Research on Improvement of Grounding Wire for Outdoor Line Hook

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Abstract. The grounding rod is used as a temporary grounding wire. It is an indispensable safety tool for electrical work. It is easy to carry and can be used flexibly in the field, so it is also called a portable grounding wire. Hanging the grounding wire is a safety barrier for the maintenance personnel to prevent sudden calls from harming the human body. However, in actual work, the grounding wire is frequently used and the operation seems to be simple, which makes people feel paralyzed, and its importance is often neglected. Incorrect use often occurs, which reduces or even sometimes loses the safety of the grounding wire. Role, so must pay enough attention.

1. Introduction
The grounding wire is an important technical measure for the power failure maintenance and repair operation of the transmission line, and is an important guarantee for ensuring the safety of the operators. The State Grid Corporation's Safety Working Regulations (Line Part) stipulates that the grounding wire must be installed at both ends of the working section before the power outage operation. In order to improve the efficiency of grounding line installation and reduce the labor intensity of workers, it is necessary to improve the existing grounding line device. The grounding rod is used as a temporary grounding wire. It is an indispensable safety tool for electrical work. It is easy to carry and can be used flexibly in the field, so it is also called a portable grounding wire. Hanging the grounding wire is a safety barrier for the maintenance personnel to prevent sudden calls from harming the human body. However, in actual work, because the grounding wire is frequently used and the operation seems to be simple, it is easy to cause people to have paralysis thoughts, and its importance is often overlooked. Incorrect use often occurs, which reduces or even sometimes loses the safety of the grounding wire. Protection must be given enough attention.

Hanging the grounding wire is an important electrical safety technical measure, and its operation process should meet the requirements of technical specifications, and it is not reasonable. Hanging the grounding wire is a safety precaution used after a power outage. If the grounding wire is not used or used incorrectly, the probability of an accident is often increased. Therefore, it is necessary to correctly use the grounding wire, regulate the behavior of hanging and removing the grounding wire, and consciously cultivate a rigorous safety work style and improve its own safety quality to avoid electrical accidents caused by the grounding wire.
At present, there are still some defects in the feasibility, convenience and efficiency of the manual grounding line device. The team installed the electromagnet inside the connector by changing the connection between the hand-held lever and the hook into the shape of the bell mouth, and controlled the connection and disengagement of the hook by controlling the on/off of the electromagnet. At the same time, the slot on the connecting member can effectively ensure the connection between the hook and the connecting member, providing a double guarantee, improving safety, feasibility, convenience and efficiency, and more effectively protecting the safety of the operator. At the same time, in order to improve the simplicity of the device, a cord reel is installed at the handle.

2. The device design

Hanging ground wire auxiliary deviceⅠ: As shown in the figure, the outdoor line hook grounding wire improvement device is mainly composed of five parts. The first part is a hook for hooking the grounding wire. The hook is shaped like a hook, but differently, it adds two in the middle part. The curved connecting portion of the increased strength also allows the wire to be clamped in the middle of the two wires, and the second portion is the connecting member for connecting the hook and the rod to ensure good fixing, which looks like a horn the bell mouth is upwards and supports the upper hook. The third part is the connecting rod. The connecting rod needs sufficient length to ensure sufficient length for hooking, and special material is used to ensure the hardness and strength of the rod. To avoid the breakage and bending of the rod, the fourth part is the rod and reel device. The reel is mainly to prevent dangerous accidents caused by the winding of the electric wire. At the same time, the requirement for the line is also sufficient strength and hardness. The fifth part is electromagnetic Iron device. The electromagnet is magnetic and controls whether it is connected or disconnected by switching on and off. The main function of the whole is to connect the grounding wire hook to the rod by means of the connecting piece, and to ensure the hook by controlling the on/off of the electromagnet. Connect and detach. At the same time, the slot on the connecting member can effectively ensure the connection between the hook and the connecting member, thereby playing the role of smoothly connecting the grounding wire. The reel installed at the handle ensures that the leads on the electromagnet are correct and prevents accidents due to wire entanglement.

![Figure 1. 3D illustration of the hook grounding device](image)
2.1. Connector
The top icon in Figure 3 is the slot that is hooked to the hook to ensure that the hook can be connected with the rod; the second icon is the lead hole of the traction electromagnet, which is used with the reel on the handle; the icon three is the fixed rod and the threaded hole of the connecting piece is used by the three functions and can be easily connected to the grounding wire. The part shown by the red line in Figure 4 is the connection hook grounding wire. The connecting piece with the rod is in the form of a combination of a cylinder and a round table, and the connecting port like the round table can effectively carry out the grounding line precision docking.

2.2. Electromagnet

| Table 1. Electromagnet parameters |
|----------------------------------|
| **Electromagnet**               |
| Name: DC disk electromagnet     |
| Model: KL-P series              |
| Rated voltage: DC24V            |
| Suction: 100N                   |
| Frequency: 50/60HZ              |
| Power: 3W                       |
2.3. The use of the connection key and the electromagnet
In Figure 6, the electromagnet and the connector mounting screws are mated, and the holes are used in conjunction with the electromagnet leads. This combination greatly simplifies the complexity of the machine, saves materials, and can be quickly replenished if damaged.

![Figure 5. 3D illustration of the electromagnet](image)

![Figure 6. Electromagnet installation diagram](image)

2.4. The reel: The addition of a reel at the end of the rod facilitates manual operation, and its function is to pull the wires of the electromagnet, making the operation safer and more convenient.

![Figure 7. Reel](image)

2.5. Advantage analysis
(1) The design idea is clear and simple, so that the operator can obviously improve the efficiency in the actual operation, and can ensure his personal safety;
(2) The application of the electromagnet can ensure the separation of the hook and the rod during the actual operation process, so as to ensure that the operator can complete the task within a certain time;
(3) The use of the connector and the electromagnet makes the hooking process simpler and provides a double guarantee;
(4) The original intention of complying with the innovative project of auxiliary artificial grounding. Hanging grounding line auxiliary device II: We have gone through three research stages for this kind of hanging grounding line auxiliary device. We have designed the basic grounding wire hooking robot, the high-profile grounding wire hooking robot and the vertical hook grounding robot. We have added some new ones in each type. The idea and design, research on the actual operating habits and the direction of demand, and finally determine the three versions, these three types will be displayed in the following pictures, and first we will introduce the basic version.
1. The basic version (Figure 8): The basic version of the normal hook robot is used with the angle adjustment device. It can also be used with a separate remote control or with an electric telescopic unit.

![Figure 8. Ordinary hook](image)

The open state of the manipulator is as shown in the following Figure 9. The manipulator clamps the grounding wire hook from both sides, and the motor drives the lead screw. The robot is equipped with a battery and a remote control receiving device, which can control the tension of the two hand claws of the manipulator by the remote end. The robot has a full opening distance of 250mm and is clamped by clamping from the sides to the middle. It is convenient to quickly and correctly align the grounding wire when hooking. This design does not change the structure of the grounding hook, but changes the insulation. The connection of the rod to the grounding hook thus ensures the reliability of the grounding. The lower end of the manipulator is connected with the insulating rod, and the plum-nut nut is used to lock the holding structure, which is convenient for quick release and quick loading.

![Figure 9. After Opening](image)

2. High version (Figure 10): The high-profile version of the grounding wire auxiliary device has two motors, one for clamping and the other for hooking, also for angle adjustment. The equipment for
the remote control and the electric expansion unit is the same as the basic version. The robot has four forks to form a bevel, so that when the wire is hung, the wire is found and the hook is found when the hook is taken. The robot has two motors, one for clamping the hook and the other for performing the hanging and picking operations. When the action is taken, the quadrant fork has caught the wire, and the wire is used as a point of application, so that the problem of wire chattering can be reduced. This robot also works with the angle adjustment device to adjust the angle appropriately.

Figure 10. Ordinary robot high version

3. Vertical hook manipulator (Figure 11): The vertical hook manipulator should be used with the modified hook. As shown in Figure 11, the robot consists of two motors, one for clamping the vertical hook and the other for passing an end chuck, which outputs a rotating power to clamp the hook. This robot is specially designed to solve the vertical hanging line. The problem, no need to adjust the angle, vertical hook we also carried out an overall redesign, in the material can use aviation aluminum 6061, sandblasting the surface, which is not only cheaper to manufacture, but also less difficult and good The problem of manufacturing precision of the hook chute thread is solved, and the problem of the hook and the robot is well solved, and the subsequent large-scale ordering is more convenient.

For the vertical hooks shown in Figure 12, we plan to design 12 different hooks to be used according to the actual situation.

Figure 11. Vertical manipulator  Figure 12. Vertical hook

4. Electric expansion unit (Figure 13, Figure 14, and Figure 15): The electric telescopic unit is shown in the figure below. The whole is composed of three 2m long insulated rods. The 2m rod is used here to ensure a longer electric extension distance. The middle rod can be driven by the motor to extend the maximum extension length. 1.5 meters, the whole unit contains the midpoint bracket, tail weight, control handle, lead screw, power supply and control box, etc. The extended state is as shown in the figure below. Considering the full extension, the overall still needs to maintain a good steel. Sex, so it retains the 500mm lap distance, the maximum extension distance is 1.5 meters.
5. Angle adjustment device: As shown in Figure 16 below, the manipulator can rotate along the axis of the two plum nuts. After the angle is manually fixed, the plum nut locks. After locking, the clips on the contact end face will be stuck to prevent deformation.

6. Car: The car is as shown in Figure 17 below. It can be deformed. When the handrail is vertical, it is used to transport work tools. When the handrail is deformed, it can be connected with the bracket to make the insulating rod as a fulcrum. The entire armrest is deformed into a crank slider mechanism, and the four links form a stable bracket to provide a reliable fulcrum for operation. The deformation of the handrail of the trolley is not only simple but also quick, and it is very convenient to connect with the bracket.
3. Conclusion

The connection diagram is represented by the mind map below, which includes the various small sections described above, as well as the overall connection effect and the effect of assembling the box. In the daily maintenance work of transmission lines, the grounding wire is often encountered. With the continuous upgrading of UHV technology, the length and weight of the insulated operating rods required to hang the grounding wire must be increased accordingly, which will result in the need. The auxiliary device, the operator secures the grounding end of the ground wire with the pole and then props up the operating rod, and then adjusts the length of the operating rod. If the strength of the auxiliary device is not high enough, the bending and swaying of the operating rod is increased, and the difficulty of the hanging is difficult. Increase, the operator needs to operate several times to successfully complete the hang of the grounding wire, which seriously affects the operation efficiency and prolongs the time of power failure maintenance. This innovation is aimed at the auxiliary grounding line auxiliary device of China's power system, and through the remanufacturing and the original foundation transformation to improve the safety performance and efficiency of the device, it is hoped that workers can work safer and more securely. More convenient and faster.
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