

Lightning arrester device

5 The invention relates to a lightning arrester device,
consisting of a catching device having an electrical con-
ductor, which is connected to an earthing installation
and which is surrounded by an insulation surrounded by a
longitudinally continuous layer made from a material
10 which forms a conductive layer, wherein on the end re-
gion, facing the catching device, of the insulation and
of the layer surrounding said insulation, a connecting
cap or like component made of an electrically conductive
material, in particular metal, is positioned, by means of
15 which the catching device and/or the electrical conductor
is connected to the layer, and/or on the end region, fac-
ing the earthing installation, of the insulation and of
the layer surrounding said insulation, a connecting cap
or like component made of an electrically conductive ma-
20 terial, in particular metal, is positioned, by means of
which the electrical conductor and/or the earthing in-
stallation is connected to the layer surrounding said in-
sulation, wherein the connecting cap is sleeve-shaped and
is applied with the sleeve casing to the insulation and
25 to the layer surrounding said insulation, and the sleeve
base of the connecting cap serves as an insertion limit
for the insulation and the layer, wherein a blind hole,
into which the stripped end of the conductor is inserted,
adjoins the sleeve base, wherein preferably the connect-
30 ing cap, in the region of the blind hole, is penetrated
in a threaded manner by stud bolts that contact with
their end extending into the blind hole the stripped end
of the conductor.

Such a lightning arrester device is known, for instance, from EP 1 760 855 B1. In similar lightning arrester devices known from prior art, the connecting cap that is sleeve-shaped, is provided with a slightly projecting thread turn on the inside, so that the connecting cap on the electrical conductor together with the insulation and together with the continuous layer can be applied in a threaded manner. In fact, the thread turn, herein, slightly penetrates the continuous layer forming a conductive layer, in order to establish here an electrical contact. Hereby, however, no mechanical fixation is achieved, since this thread connection is not sufficient to allow a high-tensile connection between the catching device and the cable comprising multiple components. In order to obtain a high-tensile connection, in prior art, the arrangement of the stud bolts is used that penetrate and engage, in the desired assembly position, the material of the stripped conductor. For securing the position, these stud bolts have to be fastened by means of a suitable adhesive in the desired position, since otherwise there is a risk that these bolts may come loose, when a lightning current event occurs, so that then the necessary high-tensile connection that is to be achieved by the stud bolts only, cannot be guaranteed anymore.

In the currently applicable standard (IEC 62561-1 2017), it is required that the connection resists to a tensile force of 900 N +/- 20 N for a minute, with the mobility being less than one millimeter.

To achieve this, is not or not sufficiently ensured with the conventional technique.

Based on this prior art, it is the object of the invention to provide a lightning arrester device of the mentioned species that secures, with a simple design, easy handling and possibly, not using an adhesive or the like, a high current load capacity, wherein, in particular, the new standards are fulfilled.

For the basic solution of this object, the invention proposes that inside the sleeve casing of the connecting cap, at least one interlocking part is integrally formed, which, in the desired assembly position, is interlockingly connected to the insulation, thereby deforming the insulation.

By this design, a high-tensile connection of the corresponding elements is secured, same as an electrical contact, wherein the interlocking part, in the desired assembly position, radially penetrates the material of the insulation and thus leads to a corresponding deformation, whereby an integral fit between the connecting cap and the insulation is achieved. For this purpose, an interlocking part may be sufficient, which engages correspondingly deep into the insulation. However, multiple interlocking parts may axially be formed behind one another in the connecting cap, and they need not engage so deep into the insulation, in order to guarantee the integral fit. By this design, the up to now usual adhesion of the stud bolts is unnecessary, since they are of no importance for the high-tensile connection. By this design, a tensile force of 900 N +/- 20 N corresponding to the standard is achieved, which can also be maintained over a minute and guarantees a mobility of less than one millimeter. By this design, a higher current load capacity is achieved, since no mobility in the axial direction is

possible, since the integral fit between the connecting cap and the insulating material (of the insulation) prevents this.

5 Preferably, it is provided that the interlocking part holds the layer pressed into the deformation of the insulation.

10 In this design, the device is configured such that by the interlocking part, when it causes, in the desired assembly position, a deformation of the insulation and interlockingly engages it, the additional layer that forms the conductive layer, is also taken along and pressed into the deformation of the insulation. Preferably, thus, by the interlocking part, the layer that forms the conductive layer is not severed by the interlocking part, 15 but the layer is squeezed and pressed into a recess or the like of the insulating material of the insulation formed by the interlocking part.

20 Further, it is preferably provided that the interlocking part is formed by at least one rib forming a thread turn that projects from the inner side of the sleeve casing of the connecting cap.

25 For instance, one thread turn forming a rib protruding relatively far from the sleeve casing may be sufficient. When multiple thread turns are provided, which form correspondingly protruding ribs, the ribs need not protrude so far, in order to nevertheless achieve and ensure the integral fit between the connecting cap and the insulation.

30 Preferably, it is further provided that the interlocking part has an inner diameter that is smaller than

the diameter of the insulation and larger than the diameter or the transverse dimension of the electrical conductor.

5 Preferably, in the desired assembly position, the interlocking part penetrates the insulation over part of the thickness of the insulation. In order to guarantee, in particular, for a threaded design of the interlocking part, the operation of the connecting cap for the purpose of unscrewing, an arrangement of width flats or the like is provided at the connecting cap, so that the connecting cap can be turned into the desired position by means of a suitable tool, for instance a wrench, when it is slid on the first portion of the cable formed of multiple components.

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15 In order to achieve simple handling, it is provided that the sleeve-shaped connecting cap has, in the region, axially viewed, before and/or behind the interlocking part, a diameter that is smaller than or equal to the transverse dimension or the diameter of the electrical conductor together with the insulation and together with the continuous layer, respectively, but larger than or equal to the transverse dimension or the diameter of the electrical conductor together with the insulation, respectively.

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25 Herein, during assembly, first, the electrical conductor together with the insulation and the continuous layer can be inserted into the sleeve-shaped connecting cap, before then the remaining fixing process is performed, which requires force, and by means of which the integral fit between the parts is established.

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For the same reason, it is provided that the interlocking part is formed spaced to the mouth end of the connecting cap, wherein the distance is preferably larger than the axial extension of the interlocking part or corresponds to approximately one third of the length between mouth and sleeve base of the connecting cap.

In particular, it may also be provided that the insulation is made of a hard material, preferably VPE.

Furthermore, it may be provided that the layer surrounding the insulation is made of an elastic material, preferably electrically conductive VPE or EVA.

It may also be provided that the layer is a multi-layer.

In a *per se* known manner, it is provided that the electrical conductor is surrounded by a semi-conductor layer or a semi-conductor casing, with the conductor being formed of multiple wires.

Advantageously, the insulation may be surrounded by a material with a polymeric matrix and a particulate filler material comprising zinc oxide powder, in particular doped zinc oxide varistor powder.

The conductive layer may be a layer that has a non-linear electrical behavior. It may have the following properties.

The material exhibits a strongly voltage-dependent resistance, which decreases with increasing field strength in a non-linear manner.

In the normal condition, the non-linear electrical material acts as an insulator. In the case of a lightning

strike, the material acts, in the region of the high electrical field strength, nearly as a low-ohmic electrical conductor. The thus obtained non-linear conductivity guarantees that in the case of touching or holding the
5 discharge portion with an earthed metal object, no sliding discharges will occur.

A cable termination is not needed for such a solution. Only a connection of the non-linear electrical coating to the electrical conductor and to the catching
10 device, respectively, at the earthing installation by means of the catching device is required. The effect thereof is that by the non-linearity of the casing material, the conductivity will decrease intrinsically from the high-voltage connection. Thus, a steady reduction of
15 critical field strengths is achieved.

Advantageous materials and designs that can also be used for the subject matter of the invention are indicated in the EP 1 760 855 B1 in the claims 3 to 13 thereof. All these features can also be employed for the
20 present lightning arrester device and are advantageous.

An embodiment of the invention is shown in the drawing and is described in more detail in the following.

There are:

Figure 1 an exploded view of the components of the
25 lightning arrester device;

Figure 2 a corresponding view in a different viewing direction;

Figure 3 a detail in a view analogous to Figure 1;

Figure 4 a detail viewed in a central longitudinal section.

5 In the drawing, a lightning arrester device is shown, which comprises a catching device 1 that is connected by an electrical conductor 2 to a not shown earthing installation. The electrical conductor 2 is surrounded by an insulation 4, wherein the insulation 4 is surrounded by a longitudinally continuous layer 5 made from a material that forms a conductive layer.

10 In Figures 1 to 3, the layer 5 is shown not extending to the end of the insulation 4, in order to make the arrangement of these layers clear. In practical applications, the layer 5 extends up to the end of the insulation 4.

15 At the end region of the insulation 4 facing the catching device 1 and the layer 5 surrounding said insulation, a connecting cap 6 made of an electrically conductive material, in particular metal, is arranged, by means of which the catching device 1 and the electrical
20 conductor 2 are connected to the layer 5. Also, at an end region of the insulation 4 facing an earthing installation and of the layer 5 surrounding said insulation, such a connecting cap 6 can be installed. Hereby, then, the electrical conductor 2 and the earthing installation can
25 be connected to the layer 5 surrounding the insulation 4.

The connecting cap 6 is sleeve-shaped, as can be seen in particular in Figure 2, and is applied, in the desired assembly position, with the sleeve casing to the insulation 4 and to the layer 5 surrounding said insulation.
30 The sleeve base 7 can serve as an insertion limit for the insulation 4 and for the layer 5. To the sleeve base 7

follows a blind hole 8, into which the stripped end of the conductor 2 is inserted in a contacting manner, when the cable is prepared as shown in Figures 1 to 3. In the embodiment, the connecting cap 6 includes, in the region of the blind hole 8, radial threaded bores 9' for stud bolts 9 that contact with their end extending into the blind hole 8 the stripped end of the conductor 2. The blind hole has a smaller diameter than the connecting cap 6, so that the stripped end of the conductor 2 is insert-
able in a matching manner.

Inside the sleeve casing of the connecting cap 6, at least one interlocking part 10 is integrally formed or attached in a different manner, which, in the desired assembly position, leads to an interlocking fit between connecting cap 6 and insulation 4, thereby deforming the insulation 4. Depending on how far the interlocking part 10 radially extends into the sleeve, or depending on how many such interlocking parts 10 are provided, the penetration depth of the interlocking part 10 into the insulation 4 can be more or less deep. An integral fit in a sufficient amount is in any case secured, in order to guarantee a corresponding tensile force transfer and thus also a higher current load capacity.

By the interlocking part 10, in the desired assembly position, simultaneously the layer 5 is also pressed into the deformation of the insulation 4, preferably without severing the layer 5, in order to secure the electrical function.

As is shown, for instance, in Figure 2, the interlocking part 10 may be formed by a rib forming a thread turn, said rib protruding from the inner side of the sleeve casing of the connecting cap 6. The interlocking

part 10 preferably has an inner diameter that is smaller than the diameter of the insulation 4, but larger than the diameter or the transverse dimension of the electrical conductor 2. In the embodiment, the sleeve-shaped connecting cap 6 has, in the region axially before and behind the interlocking part 10, a larger diameter that is smaller than or equal to the transverse dimension or the diameter of the electrical conductor 2 together with the insulation 4 and together with the continuous layer 5, respectively, but larger than or equal to the transverse dimension or the diameter of the electrical conductor 2 together with the insulation 4, respectively.

In these regions having a larger diameter, in particular in the mouth region, a slightly radially protruding threaded structure may be provided that is to serve for screwing the cable, together with the insulation 4 and layer 5, at the beginning of the assembly process into the connecting cap, without deformation of the insulation 4 occurring at that point of time. After this pre-assembly, then the connecting cap 6 can be screwed on with a suitable tool, which acts on the width flats 12, while overcoming the resistance formed by the interlocking part 10, thereby the layer 5 together with the insulation 4 being radially inwardly displaced by the interlocking part 10, so that an integral fit between the interlocking part 10 and the insulation 4 is achieved. In particular, the interlocking part 10 is spaced to the mouth end the connecting cap 6, with this distance preferably being larger than the axial length of the interlocking part 10 or may also correspond to approximately one third of the length between mouth and sleeve base 7 of the connecting cap 6. These dimensions are not mandatory, but may be advantageous.

The insulation 4 may be made of a hard material, for instance VPE. The layer 5 surrounding the insulation 4 is preferably made of an elastic material, for instance electrically conductive VPE or EVA.

5 It is to be noted that the layer 5 may comprise not just one single material layer, but also multiple material layers.

10 Such material layers may have different functions, for instance, an outer material layer may be UV-resistant, in order to achieve the corresponding UV-protection.

15 The electrical conductor 2, too, may be surrounded by a semi-conductor layer 11, as shown in Figures 1 to 3. In the drawing, the semi-conductor layer 11 projects beyond the insulation 4, which, however, is shown for illustration purposes only. In the normal case, the insulation 4 will terminate with the semi-conductor layer 11, viewed in an axial direction.

20 This semi-conductor layer serves as a smoothing layer that is provided for that the wires of the conductor 2 will practically behave as a solid round conductor.

The invention is not limited to the embodiment, but is described in the context of which is disclosed in the claims and the description.

25 All individual or combined features disclosed in the description and/or drawing are deemed essential to the invention.

Patent claims:

1. A lightning arrester device, consisting of a catching device (1) having an electrical conductor (2), which is connected to an earthing installation and which is
5 surrounded by an insulation (4), the insulation (4) being surrounded by a longitudinally continuous layer (5) made from a material which forms a conductive layer, wherein on the end region, facing the catching device (1), of the insulation (4) and of the layer
10 (5) surrounding said insulation, a connecting cap (6) or the like component made of an electrically conductive material, in particular metal, is positioned, by means of which the catching device (1) and/or the electrical conductor (2) is connected to the layer
15 (5), and/or on the end region facing the earthing installation of the insulation (4) and of the layer (5) surrounding the latter, a connecting cap (6) or the like component made of an electrically conductive material, in particular metal, is positioned, by means
20 of which the electrical conductor (2) and/or the earthing installation is connected to the layer (5) surrounding the insulation (4), wherein the connecting cap (6) is sleeve-shaped and is applied with the sleeve casing on the insulation (4) together with the
25 layer (5) surrounding the latter, and the sleeve base (7) thereof serves as an insertion limit for the insulation (4) together with the layer (5), wherein a blind hole (8), into which the stripped end of the conductor (2) is inserted, adjoins the sleeve base
30 (7), wherein preferably the connecting cap (6) is penetrated, in the region of the blind hole (8), in a threaded manner by stud bolts (9) that contact, with their end extending into the blind hole (8), the

stripped end of the conductor (2), characterized by that at least one interlocking part (10) is integrally formed inside the sleeve casing of the connecting cap (6) and is interlockingly connected to the insulation (4) in the desired assembly position, thereby deforming the insulation (4).

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2. The lightning arrester device of claim 1, characterized by that the interlocking part (10) holds the layer (5) pressed into the deformation of the insulation (4).

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3. The lightning arrester device of claim 1 or 2, characterized by that the interlocking part (10) is formed by at least one rib forming a thread turn, said rib projecting from the inner side of the sleeve casing of the connecting cap (6).

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4. The lightning arrester device of one of claims 1 to 3, characterized by that the interlocking part (10) has an inner diameter that is smaller than the diameter of the insulation (4) and larger than the diameter or the transverse dimension of the electrical conductor (2).

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5. The lightning arrester device of one of claims 1 to 4, characterized by that the sleeve-shaped connecting cap (6) has, in the region axially viewed before and/or behind the interlocking part (10), a diameter that is smaller than or equal to the transverse dimension or the diameter of the electrical conductor (2) together with the insulation (4) and together with the continuous layer (5), respectively, but larger than or equal to the transverse dimension or the

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diameter of the electrical conductor (2) together with the insulation (4), respectively.

- 5 6. The lightning arrester device of one of claims 1 to 5, characterized by that the interlocking part (10) is formed spaced to the mouth end of the connecting cap (6), wherein the distance is preferably larger than the axial extension of the interlocking part (10) or corresponds to approximately one third of the length between mouth and sleeve base (7) of the connecting cap (6).
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7. The lightning arrester device of one of claims 1 to 6, characterized by that the insulation (4) is made of a hard material, preferably VPE.
- 15 8. The lightning arrester device of one of claims 1 to 7, characterized by that the layer (5) surrounding the insulation (4) is made of an elastic material, preferably electrically conductive VPE or EVA.
- 20 9. The lightning arrester device of one of claims 1 to 8, characterized by that the layer (5) is a multi-layer.
- 25 10. The lightning arrester device of one of claims 1 to 9, characterized by that the electrical conductor (2) is surrounded by a semi-conductor layer (11) or a semi-conductor casing, wherein the conductor (2) is formed of multiple wires.