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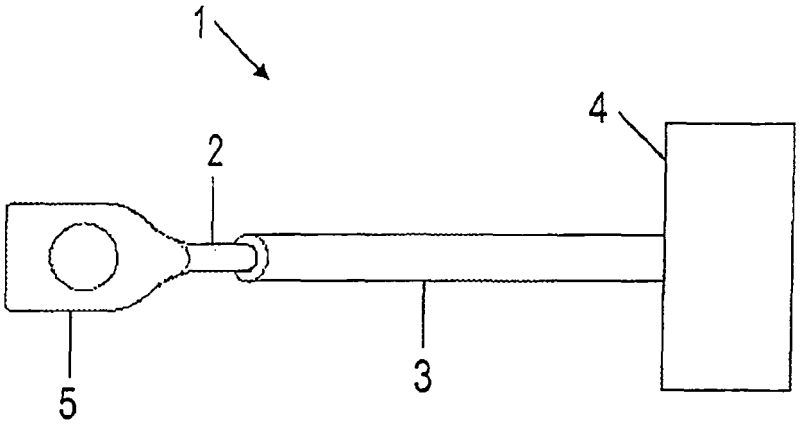
(54) Grounding device

(57) The present invention relates to grounding devices, in particular to a grounding device (1) at least consisting of a solid ground wire (2), a contact member (4) at one end of the solid ground wire (2), and a lug (5) at the other end of the solid ground wire (2). The contact member (4) is for connecting the grounding device (1) to an external metal structure to be grounded and the lug (5) is for connecting the grounding device (1) to ground. The lug (5) is formed as a through hole along the diameter of the solid ground wire (2).

Fig.1



EP 2 166 621 A1

Description

Field of the invention

[0001] The present invention relates to grounding devices, in particular to a grounding device at least consisting of a solid ground wire, a contact member at one end of the solid ground wire, and a lug at the other end of the solid ground wire.

Background and prior art

[0002] It is known that specific kinds of metal structures such as coaxial cables, pipes, tubes and waveguides must be grounded to provide potential equalization and/or lightning protection. For example, a transmission line in an antenna system connecting transmitters and receivers to antennas must be grounded to protect said antenna system against potential damages which may result from a lightning strike. In such a case the insulating jacket of the transmission line is partially removed to attach one end of a grounding device to a metallic section of said transmission line, for example the metallic outer conductor. Hence, a grounding device forms an electroconductive connection between the system to be protected and ground. The grounding device has a ground wire which is directly or indirectly connected to ground and thus said grounding device may act as a lightning conductor. For example, a cable lug at a loose end of said ground wire is used to attach the grounding device to a ground bar by a metal bolt.

[0003] US 3,643,008 (Brazee) shows a shielded cable construction providing for an annular clearance space between the inner and outer insulation jackets so that a grounding member can be inserted therein and internally connected to the cable shield without need for stripping insulation or taping.

[0004] US 6,734,355 B1 (Auclair) shows a ground connector implemented as a modified cable lug on a flexible ground lead that allows the convenient termination of a solid ground wire at a cable shield ground clamp. The ground wire and ground clamp are electrically and mechanically attached at the modified cable lug. The flexible ground lead carries the combined ground connection to a common ground point within an enclosure.

[0005] Further known grounding devices comprise a stranded wire and a loose cable lug crimped to an end thereof. That is, the ground wire and the cable lug of known grounding devices are usually separate elements. However, when a grounding device is exposed to a lightning strike a magnetic field is generated causing high mechanical forces to the grounding device, affecting in particular the connection between the ground wire and the cable lug. Due to said high mechanical forces the cable lug is often removed from the ground wire causing a malfunction. Therefore, to provide a grounding device for lightning protection, all current-carrying components and junctions have to be strong enough to withstand mechanical forces applied during a lightning strike. With respect to grounding devices in which the ground wire and the cable lug are separate elements, this is difficult to achieve.

[0006] An inherent problem of stranded ground wires is that water can penetrate through the capillaries between the individual wires of the strand. In case the stranded ground wire is directly connected to a contact element of the contact member for connecting the grounding device to the external metallic structure moisture might permeate into all parts of the grounding device if the sealing, for example, between strand and cable lug leaks. In an alternative construction (see e.g. EP 0 744 788 A1) where the ground wire is indirectly connected to the contact element, moisture does not permeate into the contact member. However, leakage between the ground wire and the cable lug may result in corrosion of the stranded ground wire and the cable lug due to the permeation of moisture. To avoid the potential risk of leakage cable lugs are usually sealed with heat shrink tubes. However, even a heat shrink tube may loosen from the cable lug in case of a lightning strike thus permitting moisture to penetrate the stranded ground wire.

[0007] A further known grounding device comprises a solid ground wire, wherein a loose end of said solid ground wire is looped to form a lug. In such a case the grounding device is usually connected to a ground bar by fastening the looped end of the ground wire with a screw. However, even such a grounding device does not provide for a secure connection in case that the grounding device is exposed to a lightning strike, since the looped end of the solid ground wire can loose from the screw due to the high mechanical forces.

[0008] It is therefore an object of the present invention to provide a grounding device enabling a secure connection to a ground bar or similar device and preventing permeation of moisture between ground wire and cable lug.

[0009] This object and other objects are solved by the features of the independent claims. Preferred embodiments of the invention are described by the features of the dependent claims.

Summary of the invention

[0010] The above-mentioned object is solved by a grounding device comprising a solid ground wire and a lug that is formed within one end of the solid ground wire. In other words, according to the present invention the lug is integrated in the solid ground wire. To enable a secure attachment of the grounding device, for example, by a metal bolt to a ground bar, the lug is formed as a through hole along the diameter of the solid ground wire. Hence, the integrated lug according to the present invention is used for connecting the grounding device to ground. At the other end of the solid ground wire means for electroconductively connecting the solid ground wire to an external metal structure are provided. Thus, such metal structure may be grounded by means of the grounding

device to provide potential equalization and/or lightning protection. For example, the metal structure is the outer conductor of a coaxial cable.

[0011] Consequently, the grounding device according to the present invention is very robust and provides for a secure connection, since the lug is formed within the solid ground wire as an integral part thereof. That is, the lug and the solid ground wire according to the present invention form a single element without any junction and thus can not loosen from each other, even if the grounding device is subjected to high mechanical forces due to a lightning strike or other external conditions and/or influences. Thus, the grounding device according to the present invention having the integrated lug provides much higher mechanical strength in comparison to known grounding devices where a cable lug and a stranded ground wire are attached (e.g. crimped) to each other or where a lug is formed by forming a loop at one end of a solid ground wire.

[0012] In addition, the solution according to the present invention is water tight, since moisture can neither penetrate any junction between lug and ground wire nor the solid ground wire. Thus, the present invention provides for a durable grounding device, since corrosion of the junction between lug and ground wire can not occur. A further advantage resulting from the construction according to the present invention is that no additional sealing (e.g. heat shrink tube) is required between the solid ground wire and the integrated lug, provided that a jacket of the solid ground wire sits tightly thereon.

[0013] According to the present invention a solid ground wire is used as a conductor between an external metal structure and ground. Therefore, moisture can not penetrate into the contact member of the grounding device, which usually comprises a contact element for connecting the external metal structure, in case the solid ground wire is directly connected to the contact element. In known grounding devices moisture permeates into the contact member through the capillaries of the stranded ground wire. In contrast thereto, a solid ground wire has no capillaries so that moisture can not permeate the wire.

[0014] A method for manufacturing a grounding device provides one end of a solid ground wire with means for electroconductively connecting the solid ground wire to an external metal structure, for example a contact member comprising a contact element. The other end of the solid ground wire is provided with a lug for connecting the grounding device to ground. According to the present invention the lug is formed as a through hole along the diameter of the solid ground wire. Thus, the solid ground wire with integrated lug can be produced in a very simple manner, because no connecting and sealing processes of a junction between lug and wire are required.

[0015] According to a preferred embodiment of the present invention the lug is formed by punching. However, the lug may also be formed by drilling or other suitable processes. When the lug is formed by punching so that the lug is a punched hole, the section of the solid ground wire around the punched hole is preferably flattened with respect to the remaining section of the solid ground wire. However, it should be noted that the section around the lug can be flattened by any suitable process without forming the lug. That is, flattening the section around the lug and forming the lug can be performed separately. By flattening the section around the lug a very stable fasting of the grounding device is possible, since the flattened section forms a flat contacting surface for the fastening means, for example a screw, to fasten the grounding device to ground. Alternatively, the steps of forming the lug and flatten the section around the lug may be performed within a single step, for example by a punching process, thus enabling a short and cost saving manufacturing process of the grounding device.

[0016] According to a further embodiment of the present invention the solid ground wire has a cross section between 10 and 20 mm^2, particularly preferred between 13 and 16 mm^2. Thus, the cross section of the solid ground wire is large enough to withstand a lightning strike. For example, for copper components a cross section of typically 16 mm^2 is required by standards.

[0017] According to a further embodiment of the present invention the lug has a diameter between 8 and 10 mm. However, it should be noted that the diameter of the lug may vary depending on the diameter of the solid ground wire. That is, the thicker the solid ground wire is the bigger the lug may be dimensioned.

[0018] These and other aspects of the invention will be apparent from and elucidated with reference to the embodiments thereafter. It should be noted that the use of reference signs shall not be construed as limiting the scope of the invention.

Brief description of the drawings

[0019]

Figure 1 shows a grounding device according to a preferred embodiment of the present invention, and

Figure 2 shows steps of a manufacturing method of a grounding device according to a preferred embodiment of the present invention.

Detailed description of the drawings

[0020] Figure 1 shows a grounding device 1 according to a preferred embodiment of the present invention. The grounding device 1 comprises a solid ground wire 2 covered by a jacket 3. At one end of the solid ground wire 2 a contact member 4 is provided, wherein the contact member 4 is only schematically depicted, since its configuration does not form part of the present invention. In general, the contact member 4 comprises a contact element (not shown) which electroconductively connects the grounding device 1 to an external metal structure (not

shown), for example the outer conductor of a coaxial cable. The solid ground wire 2 may be connected directly or indirectly to the contact element of the contact member 4.

[0021] At the other end of the solid ground wire 2 a lug 5 is provided. According to the preferred embodiment of the present invention shown in Figure 1 the lug is a punched hole. That is, the lug 5 is formed by punching the loose end of the solid ground wire 2. By the punching process not only the lug 5 is formed (as a through hole along the diameter of the solid ground wire) but also the section of the solid ground wire 2 around the punched through hole is flattened with respect to the remaining section of the solid ground wire 2. The shape of the flattened section may be determined by the punching machine or may be specifically formed as the need arises.

[0022] The grounding device 1 of Figure 1 is, for example, used for grounding a highfrequency cable. Depending on the field of application the length of the solid ground wire 2 may vary. For example, the wire length is about 0,5 or 1,0 m. Due to the simple construction of the integrated lug 5 according to the present invention the length of the solid ground wire 2 may be adapted as required. For example, when installing the grounding device the solid ground wire 2 is tailored on-site as necessary and the lug 5 is formed in the loose end thereof, for example by punching the loose end of the solid ground wire 2 or by drilling a through hole along the diameter of the solid ground wire 2. Thus, it is not necessary to adapt other components of the system to be grounded to any default length of the grounding device 1. Alternatively, a loose cable lug may be attached to the tailored end of the solid ground wire 2 as known from the prior art.

[0023] Figure 2 shows steps of a manufacturing method of a grounding device according to a preferred embodiment of the present invention. In a first step S1 one end of a solid ground wire is provided with means for electroconductively connecting the solid ground wire to an external metal structure. In a second step S2 the other end of the solid ground wire is provided with a lug for connecting the grounding device to ground. According the present invention, the lug is formed in a third step S3 as a through hole along the diameter of the solid ground wire. In a fourth step S4 the end section of the solid ground wire including the lug is flattened wherein the remaining section of the solid ground wire remains unaffected. There is no prescribed order of the steps S1 to S4. That is, the manufacturing process of a grounding device according to the present invention comprises steps S1 to S4 in an arbitrary order. Furthermore, steps S3 and S4 can be performed in a single step by punching the respective end section of the solid ground wire of the grounding device according to the present invention.

[0024] It should be noted that the present invention is not limited to the embodiments described with respect to the drawings. The grounding device according to the present invention can be used in all technical fields that require a wire to be attached to a bolt by a lug for the purpose of grounding. The present invention is applicable when a cross section of the solid ground wire is large enough to form a lug directly within the loose end of the wire.

Claims

1. Grounding device (1), comprising:

   - a solid ground wire (2),
   - means (4) at one end of the solid ground wire (2) for electroconductively connecting the solid ground wire (2) to an external metal structure, and
   - a lug (5) at the other end of the solid ground wire (2) for connecting the grounding device (1) to ground,

   characterized in that the lug (5) is formed as a through hole along the diameter of the solid ground wire (2).

2. Grounding device (1) according to claim 1, wherein the section of the solid ground wire (2) around the lug (5) is flattened with respect to the remaining section of the solid ground wire (2).

3. Grounding device (1) according to claim 1 or 2, wherein the lug (5) is a punched hole.

4. Grounding device (1) according to any of claims 1 to 3, wherein the solid ground wire (2) has a cross section between 10 and 20 mm^2.

5. Grounding device (1) according to claim 4, wherein the solid ground wire (2) has a cross section between 13 and 16 mm^2.

6. Grounding device (1) according to any of claims 1 to 5, wherein the lug (5) has a diameter between 8 and 10 mm.

7. Method for manufacturing a grounding device (1), comprising the steps of:

   - providing one end of a solid ground wire with means for electroconduc tively connecting the solid ground wire to an external metal structure (S1), and
   - providing the other end of the solid ground wire with a lug for connecting the grounding device to ground (S2),

   characterized by

   - forming the lug as a through hole along the diameter of the solid ground wire (S3).

8. Method according to claim 7, wherein the section of the solid ground wire around the lug is flattened with respect to the remaining section of the solid ground wire (S4).

9. Method according to claim 7 or 8, wherein the lug is formed by punching.

10. Method according to any of claims 7 to 9, wherein the lug is dimensioned to have a diameter between 8 and 10 mm.

Fig.1

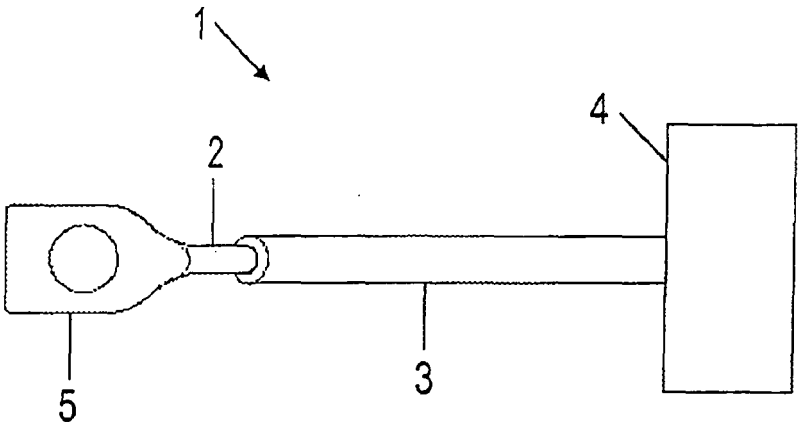
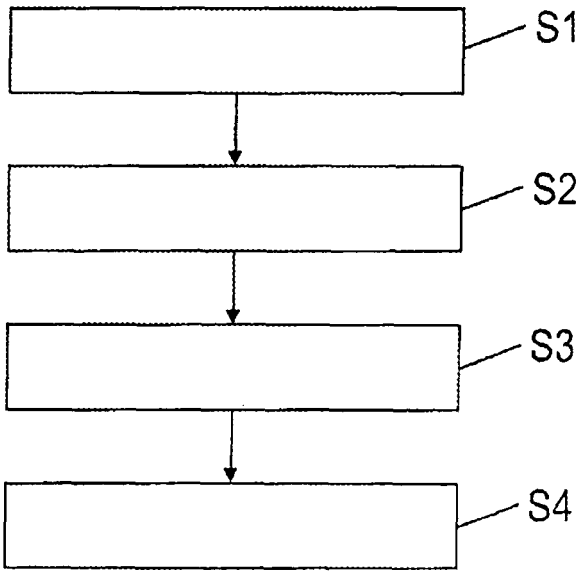


Fig.2



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EUROPEAN SEARCH REPORT

Application Number
EP 08 29 0882

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	20 February 2009	Garcia Congosto, M

CATEGORY OF CITED DOCUMENTS

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

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