

Design of permanent magnet mechanism control system for high voltage circuit breaker

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Abstract: Based on the analysis of the development trend of high-voltage circuit breaker operating mechanism, the design requirement of high-voltage circuit breaker permanent magnetic mechanism is proposed, and the high-voltage circuit breaker permanent magnetic mechanism system is designed based on PIC microcontroller to realize the effective control of high-voltage circuit breaker breaking and closing process, as well as to realize the collection of electrical parameters and fault judgment, which improves the reliability and safety of high-voltage circuit breaker.

1. 0 Introduction

With the rapid development of the national economy and the continuous improvement of mechanization and automation level, people's need for electric power safety and reliability is getting higher and higher, leading to higher requirements for the safety and stability of the electric power system. High-voltage circuit breakers can not only cut off or close the no-load and load currents in high-voltage circuits, but also cut off the overload and short-circuit currents through the action of relay protection devices when a fault occurs in the system. High-voltage circuit breakers have a perfect arc extinguishing structure and sufficient current breaking capacity, and are generally divided into oil circuit breakers, sulfur hexafluoride circuit breakers, compressed air circuit breakers, vacuum circuit breakers and so on. High-voltage circuit breaker as the main control and protection equipment of the power system, its stability is directly related to the safety of the power system.

The traditional operating mechanism has spring-operated mechanism and electromagnetic operating mechanism. Spring-operated mechanism does not require high-power power supply, but the structure is complex, the manufacturing process is complicated, the cost is high, and the reliability is difficult to ensure. The electromagnetic operating mechanism has a simple structure, but the structure is bulky and the closing coil consumes a lot of power. The permanent magnet mechanism uses permanent magnets to cooperate with the dividing and closing coils, which better solves the problem of needing high power energy when closing the gate. The permanent magnet mechanism has

only one moving part, no need for mechanical decoupling and locking device, fewer fault sources, higher reliability and long service life, and at the same time, it controls the phase of breaking and closing to realize synchronous control, thus reducing the impact of overvoltage and surge on the system, reducing the input of system protection and improving the overall life of the system.

2. 2 Control system requirements

As the main control and protection unit of high-voltage circuit breaker, the permanent magnet mechanism must ensure that it can reliably execute the breaking and closing operation under any condition in the distribution network, and at the same time be able to monitor its own operating parameters and grid operating parameters in real time, and be able to make judgments on the data and fault division. According to the operating environment and equipment operation requirements, the high-voltage circuit breaker permanent magnet mechanism control system must meet the basic requirements of strong real-time, high accuracy and good safety. In the design of permanent magnet mechanism control system of high-voltage circuit breaker, it is necessary to fully consider the demand of controllable action time of dividing and closing coil, and the setting can realize the effective control of dividing and closing time, so as to obtain the optimal dividing and closing speed. In the high-voltage circuit breaker itself and the power system parameters collection, fully consider the power system parameters change quickly, fault protection time requirements short and other characteristics, in order to ensure that in the power system or high-voltage circuit breaker fault can be broken. Since the fault current or other parameters have small values when the high-voltage circuit breakers and power systems are faulty, they are easily disturbed by external interference, so the accuracy of data acquisition has higher requirements. The high accuracy is designed with suitable hardware design and software processing methods to ensure the accuracy of the collected data and improve the accuracy of fault acquisition. High-voltage circuit breakers, as key equipment for power system control and protection, must ensure reliable control of circuit breaker breaking and closing and reliable detection of faults.

The permanent magnet mechanism, as a permanent magnet holding and electromagnetic operating mechanism, is completely different from the conventional spring mechanism and electromagnetic mechanism in terms of working principle, and the differences in control system design are also large. The permanent magnet mechanism works by controlling the energized state of the coil to realize the operation of the driving mechanism. The control system design also requires the design of an electric charging unit to provide a stable DC power supply for the action of the permanent magnet mechanism to ensure the stable performance of the driving work. The coil energization control unit is designed to control the energization time of the coil according to the system requirements to ensure that the high-voltage circuit breaker obtains optimal breaking and closing characteristics. The control system also requires a monitoring and logic control unit to monitor the electrical parameters of the power system and to make certain logical judgments to identify different faults on the grid.

3. 2 Control system of high voltage circuit breaker permanent magnet mechanism

3.1 2.1 Design of hardware structure

Since the controller works in a harsh outdoor environment and is directly related to the reliable operation of the power system, it is necessary to consider the design of electromagnetic compatibility, which can not only improve the development speed, but also save the cost of development. According to the demand analysis of the control system, the control system of high-voltage circuit breaker permanent magnet mechanism is mainly composed of PIC microcontroller system, drive unit, charging control unit, energy storage capacitor unit, capacitor voltage detection unit, control and

display unit, control command output unit, parameter acquisition unit, communication unit, etc. The general diagram of the control system structure is shown in Figure 1.

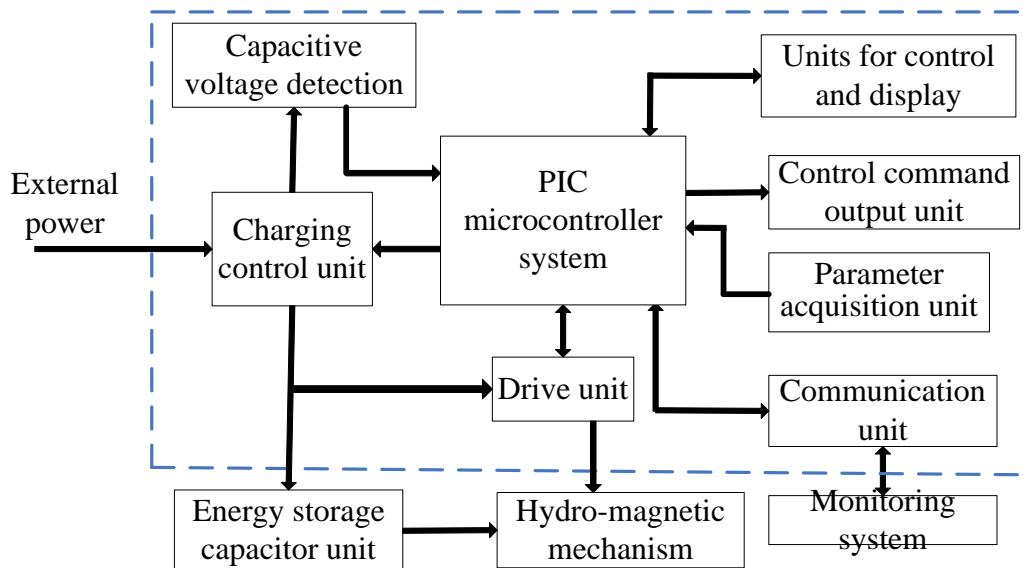


Figure 1: General diagram of the control system structure of high voltage circuit breaker permanent magnet mechanism

Description of the working process of the permanent magnet mechanism control system of high-voltage circuit breaker: After the normal power is applied, the energy storage capacitor is charged and the voltage on the capacitor is detected in real time. When the capacitor voltage meets the action requirements, the closing and dividing coils are turned on when the closing and dividing commands are received, driving the permanent magnet mechanism to act, and judging whether the closing and dividing is successful by measuring the change of the switch position. Although the high-voltage circuit breaker permanent magnet mechanism control system drive unit is relatively simple in function, but due to the instantaneous passage of large current values (in the 100A or so), not only to ensure the reliable operation of the drive, but also to consider the interference of the drive part of the action on other circuits. The high voltage circuit breaker permanent magnet mechanism control system is designed with an analog-to-digital isolated chip MAX125 and a linear optocoupler LOC110 for A/D conversion. The I/O ports of the CPU of the high-voltage circuit breaker permanent magnet mechanism control system are isolated by opto-coupler TLP-521. The power supply circuit of the high-voltage circuit breaker permanent magnet mechanism control system CPU is powered by a separate circuit of switching power supply, and the power supply of some circuits is also isolated by DC-DC for power supply. Therefore, the cascading of external sharp pulses and various noise disturbances are effectively suppressed, and the signal-to-noise ratio is improved.

4. Conclusion

Combining the working principle and operation requirements of high-voltage circuit breaker permanent magnet mechanism, PIC microcontroller is given to design high-voltage circuit breaker permanent magnet mechanism control system, which realizes effective control of high-voltage circuit breaker breaking and closing process, safeguards the safety of high-voltage circuit breaker and power system, and provides the basis for the development of intelligent power grid and intelligent electrical technology.

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