

Development and Application of Multifunctional Insulated Operating Rod for 10 kV Power Switchgears

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Abstract

In this paper, a new multifunctional insulated operating rod is presented. It can be applied to various operating hole of 10kV distribution network switching apparatus, effectively resolving some existed problems, such as easy to slip or troublesome to replace during operating cycle, single function, inconvenient to carry and so on. The head part of the developed insulated operating rod is fastened and fixed to its main part with a short bolt. The developed insulated operating rod owns the prominent advantages of simple preparation process and low fabrication cost, and the average operating time of power off and power on can be reduced to 480 s for each operation. This developed insulated operating rod can effectively lessen operating time, decrease workload, promote working efficiency and increase operation safety. It has important practical significance and promotion value in improving the efficiency and reliability of power supply in distribution network.

Keywords

Installation; Operating rod; 10 kV; Power switchgears.

1. Introduction

The safe, economical, reliable and stable operation of the power system is the basis for the rapid development of the national economy and social stability and prosperity [1]. The ultimate goal of power system construction is to supply power to large industrial and mining enterprises, general industrial users, enterprises and residents. And 10 kV electric distribution network is the most appropriate voltage level for terminal power supply [2-3]. According to the recent statistics, more than 80% of the total power generation in our country is sent to the terminal users with the 10 kV distribution network. 10 KV distribution network is the final embodiment of the national power systems in power supply, quality and reliability [4-5]. In Chongqing area, 10kV distribution network grid structure is widely used not only for new urban development zone, industrial parks and residential areas, but also for remote rural mountainous areas.

In recent years, with the increasing upgrading speed of the switching equipments and the increasing life time of the insulated operating rod, problems such as easy to slip or troublesome to replace during operating cycle, even unable to operate could occur [4]. Due to the high cost of frequent replacement of new insulated operating rod, it is not realistic to replace them. At the same time, most of the existing insulating operating rods only own a single function, and each time the workers have to bring various kinds of insulated operating rods to the work sites [5]. Once someone is failure to carry the correct rod, he has to return back to fetch the appropriate one, which will bring a great impact on the whole

maintenance work. Therefore, it is extremely important to develop a new multifunctional insulated operating rod, which can be used for various operating hole of distribution network switching apparatus.

2. Design of the multifunctional insulated operating rod

According to the type of power switchgear holes in the power distribution room and the switching station, a large number of switch device operating rod models exist. Each model can be seen as two parts, the head part and the main body part. The head part one is inserted into the cabinet to link with the switch lock. The main body part is kept out the cabinet for operator rotation operation. Thus, we can design a single operation tool capable of replacing different head parts to conveniently operate different types of switch apparatus.

The first problem needed to be solved is the connection model between the operation rod head part and the rod main body. This paper mainly focuses on two assembly methods, the hexagon corresponding model (method a) and a bolt fastening model (method b).

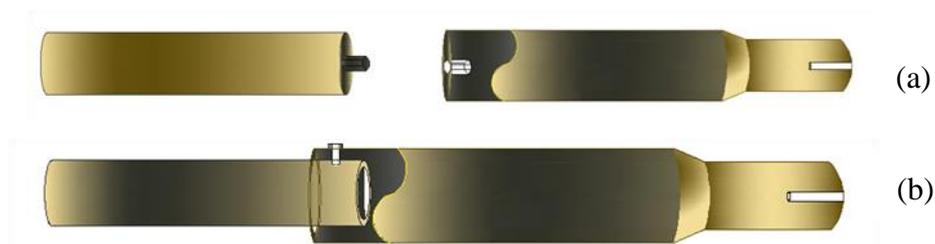


Fig. 1 The assembly structure diagram, (a) the hexagonal assembly model and (b) the bolt fastening model

Fig. 1 (a) is the structure diagram of the connection between the rod head part and the rod main body with the hexagon corresponding model. As shown, a bulge of the hexagonal bolt shape is made at the head and tail of the new insulation operation rod. The height of the bulge is 40 mm. The heat of the rod body is made to the specific corresponding hexagonal groove with a depth of 40 mm. During the operation, the online work can be operated after corresponding the rod head and the rod body according to the hexagonal assembly method. Fig. 1 (b) is the structure diagram of the bolt fastening model. Compared with the hexagon corresponding model, the rod head part can be directly sheathed on the rod main body, and the contact position are assembled and fixed by the way of bolt insertion.

Table 1 Comparative analysis about the performances of the two models

	Hexagonal assembly model	Bolt fastening model
assembling convenient	convenience	convenience
closeness	existing a gap in junction	close
manufacture complexity	complex	simple
manufacture cost	60 RMB	40 RMB
rub fastness	easy to wear	hard to wear

Table 1 is the comprehensive evaluation about the performances of the two models including assembling convenient, closeness, manufacture complexity, manufacture cost and rub fastness. These two methods both can achieve the operation of the switching apparatus. Compared to the hexagonal corresponding model, the bolt fastening model is much lighter in weight, cheaper in cost, tighter and harder to wear.

3. Development and application of the insulated operating rod

The multifunctional insulated operating rod head part is fastened and fixed to its main part with a short bolt, and the final design picture of the insulated operating rod is shown in Fig. 2. And the picture of the final fabricated product is shown in Fig. 3. This insulated operating rod is composed with a rod main body and many rod head units.



Fig. 2 The final design picture of the insulated operating rod

The operation procedure is illustrated as follows. On the basis of the hole structure of the switchgear, we firstly pick the optimal components and assemble them. Then, the assembled insulated operating rod is inserted into the switch cabinet keyhole for power off operation. And finally, the insulation operating rod components are removed and placed into the toolbox. Fig. 4 shows the actual figure using the developed multifunctional insulated operating rod for 10 kV power switchgears power off and power on.



Fig. 3 The final fabricated product of the developed insulated operating rod

In order to further validate the effect of using the developed multifunctional insulated operating rod, tests for breaker switch on and off are conducted in Chongqing electric power research institute. The proposed multifunctional insulated operating rod can effectively reduce the workload and increase operation safety. The average operating time of power off and power on can be reduced from 800 s to 480 s for each operation, saving 40% time.



Fig. 4 The actual operation figure using the developed multifunctional insulated operating rod

4. Conclusion

A new multifunctional insulated operating rod for various operating hole of 10kV distribution network switching apparatus is presented in this manuscript. The head part of the developed insulated operating rod is fastened and fixed to its main part with a short bolt. The average power off or on operating time is reduced from 800 s each time 480 s. Meanwhile, the insulation operation rod preparation process is simple, low cost, and can effectively reduce operating time, operator workload and improve operation and maintenance efficiency, increase operational safety. It has important practical significance in improving the reliability of power supply.

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