APPARATUS FOR LIGHTNING PROTECTION WITH SPRING-TYPE ELECTRODES AND AN ELECTRIC POWER LINE PROVIDED WITH SUCH AN APPARATUS

Technical field

The present invention relates to apparatuses for lightning protection of electrical equipment and supporting structures. The invention can be used for protection of, for example, high-voltage apparatuses, insulators and other elements of high-voltage electric power lines, electrical equipment and other constructions and devices requiring lightning protection.

Prior art

The patent RU2299508 discloses a current-shunting apparatus for lightning protection of electrical equipment or electric power line elements. The apparatus comprises an insulating body made of a solid dielectric, at least two main electrodes mechanically coupled with the insulating body, a rod-shaped electrode set inside the insulating body along its axis and electrically connected to one of the main electrodes, and several intermediate electrodes set on the insulating body between the main electrodes with a mutual displacement along at least a longitudinal axis of the insulating body.

The said patent has an assumption that the intermediate electrodes are made as rings allowing to be put on the insulating body having preferably a circular section. Such intermediate electrodes are sufficiently easily set on the insulating body, for example, by putting the rings on the said body. At the same time a disadvantage of this intermediate electrode's type is that fastening of the rings on the insulating body requires additional actions such as, for example, a ring crimping.

Another variant of the intermediate electrode is a clamp which could be substantially easily fixated on the insulating body in a prescribed position, however clamp usage stipulates for increased labor expenditures for their arrangement along with increased complexity of the intermediate electrode resulting in increased cost.

Summary of the invention

EmbodimentsAn object of the present invention seekis to provide a simple structure of the intermediate electrode having low manufacturing and operating costs and providing reliable fixation of the intermediate electrode on the insulating body without additional actions.

According to an aspectThe object of the present invention, there is providedis solved by an apparatus for lightning protection of electrical equipment or electric power line elements. The apparatus

comprises an insulating body made of a dielectric, at least two main electrodes mechanically coupled with the insulating body, a rod-shaped electrode set inside the insulating body along its axis and electrically connected to one of the main electrodes, and two or more intermediate electrodes set on the insulating body between the main electrodes with mutual displacement along at least a longitudinal axis of the insulating body. ~~The present invention is~~ characterized in that at least part of the intermediate electrodes is made as wire springs settable on the insulating body. An inner size of the springs is advantageously smaller than an outer size of the insulating body. In this case the inner size of the spring is determined when the spring is unstrained.

In an embodiment of the present invention at least one intermediate electrode made as the wire spring comprises at least two projections formed by ends of the wire used for the spring fabrication, wherein a length of each projection is less than a distance between an end plane of the spring and an adjacent intermediate electrode. The springs are considered to be wound (coil), wherein wire material is chosen or treated in such a way that the spring being strained takes or tend to take a shape of the spring before deformation.

The said projections are preferably disposed at opposite end sides of the spring and advantageously mutually displaced along its circumference at least at 90°. The mutual displacement of the projections along the spring circumference is optimally equal to 180°.

A surface of each intermediate electrode excluding the projections or end surfaces of the wire used for the spring manufacturing can be covered with insulation layer.

In one of the embodiments the insulating body is made of a solid dielectric. The insulating body and the rod-shaped electrode preferably have a circular cross-section.

~~The object~~ According to another aspect of the present invention, ~~is solved by~~ there is provided an electric power line as well. The electric power line comprises towers provided with insulators, at least one current-carrying wire coupled with the insulators by fastening devices and at least one apparatus for lightning protection of electric power line elements. At least one main electrode of the said apparatus connected to the protected element directly or via spark gap, and at least one other main electrode connected to ground directly or via spark gap. ~~The present invention is~~ characterized in that the apparatus for lightning protection is made as the apparatus according to the above mentioned variants.

A technical result of the embodiments of the present invention is providing the simple structure of the intermediate electrode having low manufacturing and operating costs and providing reliable fixation of the intermediate electrode on the insulating body without any additional actions. This results in increased reliability and the simplified structure of the lightning

stroke protecting means. Embodiments of tThe present invention provides with the electric power line having reliable lightning protection due to the fact that the line is equipped with the reliable and low-cost apparatuses for lightning protection operable at low discharge voltage.

Brief description of drawings

Fig. 1 schematically shows the apparatus according to the invention.

Fig. 2 shows the intermediate electrode according to the invention.

Fig. 3 shows the preferable embodiment of the intermediate electrode according to the invention.

Best mode for carrying out the invention

Fig. 1 partly shows a 10 kV electric power line lightning-proofed with use of the lightning protection apparatus according to the invention. In this embodiment the lightning protection apparatus is made as a cable segment having an insulation forming the insulating body 1 and a metallic strand used as the rod-shaped electrode 6. A metallic tube used as the second main electrode 2 is set in the middle part of the cable segment over the insulating body 1 and end terminals of the cable are used as the first main electrodes 2. Ends of the cable strand (i.e. the rod-shaped electrode 6) are fastened to a wire 4 of the electric power line by means of clamps. The second main electrode 3 is fastened to an insulator set at the tower 13 of the electric power line by means of a bracket and a wire. An electrode 14 forming a spark gap with the second main electrode 3 (a length of the gap is 2 cm for the 10 kV electric power line) is set at the tower 13 as well. Metallic springs forming the intermediate electrodes 5 are set on the cable segment.

When the wire 4 of the electric power line is loaded with overvoltage, an electric potential of the cable strand (i.e. the rod-shaped electrode 6) connected to the wire 4 becomes high via the end terminals. Due to strong capacitive coupling of the rod-shaped electrode 6 and the metallic tube, an electric potential of this tube becomes high as well. An electric potential of the tower 13 of the electric power line and the electrode 14 connected to it is equal to zero since the tower 13 is grounded. A potential difference (high voltage) arises between the second main electrode 3 (the metallic tube) and the electrode 14 and the air spark gap is disrupted under the influence of the potential difference. After that the overvoltage is applied between the cable strand and the second main electrode 3. Under the influence of this overvoltage, channels of creeping discharge run on a cable surface in one or both directions depending on an overvoltage value and sequentially arc over gaps between the springs, i.e. between the intermediate electrodes 5. Once the overvoltage passed, a follow current of industrial frequency flows through the channels,