

# A New Design for Ground Rod with Anti-Maloperation and Lighting Systems

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**Abstract.** In this paper, the common hidden perils of conventional ground rod used in power system are introduced. To conquer these problems, a new ground rod with anti-maloperation and lighting systems was developed. This new ground rod combines the anti-maloperation function and lighting function, provides real-time alarm, enables the operator to operate the equipments correctly, and thus greatly avoids the maloperation and has broad application prospect.

## Introduction

According to GB 26860-2011 [1], installing ground wire strictly pursuant to regulations is a very important and necessary measure to ensure the safety of people and equipments. At present in our country, the grounding mode in power maintenance engineering still lags behind, the technique of ground rod is poor and the risks of maloperation are high. Thereby, it is necessary to re-design the ground rod to add more functionality and improve its safety level, and thus make qualitative leaps.

## Common hidden perils of conventional ground rod

The ground rod is a safety tool to make de-energized equipments grounding, with the utility of preventing the human body from the damage of sudden energization and the induced voltage caused by nearby high voltage running equipments, and dissipating the residual charge from the devices [2]. However, ground rod may also induce two serious hidden perils of maloperation: installing ground wire with live equipments and transmitting power with ground wire installed.

The common hidden perils in the actual practices of power system include: (1) During the operation at night, a operator may hold a ground rod and a guardian holds a flashlight for lighting. It is hard for operator to see clearly the details of equipment, and thus it is a waste of time and not safe. (2) Before grounding, operator forgets to inspect electricity, causing accidents. (3) During the installing of ground wire or after the inspection of electricity by ground rod, many cases may induce sudden energization to bring accidents, such as backward power supply by users, induced electricity, moving wrong space and so on. (4) The lack of five-protection locks in the devices of high voltage line, the damage of five-protection systems in substation and the complicated working environment may also cause the accidents of transmitting power with the ground wire still installed.

To conquer the above hidden perils of ground rod, some new designs or improvements have been developed [3-5]. However, it is no end for innovation. To develop a ground rod with anti-maloperation system, lighting system may be also a good way.

## **Details of the ground rod with anti-maloperation and lighting systems**

To solve the above hidden perils, after a comprehensive investigation, a ground rod with anti-maloperation and lighting systems has been developed, as shown in the Figure 1. This ground rod consists of two parts: a rod and a working head. A flashlight with warning function is installed on the end of the rod, providing illumination for the operator as working at night or in the dark environment. An electrostatic sensor is installed in the rod and connected to the warning flashlight and a buzzer, for the purpose of detecting whether the devices nearby are electriferous. A layer of reflective coating is around the rod, to remind operator dismantling ground rod. The working head is fixed at the end of the rod and has a grounding pothook on it for installing or dismantling ground wire.

A remote control is also equipped to the ground rod to control the warning flashlight and buzzer. The remote control sends signals through coding methods to avoid the interference between each other and has working voltage of 2.7~6.0V and working frequency of 315MHz.

The electrical system of this ground rod (as shown in Figure 2) includes the following parts: a control panel, an electrostatic sensor, a warning flashlight, a buzzer and a recharger. The control panel with working voltage of 2.5~5.5V, quiescent current of 200uA, amplitude modulation (On-Off Keying, OOK), operating temperature of -10oC~+70oC, receiving sensitivity of -95DBm and operating frequency of 315MHz, connects directly to the electrostatic sensor, warning flashlight, buzzer and recharger. The recharger can supply power to electrostatic sensor, warning flashlight, buzzer.

## **Characteristics of the ground rod with anti-maloperation and lighting systems**

The major characteristic of this new ground rod is the combination of anti-maloperation system and lighting system. The lighting system can not only provide illumination but also send alarm signals when the electrostatic sensor detects the energized equipments to remind operator dismantling ground wire, so as to reduce the possibility of maloperation and accidents.

## **Instructions and use of the ground rod with anti-maloperation and lighting systems**

This ground rod is very easy to operate. In practices, the working head is fixed at the end of the rod by bolt and the bolt is connected to ground wire, so when the working head is near the equipments, operator can install or dismantle the ground wire very easily.

Meanwhile, during the grounding operation, if the ground rod is near the energized equipment, the electrostatic sensor can detect it, the warning flashlight will flicker and the buzzer will buzzing, so as to inspect whether the equipments are electriferous. By the ground rod, the inspection of electricity and grounding can be carried out simultaneously, and thus protecting the safety of people and equipments from serious maloperation.

At night or in the dark environment, the lighting system equipped on the ground rod can be used as a light source. By using the lighting system, operator can install or dismantle ground wire easily. In addition, the reflective coating around the rod can help operator to find the ground rod more easily.

Moreover, the power switch, self-checking switch and lighting switch on the rod can help operator control the ground rod in real time: the power switch can control the power of batteries; the self-checking switch can inspect the working condition of warning flashlight and buzzer; and the lighting switch can control the warning flashlight.

In addition, the ground rod is also equipped with a remote control with lighting switch and buzzer control switch on it, helping operator to control the ground rod remotely. The lighting switch on the remote control can help operator control the lighting system on the ground rod if needed. And during the dismantling of safety facilities, turning on the buzzer control switch can make buzzer buzzing all the time and thus remind operator not to forget to dismantle ground wire.

## Conclusions

This new ground rod combines the anti-maloperation system and lighting system, conquers the common hidden perils of conventional ground rod, improves the safety of operation at night or in the dark environment, and prevent serious maloperation, such as installing ground wire with live equipments and transmitting power with ground wire installed. Meanwhile, the integrated design of electricity inspection function, lighting function and warning function make operator more easier to control the ground rod. This new designed ground rod can not only save operation time, improve efficiency, but also improve safety factor notably , and thus has high practical value and significance of generalization.

## Reference

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## Figures

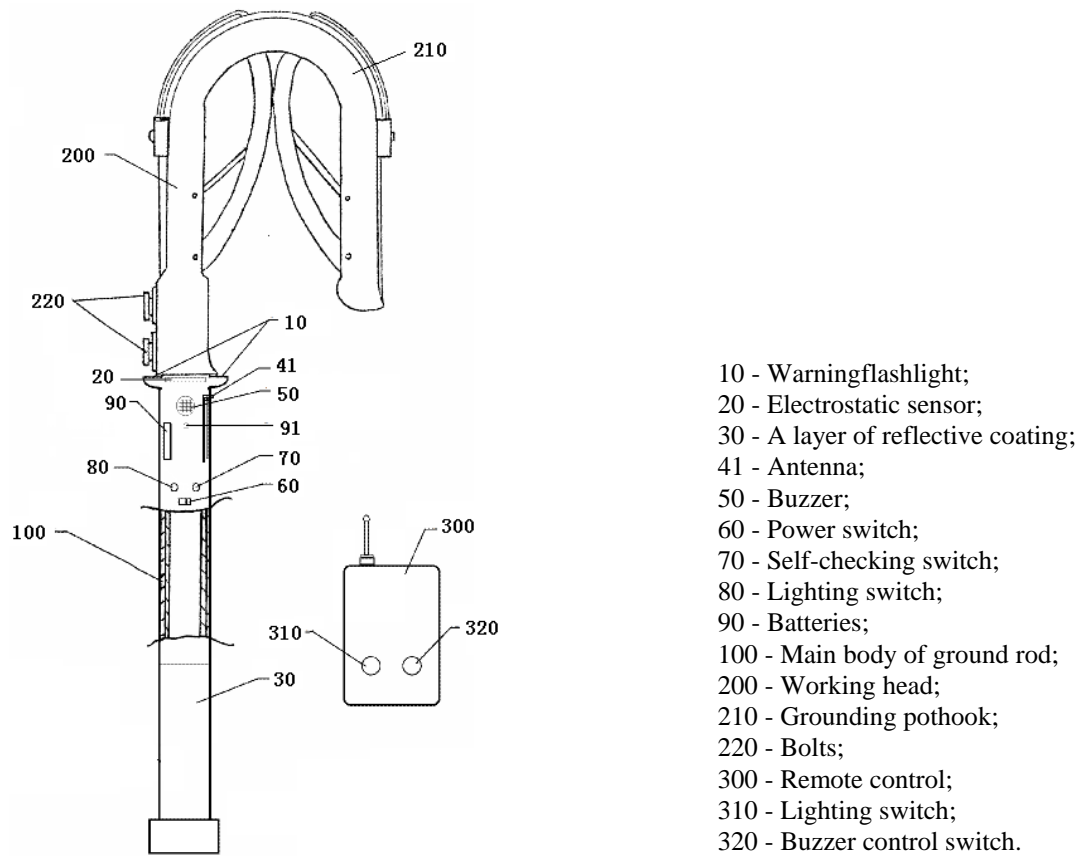


Figure 1 Details of ground rod with anti-maloperation and lighting systems

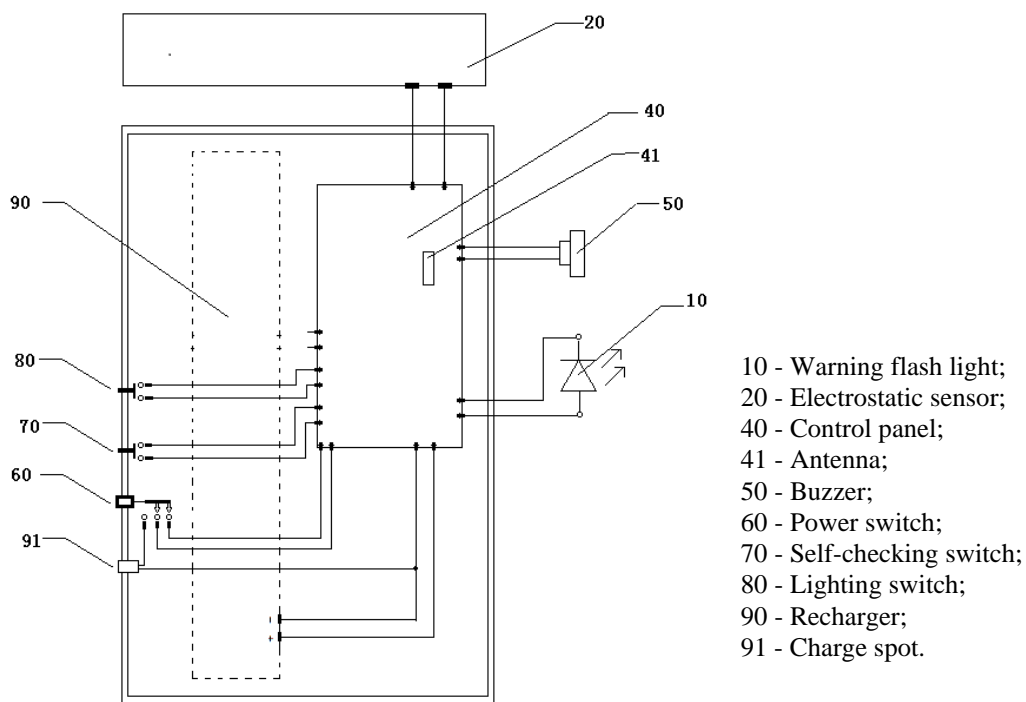


Figure 2 Schematic diagram of ground rod with anti-maloperation and lighting systems