

Arc Fault Circuit Interruption Design

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Abstract : In this paper, arc current controller is designed for the interruption of arc fault current which is occurred in the low voltage network. Arc in electrical network have the characteristics of low current, high impedance and high frequency. Conventional controller does not have the arc current interrupt function. Hence, arc current controller is designed for the interruption of arc fault current

Keywords: Arc current, Circuit Breaker, Arc Fault, Circuit interrupter, Ground fault

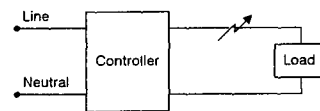
1. Introduction

Arc electric current controller has been study arc that happen in 120-250V's low voltage and 5-150A's current. Divide by parallel electric arc that arc electric current happens between line and neutral, serial electric arc that produce multitude in case line has been disconnected or is linked floppily to electric appliance, ground electric arc that happen between neutral and ground. Must select impossible and new detection method by existent detection method to detect arc ingredient in an electric circuit. Arc sensor has to be planed to have 60Hz's value such as frequency of an electric circuit. Also, impedance of sensor should be planed to have suitable value. Arc to design arc electric current controller did modeling mathematically and designed controller for arc electric current control. Proved controller performance through an arc electric current control experiment by electric current controller that propose, and confirmed excellency of old electric current controller and controller that propose that go through comparison.

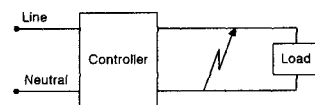
2. Arc current

Arc that electric current discharge by voltage drop with gas exists between two electrode such as electricity circuit. This time, Jules' heat happens between two electrodes and Jules' law is expressed. Jules' heat that happen high heat more than firing point and this heat is happen for electricity fire. Also, gas that exist between two electrode biological by because keep inverse enough temperature and molecules get into dissociation on the whole or partially in arc atoms again ionise. Arc is by structure that electron flows from a electrode to other electrode and temperature and geometrical special quality of arc change according to kind of electricity leading wire, crosssection of leading wire, or electric current, size of voltage and this appears differently according to actuality ionization force, and metallic propensity etc.

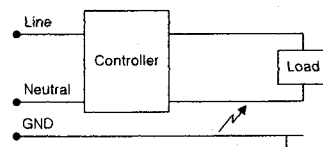
Usually, temperature from arc occurrence part can increase rapidly and ignore the effect of conductivity except this part. Arc resistance can express by mathematical model of differential equation form that use overshoot arc current and voltage to calculate arc resistance because is erratic. Handle arc to electric circuit element simply to solve solution of arc equation and element that effect is less logically ignores. Basic idea to express dynamic arc model curtly supposes by energy Q accumulated in arc that have conductance G relation.



(a) Serial arc current



(b) Parallel arc current



(c) Ground arc current

Fig. 1 Arc generate status

Arc current increase that usually in 3 form appear. According to arc occurrence location by series electric arc, arranging in a parallel electric arc, Ground electric arc appearing (a), (b), (c) of Fig. 1 occurrence form of arc shown.

Electric arc that occurrence frequency is high in parallel arc current. Arc generate status figure 1 is arranging in a parallel electric arc and dangerousness of fire by arranging in a parallel arc is most high. Also, according to above 3 arc issue form, have different special quality. Figure 2 and figure 3 are waveform that connect resistance subordinate to coupled electricity leading wire by series by arc waveform that can appear usually and appear when generate arc electric current by arc generator. Arc electric current happens in terms of normalcy waveform is distorted. This time do shoulder waveform and arc happens in terms of shoulder happens. Arc electric current is detected in 1/60sec.

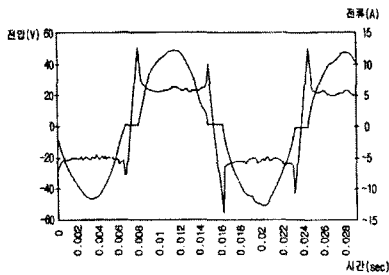


Fig. 2 Current Characteristics by arc in the resistance load

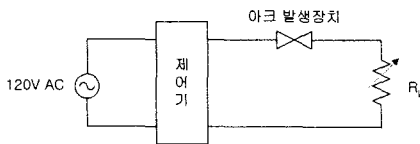


Fig. 3 Arc generate system

Figure 3 displays voltage in sputtering arc occurrence, electric current waveform. Sputtering arc can see that happen often from connection part of code.

3. Arc current controller design

Various kinds arc signal does suitable in electricity. Usually, it is not easy to use analog circuit and divide arc signal that can become one time arc, arc signal and electricity origin of a fire when detect arc electric current signal. Therefore, need to analyze much signals confused with arc electric current to detect arc electric current. Using electric current controller has been planed by purpose to control electric shock etc. to leakage electric current, human body by electricity in old. Have limit that use this controller and can not control arc electric current. This is because leakage current or characteristic of surge electric current is

different certainly with arc electric current special quality. Therefore, must plan controller in new concept for arc electric current control. Also, must be able to sort electricity thrill used usually, arc electric current that happen in noise of arc form that happen in each kind electric appliance and electricity leading wire such as vacuum cleaner. This arc electric current controller detects only arc electric current that happen in electricity leading wire sorting arc electric current that happen in noise and electricity leading wire that happen in this electric appliance and planed controller that can intercept.

Figure 3 displays composition of arc producer for a controller experiment. Arc generator planed to display connection for series arc occurrence and breed electric field, electric arc and ground connection electric arc by alteration of electric circuit. Also, arc producer manufactured by UL regulation.

Electric current of Fig. 3 Arc generate system arc electric current controllers is cut-off department which input can intercept electric current by balloon with input department, have been consisted of processor part that handle delivering detection department which detect arc electric current and data detected. Figure 4 expresses block degree of arc electric current controller.

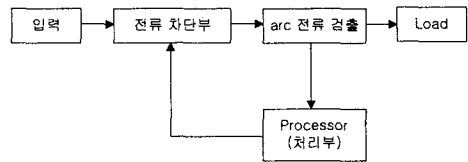


Fig. 4 The block diagram of current controlled system

Is displayed piercing arc detection input if electric current is approved through Fig. 4. The block diagram of current controlled system input part, because it flows electric current interception department. Arc electric current detection department detects electric current by real time. To processor if something wrong electric current is appraised by arc electric current when happened signal panegyric sending of goods become. Signal detected this time does conversion to digital signal that can handle in processor and pass signal at input of processor because signal is analog signal. Generate output signaling because processor that receive digital signal analyzes signal and signal happened has been consisted of structure that can intercept electric current in trip department as signal is passed at trip changing to analog signal.

4. Discussions

Approve actuality arc electric current and experimental planning controller that this treatise presents. Arc electric current does and experimented sampling from 5A to 150A. Figure 5 shows arc electric current that detect in controller.

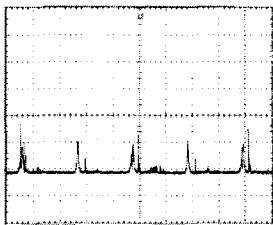


Fig. 5 Arc current waveform

Arc electric current is detected as 60Hz such as frequency of electricity that we use and can see that get into detection in current and same phase.

Figure 6 displays arc electric current and voltage waveform that appear between two electrodes when approved 120A's load.

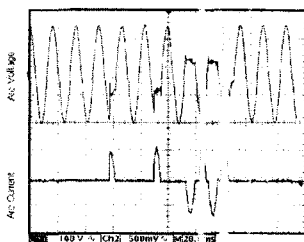


Fig. 6 The current voltage waveform of proposal current controlled system

It know that it happens that is distorted to voltage waveform in terms of arc electric current appears. Time that arc electric current happens is 90ms waveform that is and use current electric current controller and detect. Show that arc electric current is not intercepted despite arc electric current happens here.

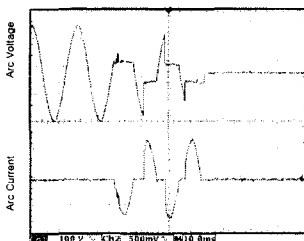


Fig. 7 The current voltage waveform of proposal current controlled system

Fig. 7 shown the current voltage waveform of proposal current controlled systems. Display electric current that Fig. 6 The current voltage waveform of proposal current controlled system figure 7 uses and detects controller that propose in treatise that see, voltage waveform. Because arc electric current begins to happen in figure 7, electric current was intercepted to 32ms, and electric current was intercepted within 0.5s when breded arc in electric current of 5-150A range.

5. Conclusion

This arc electric current controller planed controller that can do control about arc electric current that old electric current controller does not have. Controlled that current used in general environment, arc current that happen in power of low current and low voltage. Through an arc electric current control experiment in various kinds environment that arc electric current can take place, can control something wrong electric current that consist in electricity composition.

Can develop by method that can reduce calamity by electricity in complete work kind and other industry for industry by control arc electric current in that electric current that did not consist so far through this treatise. In this experiment, even if arc electric current happens consecutively in case of old electric current controller, detection and control about arc electric current were impossible. But, proposed arc electric current controller shows that can detect even if arc electric current happens consecutively. Clothes of electricity wiring can see phenomenon that become degradation by much heat that happen when this arc electric current happens. Interception of electric current did to intercept arc electric current within 20ms-0.5s in occurrence of arc electric current according to capacity of arc electric current when used controller that present in this treatise. Proposed arc electric current controller shows more superior performance than existent arc electric current controller.

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