

Study on Power Management Function and Fast Turn-off Technology of Intelligent Circuit Breaker

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Abstract

A new type of intelligent low-voltage circuit breaker is designed to solve the problems of energy loss and circuit protection of electric equipment. The mechanical switch of circuit breaker is controlled by electronic structure, and the transient current, voltage and other information in the fault circuit can be collected quickly. The improved RBM-BP neural network algorithm is adopted to realize the intelligent control operation and maintenance of electrical equipment. Intelligent low-voltage circuit breaker combined with AI platform monitors the energy consumption and power of electrical equipment in real time, and generates energy-saving suggestions for users to better control energy consumption.

Keywords

Low-voltage Circuit Breaker; Circuit Protection; Fault Identification; The Smart Grid.

1. Introduction

According to the Blue Book of World Energy 2019, electricity will replace fossil energy consumption as the main consumption energy in the future. According to IRENA, electricity will increase the proportion of global end-use energy consumption from 20% now to 45% by 2050. In power consumption under the background of rising, the traditional open open circuit when the load circuit breaker switch components long time (tens of milliseconds to hundreds of milliseconds), the action is easy produce arc, contact number of the short service life of open circuit short service life, intelligent control, have been unable to meet the power distribution automation system and the modern new energy cars, photovoltaic development of wind power and charging pile, etc. The intelligent low-voltage circuit breaker has a millisecond breaking speed; Longer switching life; It can cut out the fault circuit in time and solve the safety problem caused by the fault circuit effectively. Remote monitoring electrical system, and the implementation of efficient power management strategy, to achieve energy saving and efficiency, reduce the operating costs of photovoltaic wind power and charging pile and other industries. Intelligent circuit breaker has become an inevitable trend to replace traditional mechanical circuit breaker.

2. The Structure and Characteristics of Digital Circuit Breaker

When the circuit breaker flows through the normal operation current, with the passage of time, the protection measurement and control device in the circuit breaker detects the heat is not big, not over the heat threshold value, the circuit breaker will not perform tripping operation of course; When the circuit breaker flows through the abnormal larger current, the protection of the circuit breaker measurement and control device to detect the heat is larger, over the heat threshold value, the circuit breaker to perform tripping operation.

When the switch is closed, the lock QQ connected with the rotating shaft will jump. The three-stage main contact is closed, so that the spring is in the state of energy storage. When the main circuit is overloaded, the current flowing through the heating element exceeds its setting value, and the

temperature rises, bending the bimetal sheet and pushing the connecting rod. When the back of the jump is unlocked, the pull force of the spring separates the main contact system and cuts off the main circuit, thus providing overload protection. When the main circuit is short-circuited, the magnetic force of the electromagnetic release coil increases and the armature moves up. The main contact system of the connecting rod is separated, and the main circuit is cut off. Once the power supply voltage is lower than the setting value or the magnetic force of the coil is weakened when the voltage is lost, the force of the coil will be pulled upward by the spring. Connecting rod main contact system separation, cut off the main circuit. Play the role of under-voltage or under-voltage protection.

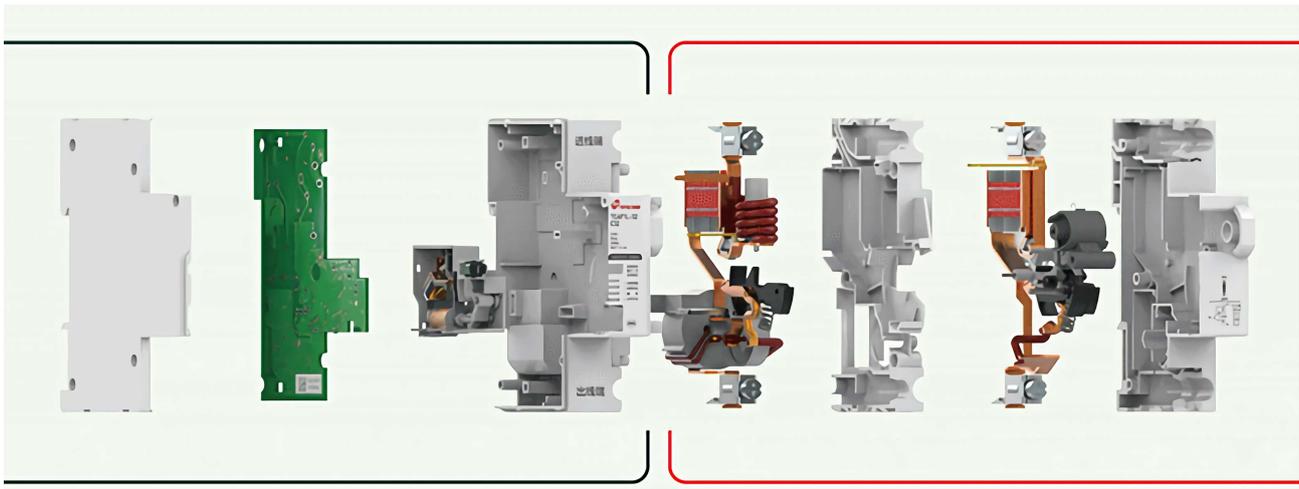


Figure 1. Internal structure of the circuit breaker

3. Research and Development of Intelligent Circuit Breaker

3.1 Pain Points of Conventional Circuit Breakers

Traditional circuit breakers have too few functions and can only provide some protection against short circuit, overload, and leakage. And these three functions are passive trigger, has been unable to effectively ensure personal and property safety. For example, when a short circuit occurs, the electrical circuit is already on fire before the short circuit occurs. Leakage protection is also too slow, the circuit is still open after the occurrence of electrocution casualties. On the other hand, it does not have data collection, transmission, remote control and other functions, which cannot meet the environmental requirements of complex power microfeatures in the new infrastructure scenario.

The intelligent circuit breaker can not only make the distribution network more safe and accurate, but also real-time monitoring of the operation parameters of the power grid, calculate the operation power meter energy consumption of electrical equipment, automatic generation of energy saving suggestions, convenient customer management operation and maintenance of some equipment. For example, Delixi electric frame CDW6i frame circuit breaker can not only achieve communication function, but also have measurement, auxiliary protection functions.

3.2 Intelligent Circuit Breaker

Intelligent circuit breaker is an intelligent management and supervision system which makes use of micro-electronic technology and new sensors. Its main feature is that the contact switch of traditional mechanical structure is controlled by power electronic control device to realize the intellectualization and datalization of circuit breaker. The sensor and the digital control unit cooperate, collect the operation data, detect the equipment fault and fault through fault calculation, and send out alarm signal before the fault occurs, play the role of fault prevention.

3.3 Fault Arc Protector

In foreign countries, the United States first proposed arc protection technology, mainly aimed at arc fault detection and protection technology. Due to the special arc signal (such as weak signal, unstable arc instability, easy to interference and other characteristics), the fault arc detection, identification is difficult, has been monopolized by several large foreign companies.

Some domestic enterprises have also begun to research and develop, but most of them have no mature products to launch on the market. However, some enterprises have developed high-reliability AFDD products through in-depth research.

Take Delixi Electric as an example, the AFDD arc fault protection circuit breaker is developed in accordance with the national standard GB / T 31143-2014. The product has been put on sale at the end of 2019, and has achieved good sales performance so far.

In addition, as the first fault arc product in the form of AFDD circuit breaker, this product fills the gap of domestic fault arc technology and breaks the technical monopoly of foreign products. With the release of the new version of the power distribution standards, civil building electrical standards, the demand for this product will be more and more.

This product is directly installed in the distribution box of 5G base station, and its main purpose is to ensure the safety of 5G base station electrical equipment. The product has the function of circuit overload operation protection, undervoltage protection, remote operation switch separation, overload long delay protection, instantaneous tripping protection and other ordinary intelligent circuit breaker function, but also has the string / parallel arc fault protection, grounding arc fault protection, small current fault detection function.

The fault arc circuit breaker is suitable for distribution lines with AC 50Hz, rated voltage not exceeding 400V, rated current not exceeding 63A, rated short circuit capacity not exceeding 6000A; but also for distribution lines with DC voltage monopole not exceeding 110V, two levels not exceeding 220V, rated current not exceeding 63A, and rated short circuit capacity not exceeding 6000A. At the same time, it can also serve as a frequent operation switch and line maintenance isolation switch.



Figure 2. AFDD

4. Conclusion

In order to address the world's most pressing power distribution challenges, integrate renewable energy into the grid, build more efficient data centers and support other sustainable energy initiatives, the intelligent circuit breaker field has set off a research and development boom at home and abroad, the circuit breaker industry is facing multiple opportunities for industrial upgrading and accelerated demand volume.

Acknowledgments

Science and technology Research Project of Chongqing Education Commission in 2020, No. KJQN202003112.

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