Research on Phase Judging Device in High Voltage Switchgears

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Abstract. In order to solve the existing high voltage switch gear when the voltage difference method using core phase, due to the different switch gear supporting capacitive sensor indicators are inconsistent, resulting in phase sequence check misjudgment and other issues, this paper uses the phase difference between the two high voltage switch gear method of phase sequence check, this method has the versatility to determine the exact characteristics such as the actual test to fully meet the requirements of high voltage switch gear core phase.

Introduction

At present, the basic test for high voltage switchgear confined to the traditional core phase voltage differential, in this way for the next line voltage switch sides basically the same situation can be more accurately check out phase; phase with the voltage difference between the minimum time generally considered close to zero when large-phase voltage difference. However, when the switching voltage lines on both sides are different, even when the voltage difference between the same phase will be relatively large, the use of the voltage difference between core phase can not be determined that the type is the same phase or different phases[1, 2]. In particular, in practical applications, when the capacitance of the capacitive sensor is not the same, the coupling of the voltage value can not reach exactly the same, so there may be a voltage difference between a conventional method of Phase judging Reactor serious problem with false positives, etc.; Moreover, the current of the power company use of high voltage switchgear manufacturers differ, phase judging phase devices are generally configured by the respective manufacturers, different models can not be generic, which brought great distress to the operator and grid operation. To solve the above problems, this paper proposed and designed a phase-in High Voltage Switchgear core phase devices[3-5].

Selected phase detection method

(1) Phase detection method outlined

At present, a lot of phase detection method can be divided into two categories simulation methods and numerical methods, simulation method is two-way signal zero-crossing time difference into a voltage or current to calculate the frequency. Detected analog phase needs a dedicated hardware circuit, and the change of the phase difference signal is not sensitive to poor accuracy. The method is the direct use of digital pulse phase pulse count to fill, and then calculate the number of pulses counted, and then take the average seek phase, therefore, count pulse frequency is higher, the higher the precision of the measurement. For hardware can be a variety of electrical instrumentation and mechanical instruments, using vector method, Multiplier method, diode mixers identification method and sampling methods, etc., can also use the test system and other computer components, practical application can use according to the specific conditions different methods, several methods are commonly used fast phase detection method, the zero correlation analysis method and waveform transform method.

Rapid detection of the phase measurement accuracy for the method is largely dependent on the selected bipolar saw tooth waveform, while the bipolar saw tooth in turn depends on the input to

determine the peak of the sinusoidal voltage signal, and since there is a grid voltage fluctuations in the bipolar saw tooth actually very unstable, it will greatly affect the accuracy of measurement, so fast phase detection method is not suitable for this design.

As for the correlation analysis, although in theory it is the best choice, but in fact it is directly dependent on the accuracy of the signal sampling points, which is a sinusoidal signal analog-digital conversion makes high demands on the one hand, with increasing number of sampling points, the degree of complexity of the algorithm will subsequently increase proportional to the square, so that the use of a correlation analysis, the design of the hardware and software requirements are very stringent, especially if high precision is desired, then mention , also need to be more stringent hardware and more complex procedures, the price is great.

The basic principle of zero over the calculation method is a method of two or more signals with a frequency difference between the zero-crossing times, and then the time difference is converted to a phase difference.

Transformation is given to the waveform distortion of the grid voltage of the non-linear factors (such as load) and the emergence of factors, the first of the signal needs to be filtered to a sine wave to make it close to the sampling signal, and a rectangular wave by the waveform transform, when the two XOR rectangular wave processing, i.e., the output pulse width corresponding to the phase difference.

(2) Based on zero-crossing method and waveform transformation Combination of phase detection method

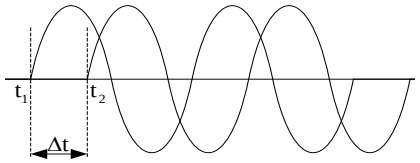

Figure 1 Schematic zero-crossing France

Through the above analysis, we found that the zero-crossing method and waveform transformation method is simple and practical, suitable for the development of practical core phase device, so this paper and designed a phase detection method and the method of zero-based Combination waveform transformation too. This method is the zero-crossing signal processing circuit is converted into a waveform of a rectangular wave, a rectangular wave signal is then input to a two-way corresponding to the pulse signal phase detecting circuit obtained by measuring the duty cycle of the pulse signal, i.e. phase can be obtained, similar to the frequency of detection of the duty cycle detection only needs to measure the high-level width of the rectangular wave, this method is not only easy to implement hardware circuit, and the software algorithm is simple.

Figure 1 shows the basic principle of the zero-crossing method. Is a diagram of the two zero-crossing time signal determining the time interval between t_1 and t_2, Δt the time difference can be converted to phase difference signal sampling period τ, n as the time between zero crossings of the two signals t_1 and t_2 the number of samples, the signal period of H. The phase difference is calculated as: $P=2\pi*\Delta t/T=2\pi*\tau*n/T$, taking into account the nonlinear factor in the grid voltage (e.g., load) and the distortion occurs, the device will first need to be filtered signal, the sampling signal is close to a sine wave to make it, and then converted into a rectangular wave by the waveform, if the exclusive OR of two rectangular wave processing, i.e., the output pulse width corresponds to the phase difference, the measured width of the pulse shown in Figure 2, corresponding to a phase difference can be obtained $\Delta\varphi$.

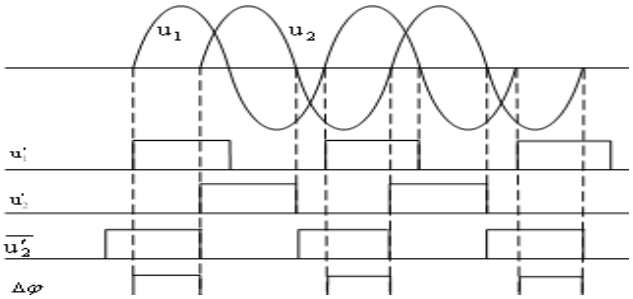

Figure 2 Schematic waveform transformations

Principle phase judging phase-in signal acquisition phase device

For the foregoing phase detection method based on zero over waveform conversion method and the Combination, we researched and developed core phase high voltage switchgear devices. When core phase of high voltage switchgear, the two electrodes are in contact with the high voltage output of the measured capacitance of the sensor line, the voltage signal at the output of the capacitive sensor to have the phase relationship between the frequency of the frequency by the limiter circuit has a phase the relationship between the voltage waveform of the signal taken out and shaped to the comparator, the output signal A and the signal shown in Figure 3 B. Assuming signals A and B is the phase difference Φ of the two signals at same frequency, they are fed to a comparator circuit can be obtained both by the phase difference measuring circuit (pulse signal).

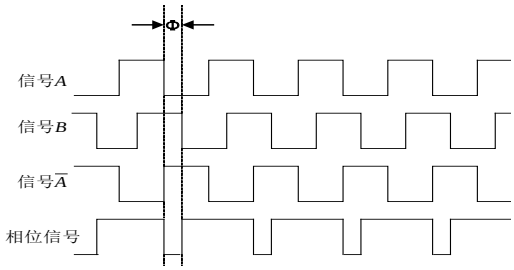

Figure 3 Acquisition phases of the principles of high voltage line voltage

As shown in Figure 3, the comparator circuit after the signal A and signal B is negated phase constituted. Then the phase difference Φ (pulse signal) to the integrating circuit is converted into a voltage signal (the magnitude of the voltage depends on the duty cycle of the pulse signal), and finally to the comparator, when the two signals are in phase (phase difference is ± within the range of 10 °), then the voltage corresponding to the integral value obtained is relatively low, the comparator outputs a low level; if the two signals are out of phase (the phase difference exceeds the range of ± 30 °), the resulting voltage is correspondingly high, the comparator outputs a high level. Obtain core phase results.

Due to the current phase of the domestic phase judging power line with what is out of phase with what is no uniform standard, usually when the power lines considered core phase retardation value of less than 10 ° for the same phase, the phase difference is greater than 30 ° out of phase, this phase active phase judging phase high-pressure line use of this standard.

According to this principle, we design the core phase device, in particular a circuit apparatus according to the phase of the core shown in Figure 4, signal 1 and signal 2 is a phase difference between two signals of the same frequency, the signal is inverted and then with the addition of a a signal can be obtained with the operation phase difference signal, the phase difference signal by integrating the re-entering of the comparator circuit outputs core phase can result.

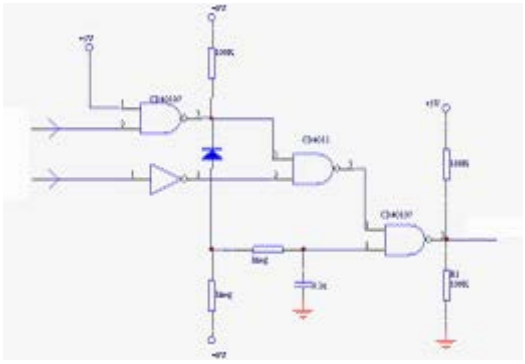

Figure 4 phase detection circuit

Three-phase phase-type phase judging device on-site use case

This paper develops a phase judging phase-in phase devices, and power gained in Songjiang pilot use, excellent core phase effects, accurate and reliable, but also to solve the different manufacturers core phase switchgear device can not universal problem. The phase-type core phase device has been successfully applied for national invention patents and utility model patents.

The phase judging phase using core phase, just the two terminals into the corresponding hole charged with high voltage switchgear phase judging indicator, you can judge the same phase or out of phase, as long as the phase difference is less than 10^{o} same phase, more than 30^{o} is out of phase. After more than six months Songjiang grid pilot operation phase of the phase judging power unit runs Songjiang Siemens, ABB, Nanhualanling and other manufacturers switch cabinet core phase were successful.

Conclusion

In this paper, the design of high voltage switch gear phase judging phase method with apparatus and phase detection method based on zero-crossing and waveform transformation method, the phase judging phase device has judged accurate, easy to use features, this paper introduces the phase-type core phase device the design principle of the phase judging phase devices while addressing the phase judging phase accuracy and versatility of the problem, through field trials, excellent results.

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