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(54) **VERTICAL EARTH UNIT**

(57) The construction of a vertical earth unit according to the invention allows to overcome geological obstacles effectively when driving the electrode deeply.

The vertical earth electrode unit features the main earth electrode /1 and 10/ with identical diameter along the entire length, composed of metallic, current-conducting tube or rod segments /4, 40/ joined with each other permanently, features a metallic protective coat /2 and 20/ composed of tube sections /6 and 60/, and features a chisel tip from the side of driving into the ground /3 and 30/. The tube sections /6 and 60/ of the protective coat /2 and 20/ mounted on the segments /4 and 40/ of the main earth electrode /1 and 10/ are free to each other.

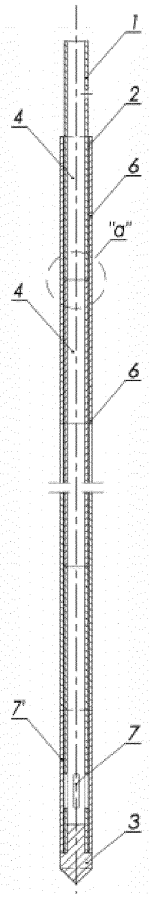

Fig.1

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Description

[0001] The subject of the invention is a vertical earth unit for use in power and telecommunications sectors.

[0002] A vertical earth electrode is a necessary element of each earthing system, where it is usually responsible for its resistance value and stability. It is executed as a working system, to ensure the correct operation of machines and devices, as a protective system, to protect people and animals in emergency conditions, and as a lightning system, to protect buildings and people and devices inside the buildings during atmospheric discharges.

[0003] Each earthing system - earthing has to ensure a resistance value required for the given purpose and the sufficient withstand current. In some places, it also has to ensure the distribution of potentials on the surface of earth during the evacuation of short-circuit currents through the system to the earth in a manner which is safe to people and animals. A resistance value level for a working system is usually several Ωs, for a protective system it is often lower, for a lightning system it is usually 8 Ω.

[0004] Earthing systems - earthing are generally constructed for several purposes at the same time. They are made of an uninsulated conductor with the sufficient withstand current, laid in the ground in parallel to its surface at the depth of between 40cm to even several metres. The conductor may form different structures starting with a single section to an expanded spatial truss. Vertical earth electrodes are terminated to and connected to the so constructed system, which makes it easier to obtain the required, stable resistance value.

[0005] A vertical earth electrode is a construction made of uninsulated elements, most often rods or tubes, joined permanently, which are vertically driven into the ground. The idea of a vertical earth electrode consists of utilising the usually better conductivity of damper, deeper soil layers, hence it is advantageous to drive it deep, especially at present, when the abrupt lowering of groundwater level is seen. By driving an earth electrode deep, its low resistance values can be reached and the distribution of potential is improved, thus reducing a possible occurrence of dangerous voltages which occur on the earth surface when short-circuit currents are discharged.

[0006] A construction of classical vertical earth electrodes usually does not allow to drive them deep due to their insufficient mechanical strength to buckling in the places of joints between segments. Tube or rod systems, joined by means of external joints, reduce this risk, however, at the same time limit the ability to go through obstacles. They increase the diameter of the earth electrode channel, i.e. the distance between the ground and the earth electrode, which causes a danger of ground glazing as a result of spark discharges. Ground glazing puts the earth electrode, thus the whole system, out of operation.

[0007] A vertical earth electrode is known from a Japanese patent description JP2011258529, made of tube segments joined through external sleeves. The first segment, from the side of driving into the ground, is ended with a chisel tip and has openings for application of a chemical substance.

[0008] A vertical earth electrode is known from a Polish patent description PL406880, which consists of a segmented main earthing system made of steel rod sections connected with each other with steel sleeves. The main segmented earthing system, from the side of driving into the ground, is ended with a steel chisel tip, and from the other side, from the place of connection with an earthing system of a given object towards the chisel tip, is supplied with an outer sheath insulating electrically. The insulation of a conductive part of the segmented earth electrode is to eliminate areas of short-circuit current discharges which are unfavourable for voltage safety.

[0009] The aim of the solution according to the invention is to create a construction of a vertical earth unit which allows to drive its elements deep into the ground or to drive them at a chosen angle.

[0010] The essence of the vertical earth unit, which features the main earth electrode with identical diameter along the entire length, composed of metallic current-conducting tube or rod segments joined with each other permanently, of which one is joined permanently with a chisel tip and has a metallic protective coat composed of tube sections, is characterised by the fact that the main earth electrode composed of tube or rod segments is freely located in a protective coat, and the tube sections of the protective coat mounted on the segments of the main earth electrode are free to each other, whereas the connection points of the main earth electrode segments are shifted in relation to the connection points of tube sections of the protective coat.

[0011] Preferably when the tube sections of the protective coat are mounted on the segments of the main earth electrode in a sliding manner.

[0012] Preferably when the tube sections of the protective coat are mounted on the segments of the main earth electrode in a loose manner.

[0013] Preferably when the first segment of the main earth electrode and the first tube section of the protective coat, situated from the chisel tip side, are supplied with openings through which a chemical solution flows out.

[0014] Preferably, the unit's chisel tip is joined permanently with a segment of the main earth electrode.

[0015] Preferably, the unit's chisel tip is joined permanently with a tube section of the protective coat.

[0016] It is also preferable when the unit chisel tip is freely joined with the main earth electrode and with the protective coat.

[0017] Preferably, in the case where the tube sections of the protective coat are mounted on the segments of the main earth electrode in a loose manner, when at least one segment of the main earth electrode and at least one tube section of the protective coat are supplied with openings through which a chemical solution flows out.

[0018] The construction of the vertical earth electrode unit according to the invention allows to effectively over-

come geological obstacles when driving the electrode deep. It is important because the deeper ground layers are usually permanently damper, hence have better, stable conductivity, favourable for the resistance value and earthing quality. An earth electrode driven deep, as compared to an earth electrode with the same resistance value driven shallow, ensures in a simplest and cheapest way the distribution of potentials on the earth surface safer for people and animals. On the other hand, an earth electrode driven at a chosen angle is more effective and significantly reduces the level of danger with low overall construction costs.

[0019] Geological obstacles can be effectively overcome by the unit due to the way of transferring energy to the chisel tip, where energy, in the form of tool strokes, is transmitted to the chisel tip always also as strokes, with a small loss of effective energy, smaller if the chisel tip is temporarily blocked by an obstacle. This is caused by the fact that the main earth electrode is independent in terms of movement from the protective coat and because the tube sections on the main earth electrode segments are mounted freely between each other.

[0020] The tube sections of the protective coat, mounted in a sliding or loose manner on the main earth electrode, serve to transmit the tool energy, through their successive impacts, and the main earth electrode acts as a guide. Such a construction, with forces being advantageously distributed along the perimeter of the subsequently colliding tube sections, is minimising energy losses and prevents the unit's buckling consequently leading to earth electrode damage. The vertical earth unit, in which the tube sections of the protective coat are mounted on the segments of the main earth electrode in a loose manner, enables it to be driven into the ground at an angle, which effectively and very significantly improves the distribution of potentials on the earth surface when the current is discharged by the earth electrode.

[0021] The unit construction, i.e. a protective coat being freely mounted on the main earth electrode, and the way of transmitting energy as strokes, allows to use the inertia of the main earth electrode to improve the unit being driven effectively.

[0022] The unit construction according to the invention is reducing possible mechanical damages of the earth electrode coating covered with zinc or copper, being the source of fast electrochemical corrosion.

[0023] The subject of the invention is shown with its exemplary execution in the figure, where in fig. **1** a vertical earth unit is shown schematically in the longitudinal section - with the protective coat mounted in a sliding manner on the main earth electrode, fig. **2** - the unit joint detail from fig. 1, fig. **3** - the unit in longitudinal section - with the protective coat mounted in a loose manner on the main earth electrode -, fig. 4 - the unit joint detail from fig. 3, and fig. **5** - the unit in the longitudinal section - with two protective coats.

[0024] The vertical earth unit according to Fig.1 forms the main electrode 1 with the same diameter along the whole length, located in a sliding manner in the protective coat 2 and the chisel tip 3, making it easier to drive the earth electrode in the ground. The main earth electrode consists of metallic tube segments 4, joined permanently with threaded sleeves 5, as shown in Fig.2. The protective coat 2, with the main earth electrode 1 provided inside, consists of tube sections 6, which are joined freely. The connection points of the tube sections 4 of the main earth electrode 1 are shifted in relation to the connection points of the tube sections 6 to increase construction stiffness to counteract the buckling effect. The chisel tip 3 of the unit is freely joined with the main earth electrode 1 and with the protective coat 2, which enables to drive the earth electrode into very hard ground, because the increased number of degrees of freedom of the earth electrode construction elements increases the impact energy of the acting chisel tip. To improve ground conductivity in the place where the earth electrode is driven, the first segment of the main earth electrode 1 and the first tube section 6 of the protective coat 2, situated from the chisel tip 3 side, are supplied with openings 7 and 7' through which a chemical solution flows out.

[0025] Fig.3 presents another vertical earth electrode unit formed by the main earth electrode 10 with the identical diameter along the entire length, located in a loose manner in the protective coat 20 and the chisel tip 30, making it easier to drive the earth electrode into the ground. The main earth electrode 10 loosely located in the protective coat 20 enables to drive the unit into the ground at an angle, of preferably of 20-70°. The main earth electrode 10 consists of metallic tube segments 40, joined permanently through threaded sleeves 50, as shown in Fig.4. The protective coat 20, with the main earth electrode 10 provided inside, consists of tube sections 60, which are joined freely. The connection points of the tube sections 4 of the main earth electrode 10 are shifted in relation to the connection points of the tube sections 60 to increase construction stiffness, and hence to counteract the buckling effect. The chisel tip 3 of the unit is freely joined with the main earth electrode 10 and with the protective coat 20, which enables to drive the earth electrode into very hard ground, because the increased number of degrees of freedom of the earth electrode construction elements increases the impact energy of the acting chisel tip.

[0026] Fig.5 presents another vertical earth unit, formed by the main earth electrode 15 located in a loose manner in the metallic protective coat 16, and then located freely in the second protective coat 17.

[0027] The main earth electrode 15 consists of metallic tube segments joined permanently through threaded sleeves as shown in the previous examples of execution. The protective coats 16 and 17 consist of tube sections which, in the unit construction, are freely interconnected, as in the previous examples of execution.

[0028] The chisel tip 19 of the unit is freely joined with the main earth electrode 15 and with two protective coats 16 and 17, which enables to drive the earth electrode

into very hard ground, because the increased number of degrees of freedom of the earth electrode construction elements increases the impact energy of the acting chisel tip 19.

Claims

1. A vertical earth unit incorporating the main earth electrode with identical diameter along the entire length, composed of metallic current-conducting tube or rod segments joined with each other permanently, features a metallic protective coat composed of tube sections, and features a chisel tip from the side of driving into ground, **characterized in that** the main earth electrode /1 and 10/ composed of tube or rod segments /4,40/ is located in the protective coat /2 and 20/ in a free manner, and the tube sections /6 and 60/ of the protective coat /2 and 20/ mounted on the segments /4 and 40/ of the main earth electrode /1 and 10/ are free between each other, whereas the connection points of the segments /4 and 40/ of the main earth electrode /1 and 10/ are shifted in relation to the connection points of the tube sections /6 and 60/ and the protective coat /2 and 20/.

2. A vertical earth unit according to claim 1, **characterized in that** the tube sections /6 and 60/ of the protective coat /2 and 20/ are mounted on the segments /4 and 40/ of the main earth electrode /1 and 10/ in a sliding manner.

3. A vertical earth unit according to claim 1, **characterized in that** the tube sections /6 and 60/ of the protective coat /2 and 20/ are mounted on the segments /4 and 40/ of the main earth electrode /1 and 10/ in a loose manner.

4. A vertical earth unit according to claim 1, **characterized in that** the first segment /4 and 40/ of the main earth electrode /1 and 10/ and the first tube section /4 and 40/ of the protective coat /2 and 20/, situated from the chisel tip side /3 and 30/, are provided with openings /7,70,7' and 70'/ through which a chemical solution flows out.

5. A vertical earth unit according to claim 1, **characterized in that** the chisel tip /3 and 30/ of the unit is joined permanently with the segment /4 and 40/ of the main earth electrode /1 and 10/.

6. A vertical earth unit according to claim 1, **characterized in that** the chisel tip /3 and 30/ of the unit is joined permanently with the tube section /6 and 40/ of the protective coat /2 and 20/.

7. A vertical earth unit according to claim 1, **characterized in that** the chisel tip /3 and 30/ of the unit is joined freely with the main earth electrode /1 and 10/ and with the protective coat /2 and 20/.

8. A vertical earth unit according to claim 3, **characterized in that** at least one segment /4 and 40/ of the main earth electrode /1 and 10/ and at least one tube section /6 and 60/ of the protective coat /2 and 20/, is provided with openings /7,70,7' and 70'/ through which a chemical solution flows out.

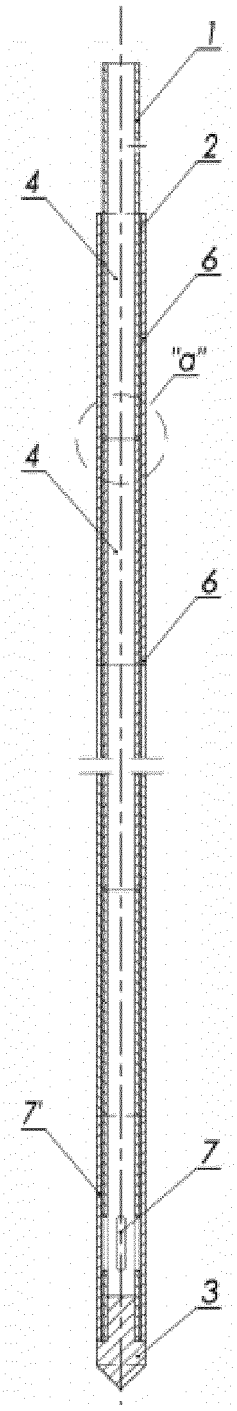

Fig.1

detail "a"

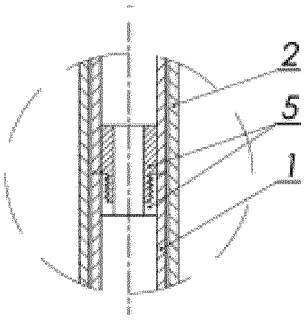

Fig.2

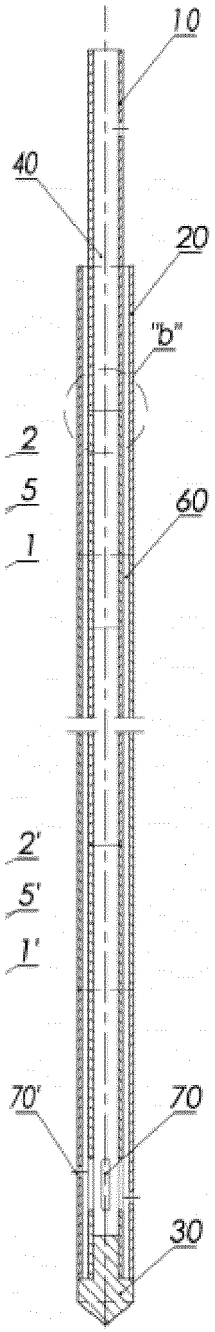

Fig.3

detail "b"

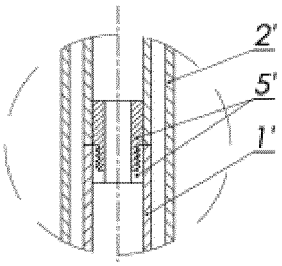

Fig.4

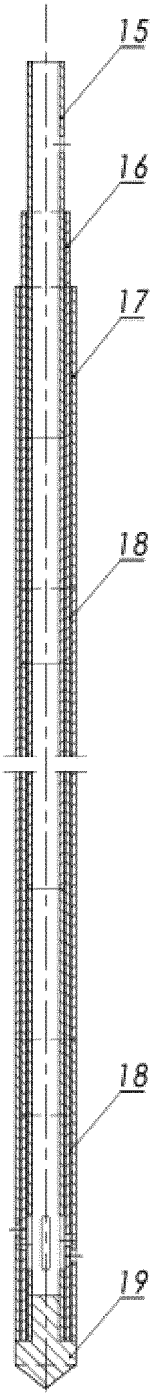

Fig.5

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EUROPEAN SEARCH REPORT

Application Number
EP 18 16 3442

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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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
The Hague	4 July 2018	Kandyla, Maria

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04-07-2018

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