A portable cable head insulating rubber cap

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Abstract. The importance of safety, efficiency and economy in the production of power systems is increasing. However, in the daily work, the traditional insulating tape which is used to insulate the bare wires has the problems of low safety, poor efficiency and serious waste. To this end, a portable cable head insulating rubber cap is proposed. The advantages of the new insulating rubber cap are remarkable. It is easy to install and disassemble and can be reused. It effectively solves the problems of safety, efficiency and economy in the past working methods. It is of great significance to ensure safe production and improve the quality of work.

1. Introduction
In the power system work, it is often necessary to insulate the exposed wires to prevent accidents such as electric shock and short circuit. For example, in the relay protection test and debugging, it is often necessary to remove the wiring of the rear terminal block of the screen (cabinet). In most cases, the terminal is energized, so insulation is required to prevent mis-touching or short-circuiting. [1] The usual practice is to wrap the terminal with insulating tape, but since the insulating tape is a consumable item, the number of terminals required for each package is large, which wastes the cost of the insulating tape. At the same time, the packaging and dismantling of the insulating tape consume a lot of time, resulting in a decrease in work efficiency. In terms of safety, the adhesive tape is more viscous. When the insulation is removed, it is very difficult to remove the insulating tape, which is easy to damage the cable and mis-touch the live part. [2-3]

Therefore, in view of the above-mentioned deficiencies, it is urgent to provide a new type of cable terminal insulation treatment tool which is simple in structure, convenient to use, reliable, safe and reusable.

2. Experimental data analysis of insulation treatment using traditional insulating tape
In order to better understand the current situation of using bare insulating cable insulation treatment with traditional insulating tape, and to facilitate data analysis, this paper has carried out experiments on the use of traditional insulating tape. The experimenters consisted of first-line workers with different work experience. Each person uses a traditional insulating tape to perform 100 experiments.

The experimental data are as follows: Table 1 shows the data of traditional insulating tape.
Table 1 Experimental data of traditional insulating tape

| Number | Name | Experience (year) | Total number of times | Insulation packaging, disassembly time (min) | Average time (min) | Number of errors | Average number of errors | Error rate | Average error rate |
|--------|------|-------------------|-----------------------|-----------------------------------------------|-------------------|------------------|------------------------|------------|-------------------|
| 1      | A    | 9                 | 100                   | 20                                            | 25.5              | 5                | 7.83                   | 5%         | 7.83%             |
| 2      | B    | 13                | 100                   | 18                                            |                   | 3                | 7.83                   | 3%         | 3%                |
| 3      | C    | 10                | 100                   | 21                                            |                   | 3                | 7.83                   | 3%         | 3%                |
| 4      | D    | 5                 | 100                   | 28                                            |                   | 8                | 7.83                   | 8%         | 8%                |
| 5      | E    | 3                 | 100                   | 31                                            |                   | 13               | 7.83                   | 13%        | 13%               |
| 6      | F    | 3                 | 100                   | 35                                            |                   | 15               | 7.83                   | 15%        | 15%               |

It can be seen from Table 1 that the average time for the first-line employees with 6 different work experiences to use the traditional insulating tape for insulation packaging and disassembly 100 times is 25.5 minutes, the average number of turnovers is 7.83, and the average error rate is 7.83%. Obviously, there is room for improvement in terms of work time and quality of work.

3. New combination tool principle and structure

Aiming at the many deficiencies of traditional insulating tapes, this paper proposes a new cable terminal insulation treatment tool with simple structure, convenient, reliable, safe and reusable. That is, the portable cable connector blocks the insulating rubber cap. The utility model is characterized in that the utility model comprises an insulating cylinder body with an upper end sealing the lower end opening, the lower end of the cylinder body is connected with a bell-shaped cable fixing insulating wall sleeve, the outer surface of the wall sleeve is threaded, and the cylinder body is sleeved with a screw thread. The nut is tightened, and the upper end of the cylinder body has an elastic damping insulation baffle. The wall thickness of the wall sleeve is gradually thinned from bottom to top. The elastic damping insulating baffle forms a bell mouth shape.

The advantages of the new insulating rubber cap are remarkable.

Firstly, the double-fixed mode in which the upper-end card slot is used for the bare-head cable and the lower end thread is fastened ensures the reliability of the insulation plugging. The internal design is two parts (upper end card slot, lower end thread fastening element), and the material is made of insulating plastic. When the plugging is performed, the cable lug is inserted into the inside of the insulating rubber cap, where in the upper inner card slot of the rubber cap catches the bare portion of the cable lug, and the lower end rotates the screw fastening component to fasten the cable connection, and the two components are double fixed. The function is to ensure reliable insulation and sealing of the cable terminal.

Secondly, the installation and disassembly are simple and the work efficiency is improved. When installing, it is only necessary to insert the cable head into the inside of the device, insert it upwards, and open the upper part with a flexible damping insulating baffle. The exposed cable head will be caught by the insulating baffle. Rotate the nut down and the lower insulating wall will close to lock the cable. When disassembling, just loosen the nut and pull out the cable. [4]

Finally, it can be reused and reduced in cost. Because the insulating plugging cap can be used repeatedly, it replaces the function of insulating tape, and is economical and environmentally friendly.

4. Portable cable head insulation rubber cap structure

Referring to Figures 1 and 2, the component names are as follows: cylinder 1, elastic damping insulating baffle 2, thread 3, fastening nut 4, wall sleeve 5, bare cable lug 6, cable 7.

Referring to Figures 1 and 2, the new insulating rubber cap includes an insulating cylinder 1 (insulating rubber cap) with an upper end sealing the lower end opening, and a bell-shaped cable fixing insulating wall sleeve 5 at the lower end of the cylinder body 1 for facilitating the cable 7. Insert and fix. The outer surface of the wall sleeve 5 is provided with a thread 3, and the cylinder body 1 is sleeved with a fastening nut 4 screwed to the thread 3. The upper end of the cylinder body 1 has an
elastic damping insulating baffle 2, forming an upper end card slot for facilitating the bare cable to make sure terminal 6 can be positioned and protected.

The wall thickness of the wall sleeve 5 is gradually thinned from bottom to top to facilitate the locking of the cable 7.

![Figure 1. Structure diagram before cable plugging](image1)

![Figure 2. Structure diagram after cable plugging](image2)

The elastic damping insulating baffle 2 is formed in a bell mouth shape for facilitating positioning and protection of the bare cable lug 6.

The exterior of the new insulating rubber cap is made of elastic insulating material. The inner part is designed in two parts (upper end card slot, lower end thread fastening component), and the material is made of insulating plastic. When the plugging is performed, the bare cable lug 6 is inserted into the inside of the cylinder 1, wherein the elastic damping insulating baffle 2 (slot) of the upper end of the cylinder 1 clamps the exposed portion of the bare cable lug 6 and the lower end of the tightening nut 4 will be fastened and the two components are double-fixed to ensure reliable insulation of the exposed cable lug. After the work has finished rotating the tightening nut 4 in the reverse direction, the cable 7 can be pulled out.

5. Conclusion

In order to verify the improved tool use effect, the same experiment was carried out using the same person used in the first part of the experiment, and the new experiment was carried out with the new insulating rubber cap under the same conditions. The improved data is shown in Table 2. Table 2 shows the experimental data of the sealed rubber cap for the portable cable terminal.

| Number | Name | Experience (year) | Total number of times | Insulation packaging, disassembly time (min) | Average time (min) | Number of errors | Average number of errors | Error rate | Average error rate |
|--------|------|-------------------|-----------------------|---------------------------------------------|-------------------|------------------|-------------------------|-----------|-------------------|
| 1      | A    | 9                 | 100                   | 13                                          | 19                | 0                | 0                      | 0%        | 0%                |
| 2      | B    | 13                | 100                   | 11                                          |                   | 0                | 0                      | 0%        | 0%                |
| 3      | C    | 10                | 100                   | 13                                          |                   | 0                | 0                      | 0%        | 0%                |
| 4      | D    | 5                 | 100                   | 24                                          |                   | 0                | 0                      | 0%        | 0%                |
| 5      | E    | 3                 | 100                   | 25                                          |                   | 0                | 0                      | 0%        | 0%                |
| 6      | F    | 3                 | 100                   | 28                                          |                   | 0                | 0                      | 0%        | 0%                |

Comparing Tables 1 and 2, it can be clearly seen that after using the improved insulating rubber cap, the average time is reduced from 25.5 min to 19 min, and the average error rate is reduced from 7.83% to 0%. Therefore, it can be stated that the use of the improved insulating rubber cap can effectively improve the working quality and efficiency of the insulating plugging.
6. Conclusion
For the inefficiency, low security and low economy of the exposed wires in the power system, this paper proposes a portable cable terminal to block the insulating rubber cap. The new insulating rubber cap solves the problems of resource loss, disassembly, the danger of electric shock and low work efficiency when the cable head is insulated and sealed in the power system. The new insulating rubber cap is easy to install and disassemble, and improves work efficiency. It can be reused, replacing the role of insulating tape, which is economical and environmentally friendly.

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