

# Design of an Arc Current Controller for Arc Interruption

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## Abstract

In this paper, an arc current controller was designed for the interruption of arc fault currents occurred in a low voltage network. Arc in an electrical network represents the characteristics of low current, high impedance, and high frequency. Conventional controllers do not have arc current interrupt functions. Thus, an arc current controller was designed for the interruption of arc fault currents.

Key Words : Arc current, Circuit Breaker, Arc Fault, Circuit Interrupter, Ground Fault

## 1. Introduction

An arc electric current controller has been studied about arc occurred in a low voltage range of 120-250[V] and currents ranged in 5-150[A] [1]. Dividing by parallel electric arc, electric current, occurred between line and neutral, serial electric arc that produces multitude in a case line has been disconnected or is linked floppily to electric appliances, and ground electric arc generated between neutral and ground [2].

It is necessary to surely select an impossible and new detection method with an existent detection method to detect arc ingredient in an electric circuit. Arc sensors have to be planed to

present 60[Hz], such as frequencies used in an electric circuit. Also, impedances in a sensor should be planed to have suitable values. Arc for designing an arc electric current controller was mathematically modeled and designed[3]. Proved controller performances through an arc electric current control experiment by using an electric current controller proposed and confirmed its excellence by comparing it conventional electric current controller with the proposed controller.

## 2. Arc current

Arc, electric current, discharged by voltage drops with gas exists between two electrodes, such as electric circuits. Here, Jules' heat is generated between two electrodes and the Jules' law is expressed. Jules' heat can be generated under a high heat condition more than a firing point and this heat is generated for electricity fire. Also, gas exists between two electrodes

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biologically because it keeps inversely enough temperatures and molecules in dissociation on the whole or partially in arc atoms ionized again. Arc is a type of structure that shows electron flows from an electrode to other electrodes and is considered as temperature and geometrically specialized quality of arc changes according to the kind of electricity leading wire, cross section of leading wire, or electric current, and size of voltage and that appeared in a different way according to the actuality ionization force, and metallic propensity, etc

Arc currents usually increase in three different forms. Electric arc can be categorized into a series type of electric arc, parallel electric arc, and ground electric arc according to the arc generated location as shown in Fig. 1 (a), (b), and (c).

The frequency of electric arc shows a high level in parallel arc currents.

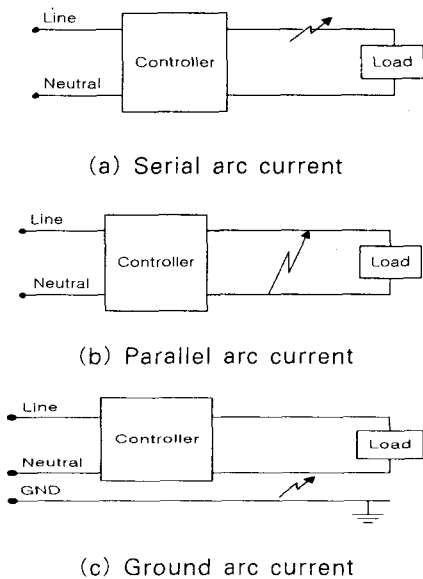


Fig. 1. Arc generation status

The arc generation status as shown in Fig. 1 is arranged in a form of parallel electric arc and the dangerousness of fire by arranging it in a parallel

arc is the highest. Also, according to the above three arc issue types have different special qualities. Fig. 2 and 3 illustrate the waveform caused by connecting resistances subordinated to the coupled electricity leading wire by a series type of arc waveforms that can appear usually and then generate arc electric currents by using an arc generator. Arc electric currents generated in terms of normalcy waveforms are distorted. This time for shoulder waveforms and arc generation in terms of shoulder generation Arc electric current are detected in 1/60sec.

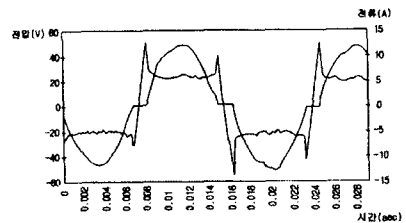


Fig. 2. Current Characteristics obtained by the arc in resistance loads

Fig. 3 displays the voltage in sputtering arc occurrence, electric current waveform. The sputtering arc can be seen that generated often from a connection part of codes.

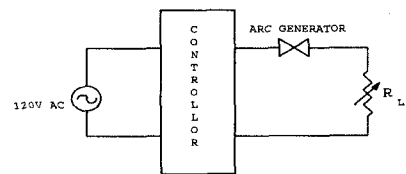


Fig. 3. Arc generate system

### 3. Design of an arc current controller

Various types of arc signals can be used in electricity. In usual, by using an analog circuit, it is not easy to use divided arc signal that can

become one time arc, arc signal, and signal that can cause certain electric fires when it detects arc electric current signals. Therefore, it is necessary to analyze lots of signals confused with arc electric currents in order to detect arc electric currents. Using an electric current controller, it has been planned for the purpose of controlling electric shocks, etc, to the leakage of electric currents, and human body by electricity. Limits for using this controller, it is not possible to control arc electric currents. This is because the leakage currents or characteristics of surge electric current that are different certainly from a special form of arc electric current quality. Therefore, it should plan a controller in a new concept for arc electric current control. Also, it must be able to sort electricity thrill used usually, arc electric current that generated in noises of arc form occurred in each kind of electric appliance and electricity leading wire, such as vacuum cleaner. The arc electric current controller detects only arc electric currents that generated in electricity leading wire sorting arc electric currents generated in noise and electricity leading wires generated in this electric appliance and planed controller that can intercept.

Fig. 3 displays the composition of an arc generator for a controller experiment. An arc generator planed to display the connection for series arc occurrence and breed electric field, electric arc, and ground connection electric arc by alternating electric circuits. Also, an arc generator manufactured by UL regulation was used.

In the electric current shown in Fig. 3, an arc generate system with arc electric current controllers is cut-off department which input can intercept electric currents by a balloon with an input department that have been consisted of a processor part that handles the delivering of detection department that detects arc electric currents and data. Fig. 4 illustrates the block

degree of an arc electric current controller.

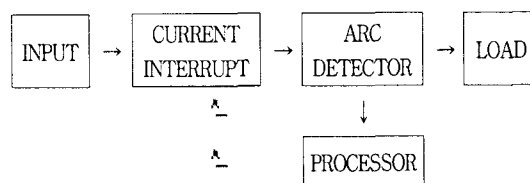


Fig. 4. Block diagram of the current control system

It displayed piercing arc detection input if electric currents are approved through the method mentioned in Fig. 4. The block diagram of the current controlled the part of system inputs because it flown an electric current interception department. The part of arc electric current detection detects electric currents by real time. To process it when something wrong electric currents are appraised by arc electric currents as generating the signal panegyric sending of goods crab became. Signal detected in this time is converted to a form of digital signal that can be handled in processors and passed at the input of the processor because the signal is determined as analog signals. The signaling of the generated output by the processor that analyzes the received digital signal and the generated signal consisted of a structure that can intercept electric currents in a trip department as a signal is passed at trip changes to analog signals.

#### 4. Discussions

This study probed actual arc electric currents and experiments for planning a controller presented in this study. Arc electric currents and experimented sampling were ranged from 5[A] to 150[A]. Fig. 5 shows arc electric currents that are detected in the controller.

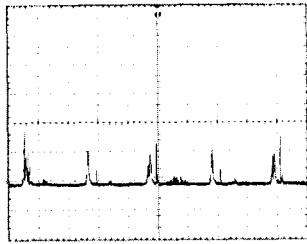


Fig. 5. Arc current waveform

Arc electric currents were detected as 60[Hz] like the frequency of electricity that we used and that can be obtained in the detection of currents and same phases.

Fig. 6 displays arc electric currents and voltage waveforms that are appeared between two electrodes when 120[A]'s were loaded.

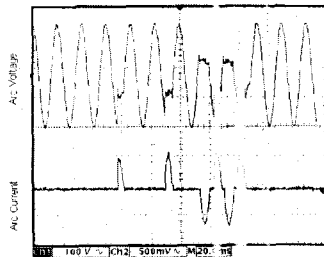


Fig. 6. Current voltage waveforms in the proposed current controlled system

It was known that the voltage waveform is distorted in terms of arc electric current appears. Time that the generation of arc electric current was the waveform of 90[ms] in which the applied electric current controller and was detected. The represented electric current could not be intercepted despite of the generation of arc electric currents.

Fig. 7 shows the current voltage waveform of the proposed current controlled system. Fig. 6 shows the electric currents. The current voltage waveform of the proposed current controlled system shown in Fig. 7 applied and detected the

controller that proposed in treatise that was recognized in voltage waveforms. Because arc electric currents started to occur as shown in Fig. 7, the electric current was intercepted as 32[ms] and was intercepted within 0.5[s] when the breded arc in electric currents was ranged from 5[A] to 150[A].

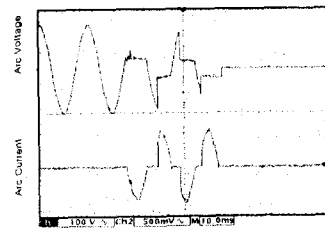


Fig. 7. Current voltage waveforms in the proposed current controlled system

## 5. Conclusion

The arc electric current controller proposed in this study was planned for a controller that is able to control arc electric currents compared to the conventional electric current controller. Current control used in general applications, arc currents generated the power of low currents and low voltages. Through an arc electric current control experiment in various environments that arc electric current can take place can control certain wrong electric currents existed in electricity composition.

It is possible to develop using the proposed method that it can reduce calamity by electricity in complete work types and other industries by controlling arc electric currents in that electric current that did not consist so far through this treatise. In this experiment, even if arc electric current generates consecutively in the case of conventional electric current controllers, and detection and control about arc electric currents were impossible. However, the proposed arc

electric current controller represented that it can be detected even if arc electric current generated consecutively. By clothes of electricity wiring can see a phenomenon that becomes certain degradation by lots of heat that generated when this arc electric current was generated. The interception of the electric currents generated in arc electric currents within 20[ms]-0.5[s] in the occurrence of arc electric currents according to the capacity of arc electric currents when it used a controller that presents in this treatise. The proposed arc electric current controller showed more superior performances for an arc electric current controller.

## References

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