OPTIMAL DESIGN FOR POWER CABLE METAL SHEATH VOLTAGE COMPENSATION DEVICE

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ABSTRACT

By reason of urban construction, the length of cables may change after reconstruction. The circulating shield current generated by the imbalanced voltage which caused by the change of cable length will make the system dangerous. This paper analyzed the inductive voltage in the cable sheath, proposed the method to reduce the shield voltage with the compensation device. The results of the research are satisfactory. This paper has researched on the theory analysis, modeling, design, and prototype trial-production. The integrated system contained compensation device and over-voltage protection has been designed and manufactured.

KEYWORDS

Power Cables, Metal Sheath, Inductive Voltage, Compensation Device, over-voltage protection.

Ⅰ. INTRODUCTION

The power cables are widely used in the urban to meet the needs of urban development. In the distribution network, the proportion of single-core cable has grown by the growing of loads. And the inductive voltage is the common problem of the single-core cable. Usually, the way of cross bonding the shields can reduce the inductive voltage. But, the cables may be reconstructed by the reason of urban construction. The length of cables may change after reconstruction. The circulating shield current generated by the imbalanced voltage which caused by the change of cable length. And the imbalanced voltage will threat the system safety[1]-[3]. So the reason of the inductive voltage should be further studied. Then we can find the effective measures to cancel the shield inductive voltage. The reason of inductive voltage generation was analyzed in [4]. Reference [4] also formulated the mathematical model which described inductive voltage generated by the cable with different length. The Compensation device has been designed. Its effectiveness and the model's correctness were verified by the simulation and experiment.

This paper developed the Compensation device in [4], and further studied the over—voltage protection of the Compensation device. The design of the Compensation device was optimized also.

II. BASIC THEORY OF COMPENSATION DEVICE FOR POWER CABLE SHEATH

A. Basic Theory

Limited by condition, the length of reconstructed cables is changed so that the end of the cable won't match the length condition of cross bonding. As we can see in Fig. 1(a), there will be voltage between the earthing points while the length condition is unmatched. And this voltage will generate a circulating shield current.

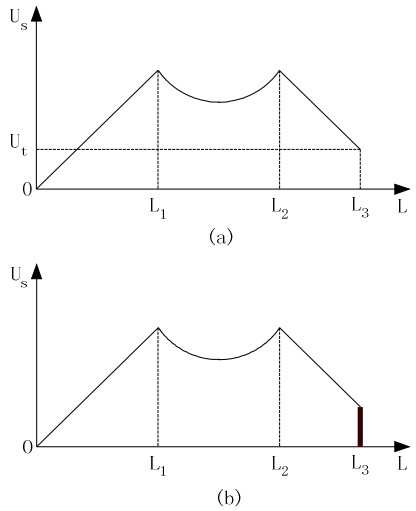

Fig. 1 Distribution diagram of voltage in metal shield before and after compensating inductance

We add the inductance at the end terminal of cable as Compensation device. The inductance is a section of coil winded on iron core. The inductance series between the end of the metal shield ending and earthing terminal (Fig. 2). As it is shown in Fig. 2, there will be alternating magnetic field around the cable while there is AC current passing the single-core cable. The alternating magnetic field links with the core, the shield and the inductance. Then the induced electromotive force is generated to cancel the imbalance voltage caused by the length changing. The shield voltage distribution compensated by inductance is shown in Fig. 1 (b). Let us compare the voltage of L3 between Fig. 1 (a) and Fig. 1 (b). In Fig. 1 (a), the voltage is Ut. With the Compensation device in Fig. 1 (b), the voltage is 0.

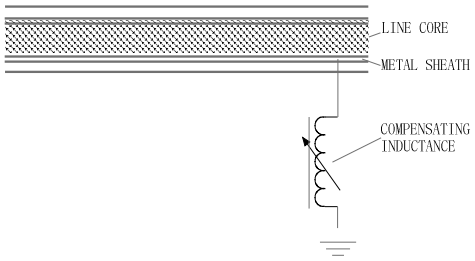

Fig. 2 Diagrammatic sketch of compensating inductance connect