud is not painted before the assembly process (for example is covered during a painting process by a cover or the like). In this case, an electrical contact between an electrical connection member such as a cable lug and the stud may also be produced directly via a flange upper face of the stud. In this case, the contacting device may also be formed without a contact element and without a scratching element.

[0044] The cylindrical stud-receiving portion is preferably formed here as a threaded (threadeable) portion that can be grooved, in such a way that, in the end assembly position, a self-locking effect and a relatively high axial force can be produced on the one hand, which enables good contacting between the electrical connection member and the flange upper face. A relatively high axial force also contributes to a high tightness of the first fluid seal, which is produced by means of the sealing collar. Further, by means of the cylindrical stud-receiving portion, a second fluid seal can be formed between the stud-receiving portion and the threaded stud.

[0045] The latter aspect is then significant in particular when, in accordance with a preferred embodiment, the stud-receiving portion of the covering cap is formed at an axial through-opening in the covering cap.

[0046] Although it is generally possible to form the covering cap as a closed cap at its axial end opposite the cap end face, an axial through-opening, forming the stud-receiving portion, is preferred. This is because it is thus possible to use an axially relatively short stud to form a contact arrangement. Since a second fluid seal can additionally be established between the stud and the stud-receiving portion, the fluid tightness in the interior of the covering cap is not compromised hereby.

[0047] This advantage is then also of course provided if a contact element and, where applicable, a scratching element are moulded into the interior of the covering cap.

[0048] In accordance with a further embodiment that is preferred on the whole, the covering cap is connected via a separable connection to an antitwist protection device, which is designed to be fastened in a manner secured against rotation on an antitwist protection portion of a stud.

[0049] In this embodiment, the function of an antitwist protection means can be integrated into the contacting device, wherein, once fitted on a stud, the separable or releasable connection is separated or released in order to be able to rotate the covering cap with respect to the antitwist protection device.

[0050] Here, the separable connection may be a detent connection, an adhesive connection, or another easily releasable connection. The antitwist protection device is preferably formed in one piece with the covering cap, and the separable connection can be formed for example by a predetermined breaking point or a plurality of predetermined breaking points, such as thin webs or a webbing.

[0051] In this case, it may also be, during the assembly process, that the antitwist protection portion is not yet engaged with the antitwist protection portion of the stud at the start of the screwing process. In this case, it is preferable if the tool used for assembly comprises a receptacle for the antitwist protection device, said receptacle holding the antitwist protection device in the direction of rotation whilst the tool initiates a screwing process.

[0052] Here, the antitwist protection device may have axially upright webs, similarly to the prior art, between which one or more radial openings are formed, via which electrical connection members can be guided and held in a manner secured against rotation.

[0053] In accordance with a further preferred embodiment, the covering cap is connected via a separable connection to a holding device for holding at least one electrical connection member.

[0054] In this embodiment, it is possible to connect the holding device to the covering cap in a manner similar to that of the antitwist protection device.

[0055] It is particularly preferable if the antitwist protection device and the holding device are formed by a one-piece holding arrangement.

[0056] In this case, the holding arrangement may perform both the function of an antitwist protection means and a holding function for at least one electrical connection member.

[0057] Here, the holding device integrated therein or formed separately from the antitwist protection means may hold one or more electrical connection members. This makes it possible to already connect the contacting device to the corresponding electrical connection members during the cable fabrication process, such that a cable loom produced in this way can then be supplied completely preassembled for the end assembly of a vehicle. The necessary number of individual parts can thus be considerably reduced, thus also saving freight and storage costs.

[0058] It is consequently preferable with the method according to the invention for producing a contacting device if, in the moulding step, an antitwist protection device and/or a holding device for an electrical connection member is moulded onto the covering cap via a separable connection.

[0059] A holding arrangement for cable lugs is known from document WO 2009/100887 A1, in which the functions of a holding device and of an antitwist protection device are integrated. It is preferable if a holding arrangement of this type is connected via a separable connection to a contacting device according to the invention. This is preferably achieved via a moulding step, such that the holding arrangement is formed in one piece with the contacting device, wherein the separable connection can be formed by predetermined breaking points, such as webs or the like. The disclosure of document WO 2009/100887 A1 is therefore incorporated in the present case in its entire scope by way of reference in order to supplement the present disclosure.

[0060] In the method according to the invention for producing the contacting device, the contact element and, where applicable, the scratching element are preferably placed into an injection moulding machine, and the contact element and, where applicable, the scratching element is then insert moulded with plastic, wherein the insert-moulded plastic forms the covering cap and preferably an antitwist protection device and/or a holding device. The contacting device thus produced can then be supplied for example to a cable harness manufacturer.

[0061] On the whole, at least one of the following advantages is provided due to the invention. On the one hand, the contact arrangement is highly resistant to corrosion. Compared to previous systems, weight can be saved. The number of individual parts that may become lost during the final assembly process is reduced, more specifically preferably to zero. Storage in the region of the end assembly process is reduced, since the contacting device is preferably a component of a cable loom. The stud may preferably be provided with a standard corrosion protection. However, the stud does not have to comprise a metric thread, but can be formed as a coarse threaded stud. The contacting device may also be used without the antitwist protection device and/or holding device. Furthermore, shorter studs can be used because the tip of the stud preferably digs into a through-opening in the covering cap and the effective length is greater. A self-locking effect can be produced as a result of the grooved thread engagement. With studs that are provided with a protective cap when the vehicle body is painted, it is possible to dispense with the contact element and, where applicable, the scratching element, since the threaded portion of the stud and the surface of the flange of the stud can be free from paint.

[0062] It goes without saying that the features mentioned above and those yet to be explained hereinafter can be used not only in the respective combination specified, but also in other combinations or in isolation, without departing from the scope of the present invention.

[0063] Exemplary embodiments of the invention are illustrated in the drawing and will be explained in greater detail in the description below. In the drawing:

Fig. 1 shows a schematic longitudinal sectional view through a first embodiment of a contact arrangement according to the invention in the form of an earth contact arrangement;

Fig. 2 shows a schematic plan view of the contact arrangement in Fig. 1;

Fig. 3 shows a schematic longitudinal sectional view through a further embodiment of a contacting device;

Fig. 4 shows a holding arrangement for electrical connection members according to the prior art;

Fig. 5 shows a schematic longitudinal sectional view through a further embodiment of a contacting device according to the invention once a plurality of connection members have been received in an integrated holding device;

Fig. 6 shows the contacting device in Fig. 5 once fitted onto a stud; and

Fig. 7 shows a contact arrangement finished by means of the contacting device in Figs. 5 and 6 once the contacting device has been screwed onto the stud.

[0064] A first embodiment of a contact arrangement according to the invention in the form of an earth contact arrangement 10 is illustrated in Figs. 1 and 2. The contact arrangement 10 is used for electrically connecting an electrical connection member 12, which can be formed for example as a cable lug, to a sheet 14, which for example may constitute part of a vehicle body. In vehicle construction, it is necessary to connect a large number of electrical devices to an earth, which is often formed by the vehicle body itself.

[0065] The contact arrangement 10 comprises a stud 16, which is welded onto the surface of the sheet 14 with access from one side. The stud 16 comprises, in a manner known per se, a flange 18, of which the underside is connected via a welded connection 20 to the sheet 14. The stud 16 further comprises a shaft 22 of smaller diameter extending from the other side of the flange 18, said shaft comprising a thread 24 in the present case. The thread 24 may be a metric thread, but may also be what is known as a coarse thread or the like.

[0066] The electrical connection member 12 comprises a through-opening 26, of which the diameter is greater than that of the shaft 22, but is smaller than that of the flange 18. In the illustration in Fig. 1, the connection member 12 is slid over the shaft 22 and bears against an upper face of the flange 18.

[0067] In order to establish the electrical contact, a contacting device 30 is provided. The contacting device 30 comprises a covering cap 32 formed from an electrically non-conductive material or from a material that is only slightly conductive, such as a hard plastic material. The covering cap 32 comprises a wall 34, which is annular in cross section and of which the inner diameter is greater than the outer diameter of the shaft 22 and of which the outer diameter is smaller than the outer diameter of the electrical connection member 12. The covering cap 32 further comprises a cover 36, which closes an axial end of the annular wall 34. The wall 34 and the cover 36 enclose an interior 38.

[0068] In one embodiment, a through-opening 40 is formed in the cover 36 and forms a cylindrical stud-receiving portion.

[0069] At the axial end opposite the cover 36, the annular wall 34 comprises an annular end face 42, on which an annular sealing collar 44 is formed. The sealing collar 44 can be formed by a resiliently deformable sealing lip.

[0070] To produce the contact arrangement 10, the contacting device 30 is screwed onto the shaft 22, wherein the shaft 22 penetrates the through-opening 40. The through-opening 40 may be smooth internally in a starting stage, wherein the thread 24 grooves into the wall of the through-opening 40. The covering cap 32 is thus screwed onto the shaft 22 in the manner of a nut until the sealing collar 44 bears against the upper face of the connection member 12. In this case, the sealing collar 44 can deform resiliently where necessary. The sealing collar 44 is formed such that a first fluid seal 46 for sealing the interior 38 is formed between the annular wall 34 and the connection member 12.

[0071] By screwing the shaft 22 of the stud 16 into the through-opening 40 in the covering cap 32, in particular when a thread is grooved into the wall of the through-opening 40, a second fluid seal 48 is formed, which likewise seals the interior 38.

[0072] A tool engagement portion 50 is formed on the covering cap 32. Said tool engagement portion can be formed by a slit for positioning a screwdriver, or by a torx receptacle or the like. The outer periphery of the covering cap 32 however is preferably polygonal (hexagonal in this case), such that an open-ended spanner or the like can be used as a tool to screw the covering cap 32 onto the shaft 22. During the screwing process, an axial force 52 is produced due to the thread engagement and is used to press the connection member 12 firmly onto the upper face of the flange 18 in order to produce here an electrical contact. As is shown in Fig. 1 on the left-hand side, a current i can consequently flow from the electrical connection member 12 via the flange 18 of the stud and into the sheet 14.

[0073] Due to the axial force 52, a third seal is also formed between the upper face of the flange 18 and the connection member 12, said seal sealing an interior 38, as is illustrated in Fig. 1 at 54.

[0074] The covering cap 32 in Fig. 1 comprises an axial through-opening 40 in the region of the cover 36. Alternatively hereto, the covering cap 32 may also be formed such that it is closed in the region of the cover, as is indicated schematically in Fig. 1 at 36'.

[0075] Due to the seal of the interior 38, fluid (such as splashed water) can be prevented from infiltrating the interior 38. Since the stud 16 and the connection member 12 can be produced from different materials, a corrosion muck could thus be produced in particular on one component part or another, in particular on the stud 16, in the event of infiltration of splashed water due to the electrochemical series, this being prevented here as a result of the seal arrangement with the fluid seals 46, 48. In the case of the cover 36' without a through-opening, a second fluid seal 48 as in the first embodiment with the cover 36 is not necessary. Due to the axial force 52 however, a type of fluid seal 54 is also established between the connection member 12 and the upper face of the flange 18.

[0076] As is illustrated on the left-hand side in Fig. 1, the interior 38 may be empty. In this case, the covering cap 32 can only be used in order to fix the connection member 12 to the stud, such that a current i can flow, as is shown in Fig. 1 on the left-hand side from 12 to 14.

[0077] In many cases, the stud 16 is painted however during production of the contact arrangement 10, more specifically including the upper face of the flange 18. In this case, no electrical contact can be produced between the connection member 12 and the sheet 14 in the manner illustrated in Fig. 1 on the left-hand side.

[0078] In this case, the contacting device 30 comprises a contact element 60 in the interior 38, as is illustrated in Fig. 1 on the right-hand side, wherein the contact element 60 comprises an axially continuous contact element opening 58. Here, the contact element 60 is produced from an electrically conductive material and comprises a contact element end face 62, which in the assembled state bears against the upper face of the connection member 12, as is illustrated in Fig. 1 on the right-hand side. The contact element opening 58 comprises a scratching portion 66 towards the contact element end

face 62 in the axial direction and a contact portion 64 towards the cover 36 in the axial direction. The contact portion 64 can be formed as a threaded portion, but is preferably formed as a smooth wall portion, wherein the material of the contact element 60 is selected such that a thread is grooved into the contact portion 64 as the contacting device 30 is screwed on.

[0079] Here, the scratching portion 66 is arranged adjacently to the contact element end face 62, such that it engages first with the shaft 22 and the thread 24 thereof when the contacting device 30 is screwed on. The scratching portion 66 is designed to remove at least some of a coat of paint on the shaft 22 and/or the thread 24. It is thus ensured that an electrical contact is established between the contact portion 64 and the shaft 22, once the shaft 22 is screwed into the contact element opening 58. In the finished assembled state, the contact element 60, as mentioned, bears against the upper face of the connection member 12, such that, for this case, an electrical current i' can flow from the connection member 12 via the contact element 60 and via the shaft 22 and the flange 18 of the stud 16 into the sheet 14.

[0080] The contact element 60 is preferably produced from a softer material compared to the stud 16. The contact element 60 is further preferably produced from a particularly good electrically conductive material, such as copper or the like. Due to the seal of the interior 38, an infiltration of splashed water and corrosion at the interface between the stud 16 and/or between the contact element 60 and connection member 12 can be avoided here.

[0081] As described above, the outer periphery of the covering cap 32 may be polygonal. The contact portion 64 preferably comprises an outer periphery which is accordingly polygonal, as can be seen in Fig. 2 at 68. As a result of this measure, the contact element 60 can be received in the covering cap 32 in a rotationally engaged manner.

[0082] It is particularly preferable if the contact element 60 is integrally moulded into the covering cap 32 in a moulding step during the production of the covering cap 32.

[0083] In a further embodiment, the contacting device 30 may additionally comprise a holding arrangement 70. The holding arrangement 70 comprises a holding device 71 for receiving one or more connection members 12, wherein the holding device 71 is preferably designed to centre the connection members 12 in order to facilitate a threading of said connection members onto the shaft 22.

[0084] The holding arrangement 70 further preferably comprises an antitwist protection device 72, which is designed to cooperate with an antitwist protection portion 74 formed on the outer periphery of the flange 18. In the finished assembled state, the holding arrangement 70 can thus be fixed in the direction of rotation with respect to the stud 16. Furthermore, the connection member or connection members 12 can be fixed in position in the peripheral direction by means of the antitwist protection device 72.

[0085] Here, the holding arrangement 70 is preferably connected to the covering cap 32 via a separable connection 76. It is thus possible for the connection member or connection members 12 to be preassembled on the contacting device 30 in the connected state, for example so as to produce a cable loom or cable harness. When assembling such a contacting device 30, this is then fitted on the shaft 22, and the holding arrangements 70 is preferably held by means of a suitable tool, wherein the tool is preferably likewise designed to rotate the covering cap 32 relative to the holding arrangement 70, whereby the separable connection 76 is separated or released, as is shown schematically in Fig. 1 on the right-hand side at 78.

[0086] In a preferred embodiment, the holding arrangement 70 and the covering cap 32 are produced in a moulding step from the same material, for example in an injection moulding process.

[0087] It is also shown in Fig. 1 on the right-hand side that the holding device 71 may comprise one or more axially upright antitwist protection webs 80, which form radial openings 82 (see Fig. 2) therebetween, through which the electrical connection members 12 can be guided radially outwardly so as to be fixed in the peripheral direction.

[0088] An alternative embodiment of a contacting device 30" is shown in Fig. 3 and corresponds generally to the contacting device 30 in Figs. 1 and 2 in terms of structure and operating principle. Like elements are therefore denoted by like reference signs. It is basically the differences that will be explained hereinafter.

[0089] The contacting device 30" thus comprises, in the interior 38, a contact element 60" made of a first material and a scratching element 86 made of a second material, on the inner periphery of which a scratching portion 66" is formed. The scratching element 86 may thus be produced from a harder material compared to the contact element 60" in order to ensure that paint on the surface of the shaft 22 of the stud can be scratched off effectively.

[0090] It goes without saying that, in this case, even the scratching element 86 can be integrally moulded during the production of the covering cap 32". Further, in this case, an end face of the scratching element 86 bears against an upper face of a connection member 12 in the end assembly position, such that an electrical current can flow from the connection member 12 via the scratching element 86, the contact element 60", and the stud 16 to the sheet 14.

[0091] Fig. 4 shows a prior art holding arrangement 70P, as is known from document WO 2009/100887 A1 mentioned in the introduction. The holding arrangement 70P comprises a lower part 90 and an upper part 92, which are interconnected in one piece via a hinge 94, for example in the form of a living hinge. With this holding arrangement 70, one or more connection members 12 can first be inserted into the lower part, whereupon the upper part 92 is then bent over onto the lower part 90 until it latches with the lower part 90 by means of one or more detent devices 96 in order to thus fix the connection members 12 firmly on the holding arrangement 70. Here, the holding arrangement is used to fix the connection members 12 in the peripheral direction and preferably also to centre said connection members in order to facilitate a threading of said connection members onto a stud 16. In the prior art, a holding arrangement 70 of this type is fitted onto a stud and a nut 98 is then screwed onto the stud 16 in order to produce a contact arrangement, as is indicated schematically in Fig. 4.

[0092] A further embodiment of a contacting device 30''' is shown in Fig. 5 and generally corresponds to the contacting device 30 in Fig. 1 in terms of structure and operating principle, wherein like elements are denoted by like reference signs. It is basically the differences that will be explained hereinafter.

[0093] With the contacting device 30''' in Fig. 5, a through-opening 40''' is provided in the covering cap 32''', as in the embodiment in Fig. 1, whereas the covering cap 32'' in Fig. 3 comprises a closed cover 36'' (corresponding to the cover 36' in Fig. 1).

[0094] Further, the contacting device 30''' in Fig. 5 comprises a contact element 60''' and a scratching element 86''', as in the embodiment in Fig. 3.

[0095] The contacting device 30''' further comprises a holding arrangement 70''', which may generally correspond to the holding arrangement 70P in Fig. 4 in terms of structure and operating principle. Here, the holding arrangement 70''' is connected to an outer peripheral portion of the covering cap 32''' via a plurality of releasable connections 76''' distributed over the periphery. The covering cap 32''' is connected here to the upper part 92'''.

[0096] It is also shown in Fig. 5 that a total of five connection members are received in the holding arrangement 70''' and are centred therein, of which only one is denoted in Fig. 5 by 12A and comprises a through-opening 26A.

[0097] In Fig. 6, the contacting device 30''' in Fig. 5 is shown in a state in which it is fitted onto a stud 16, wherein the shaft 22 of the stud 16 is guided axially through the through-openings 26 in all connection members 12 and bears against the end face of the scratching element. In this case, the releasable connections 76''' are not yet separated. Proceeding from this state in Fig. 6, the holding arrangement 70 is then held in a suitable manner in the peripheral direction, and the covering cap 32''' is rotated such that the scratching element 86''' initially removes paint from the shaft 22, then the shaft penetrates the contact element opening 58''', where it cuts a thread, and lastly penetrates the

through-opening 40''' in the covering cap 32''', where it likewise grooves a thread. In so doing, the releasable connections 76''' are released or broken open.

[0098] In Fig. 7, the end state is shown, in which the lowermost electrical connection member 12A bears against the upper face of the flange of the stud 16, where it forms a fluid seal 54'''. The connection members 12A are pressed together axially from above by means of the covering cap 32''' in order to ensure an electrical contact therebetween. Further, a first fluid seal 46''' is established between an upper face of the uppermost connection member and the sealing collar (not denoted in greater detail in Fig. 7) of the covering cap 32'''. A second fluid seal 48''' is established between the outer periphery of the stud 16 and the through-opening 40''', as is illustrated in Fig. 7. In Fig. 7, a screw-in path 102 can be seen, which is the axial path over which the covering cap 32''' is displaced in the axial direction relative to the holding arrangement 70''' during the screwing-in process. In the end position shown in Fig. 7, an inner periphery of the lower part of the holding arrangement 70''' preferably engages on an outer periphery of the flange of the stud 16 in order to thus establish an antitwist protection effect with respect to the stud 16 also.

Claims

1. Contacting device (30) for an electrical contact arrangement (10), in particular for an earth contact arrangement, comprising

a covering cap (32), which is produced from an electrically non-conductive material by moulding, which comprises an interior (38) for receiving an electrical contact element (60), and which, on a cap end face (42), comprises a sealing collar (44) for forming a first fluid seal (46) with a counterelement (12),

characterized by

an annular contact element (60), which is produced from an electrically conductive material and which comprises a central contact element opening (58) for receiving and for electrically contacting a stud (16),

the contact element (60) being moulded into the interior (38) of the covering cap (32) such that the contact element (60) and the covering cap (32) form a one-part contacting device (30).

2. Contacting device according to Claim 1, characterized in that a first inner peripheral portion of the contact element is formed as a smooth contact portion (64) that can be grooved by a thread (24) of the stud (16).

3. Contacting device according to Claim 1 or 2, characterized in that a second inner peripheral portion of the contact element is formed as a scratching portion (66), by means of which a coat of paint on the stud (16) can be removed at least in part.

4. Contacting device according to one of Claims 1-3, characterized by a scratching element (86), which is moulded into the interior of the covering cap (32) adjacently to the contact element (60) in the axial direction.

5. Contacting device according to one of Claims 1-4, characterized in that a tool engagement portion (50) for rotating the covering cap (32) is formed on the covering cap (32), the contact element (60) being moulded into the covering cap (32) such that the contact element (60) is connected to the covering cap (32) in a rotationally secured manner.

6. Contacting device according to one of Claims 1-5 or according to the preamble of Claim 1, characterized in that the covering cap (32) comprises a cylindrical stud-receiving portion (40), into which a threaded stud (60) can be screwed in such a way that a second fluid seal (48) can be formed between the threaded stud (16) and the covering cap (32) and/or that an axial force (52) is produced in order to form the first fluid seal (46).

7. Contacting device according to Claim 6, characterized in that the stud-receiving portion is formed at an axial through-opening (40) in the covering cap (32).

8. Contacting device according to one of Claims 1-7, characterized in that the covering cap (32) is connected via a separable connection (76) to an antitwist protection device (72), which is designed to be fastened in a manner secured against rotation on an antitwist protection portion (76) of a stud (16) and/or to hold at least one electrical connection member in a manner secured against rotation.

9. Contacting device according to one of Claims 1-8, characterized in that the covering cap (32) is connected via a separable connection (76) to a holding device (71) for holding at least one electrical connection member (12).

10. Contacting device according to Claim 8 and according to Claim 9, characterized in that the antitwist protection device (72) and the holding device (71) are formed by a one-piece holding arrangement (70).

11. Contact arrangement (10) comprising a threaded stud (16) and a contacting device (30) according to one of Claims 1-10, wherein at least one electrical connection

member (12) is arranged between the contacting device (30) and a flange (18) of the threaded stud (16), and wherein an interior (38) of the covering cap (32) is sealed in a fluid-tight manner with respect to the surrounding environment.

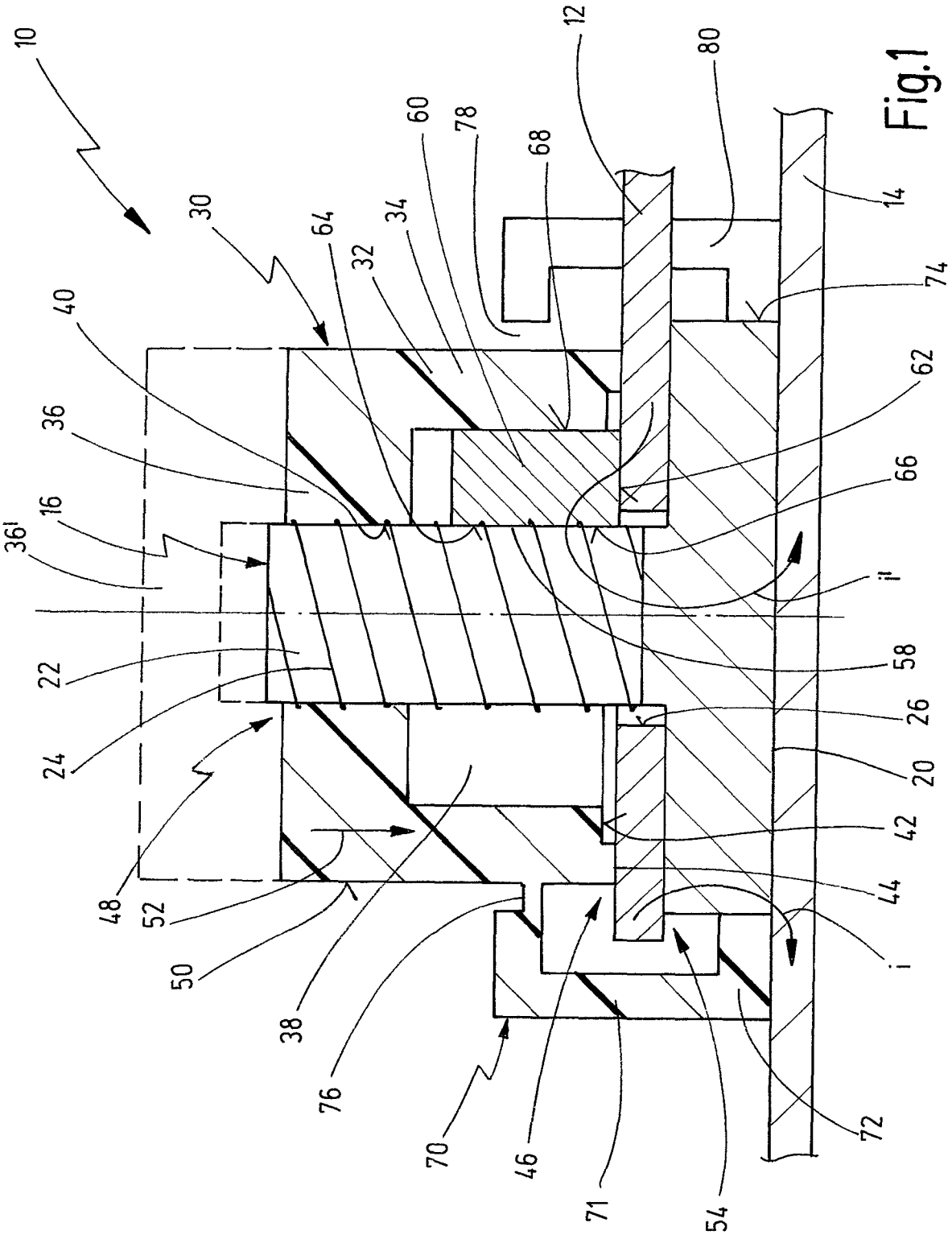
12. Method for producing a contacting device (30) according to one of Claims 1-10, comprising the following step: producing the covering cap (32) in a moulding step, wherein the contact element (60) is integrally moulded into the covering cap (32) during the moulding step.

13. Method according to Claim 12, wherein, in the moulding step, an antitwist protection device (72) and/or a holding device (70) for an electrical connection member (12) is formed onto the covering cap (32) via a separable connection (76).

14. Method for producing a contact arrangement (10) according to Claim 11, said method comprising the following steps:

- fitting the contacting device (30) onto a threaded stud (16), and

- screwing the contacting device (30) onto the threaded stud (16) until the sealing collar (44) of the covering cap (32) forms a first fluid seal (46) with an electrical connection member (12), which is arranged between the contacting device (30) and a flange (18) of the threaded stud (16).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12
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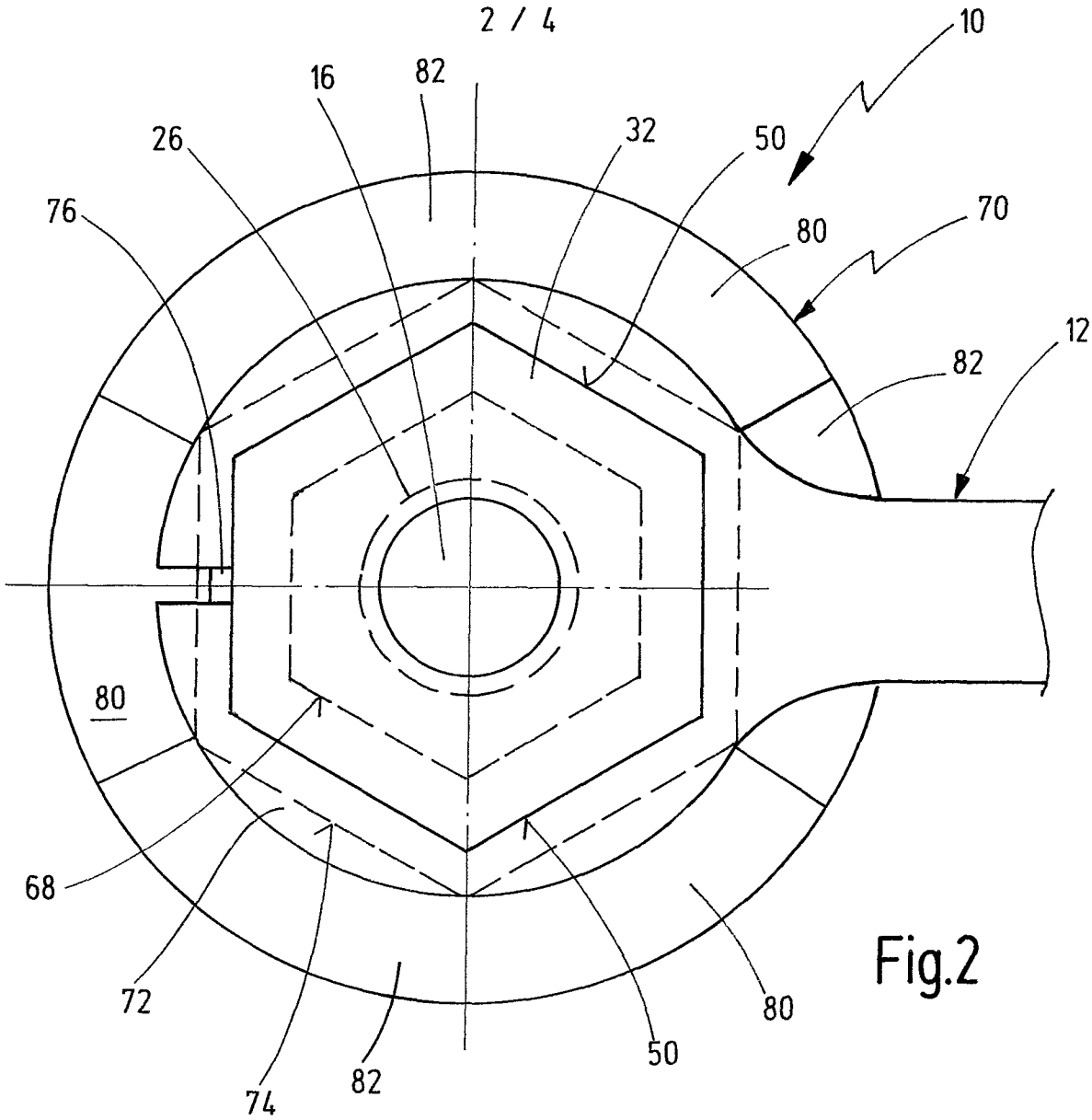
68
14
30
64
34
32
74
40
62
36
66
16
36'
i'
22
58
26
24
20
42
48
44
52
i
50
38
76
72
70
46
71
54

Fig.1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74
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80

Fig.2

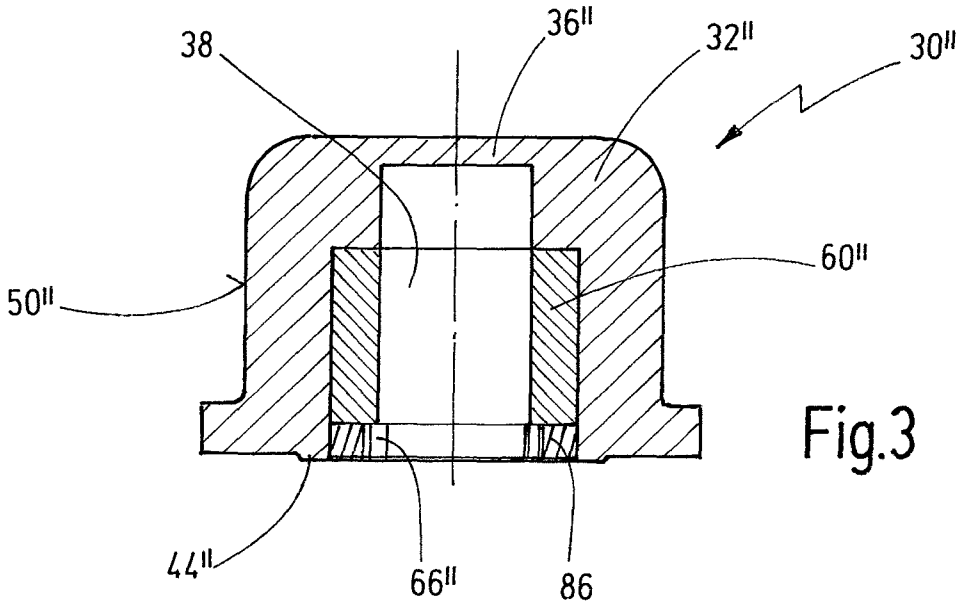

38
36II
32II
30II
60II
50II
44II
66II
86

Fig.3

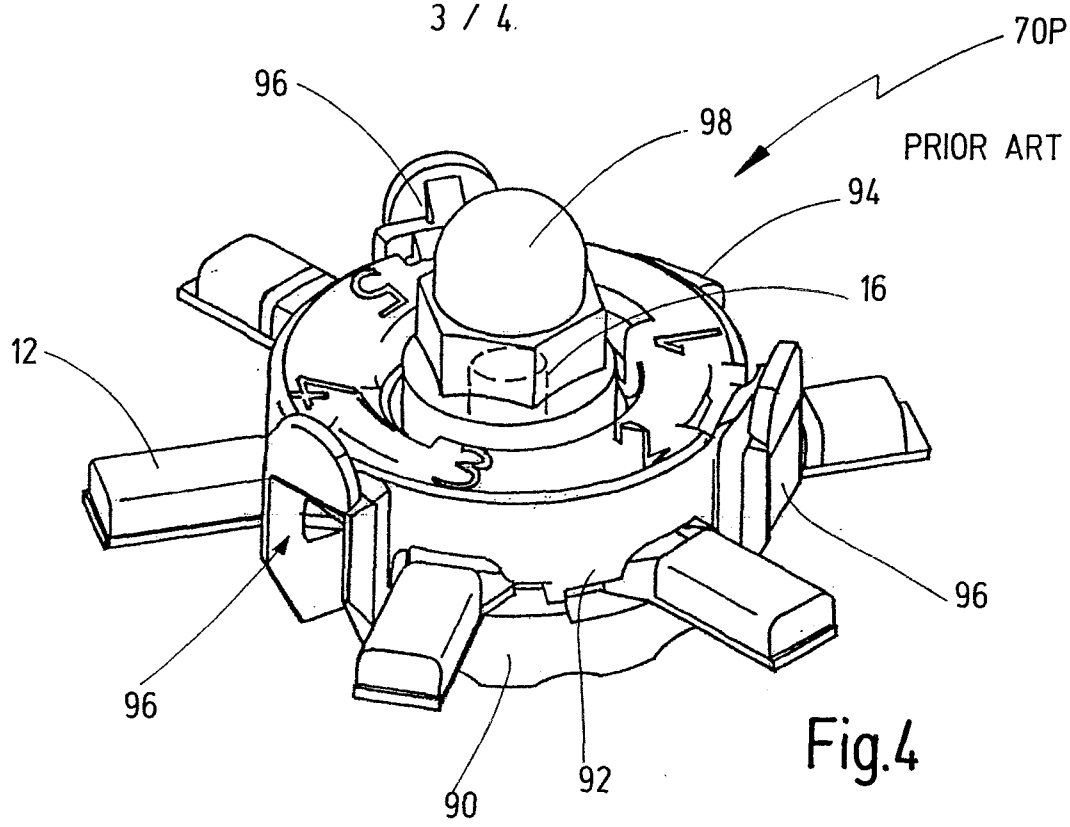
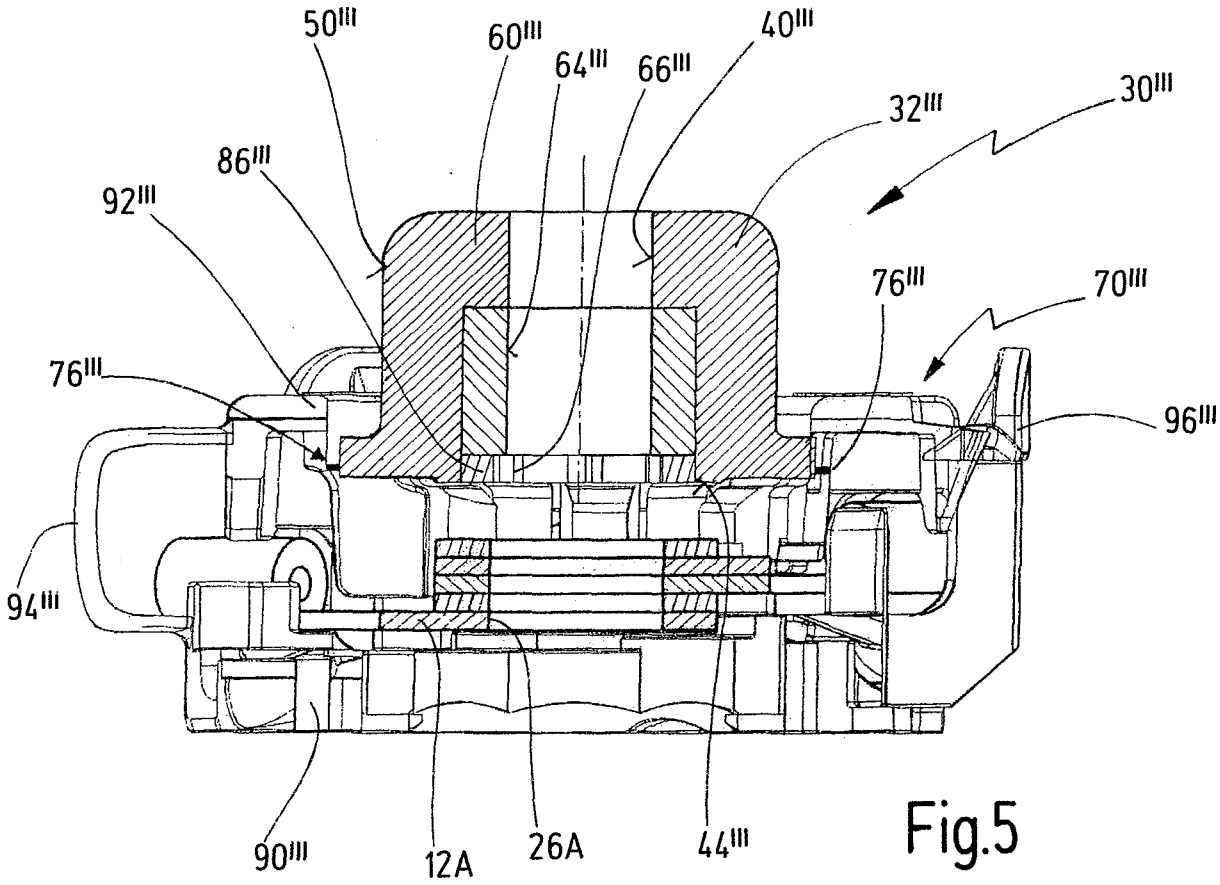

70P
PRIOR ART
96
98
94
16
12
96
96
90
92

Fig.4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60III
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40III
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70III
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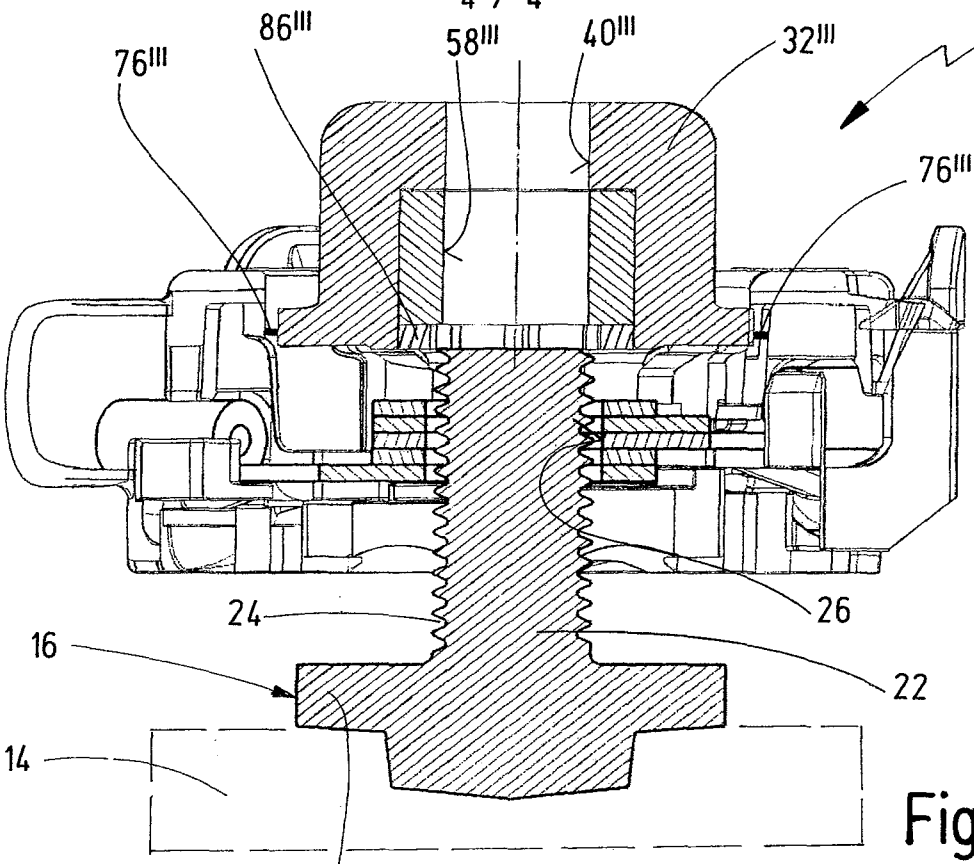
94III
90III
12A
26A
44III

Fig.5


86III
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40III
32III
30III
76III
76III
24
26
16
22
14

Fig.6

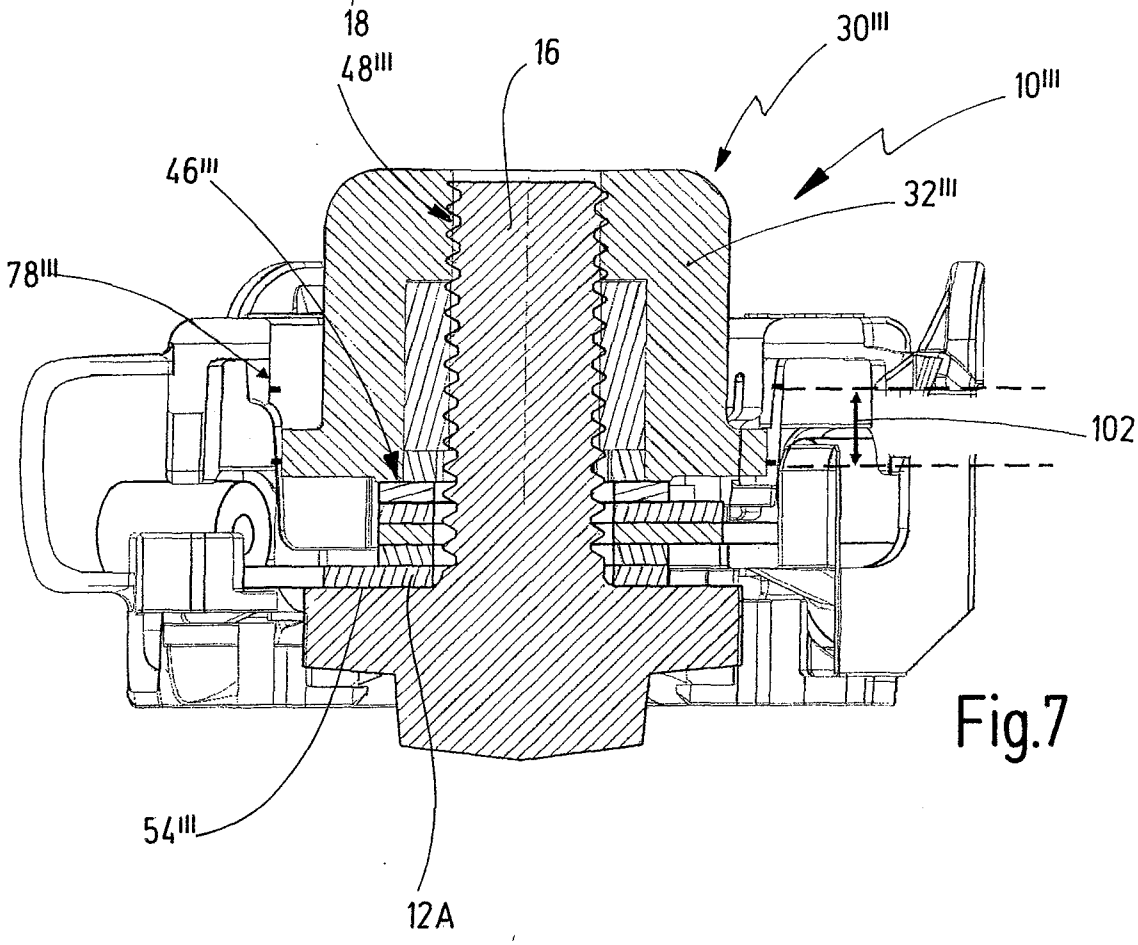
18
48III
16
30III
10III
46III
32III
78III
102
54III
12A

Fig.7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2014/057195

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☒ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/057195

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01R4/34 H01R4/64 H01R4/70 H01R43/24
ADD. H01R4/30

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	DE 197 41 830 A1 (PUDENZ WILHELM GMBH [DE]) 25 March 1999 (1999-03-25) claims 1, 3 column 1, line 56 - column 2, line 21 column 2, line 68 - column 3, line 61 figures 1, 2	1,2,4,6, 7,12 3,5, 8-10,13

X Y A	US 2004/062622 A1 (SCHATY HARALD [DE] SCHAETY HARALD [DE]) 1 April 2004 (2004-04-01) paragraphs [0021], [0047], [0050], [0054] figures	6,7,11, 14 5,8-10 1,2,12

	-/--	

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 June 2014	24/06/2014

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Stichauer, Libor

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/057195

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DE 10 2006 034501 A1 (DAIMLER AG [DE]) 31 January 2008 (2008-01-31) cited in the application	3
A	paragraph [0020] - paragraph [0022] figures 1, 2, 3a	1,4

Y	US 2011/053434 A1 (SENG HANS-PETER [DE] ET AL) 3 March 2011 (2011-03-03)	8-10,13
A	paragraphs [0020], [0075], [0080], [0093] figures 1-8	1,6,12

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2014/057195

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 19741830 A1	25-03-1999	NONE	
US 2004062622 A1	01-04-2004	AT 470252 T	15-06-2010
		EP 1350286 A1	08-10-2003
		JP 2004518250 A	17-06-2004
		US 2004062622 A1	01-04-2004
		WO 02056422 A1	18-07-2002
DE 102006034501 A1	31-01-2008	NONE	
US 2011053434 A1	03-03-2011	AT 520170 T	15-08-2011
		CN 101946369 A	12-01-2011
		DE 102008010352 A1	20-08-2009
		EP 2160801 A1	10-03-2010
		US 2011053434 A1	03-03-2011
		WO 2009100887 A1	20-08-2009
		WO 2009102780 A1	20-08-2009

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-14

   Contacting device, contact arrangement comprising such a contacting device, method for producing such a contacting device and method for producing such a contact arrangement

1.1. claims: 1-5, 12, 13(completely); 6-11(partially)

   Contacting device wherein an annular contact element is moulded into the interior of the covering cap (claims 1-5; claims 6-10 as dependent on claims 1-5), contact arrangement comprising such a contacting device (claim 11 as dependent on claims 1-5), method for producing such a contacting device (claims 12-13)

1.2. claims: 14(completely); 6-11(partially)

   Contacting device wherein a first and a second fluid seals are formed (claim 6 as dependent on the preamble of claim 1; claims 7-10 as dependent on claim 6), contact arrangement comprising such a contacting device (claim 11 as dependent on claim 6), method for producing such a contact arrangement (claim 14)
