THE SUMMARY OF Ph. D. DISSERTATION

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Title

A Study on an Effect of Surface Film Formation on Electrical Sliding Contacts

Abstract

An electrical sliding contacts mechanism has been used for current correcting system in various electrical equipments. Especially in electrical machines such as dc motors and synchronous generators sliding contacts are necessary for the operation. Nowadays, the improvement of reliability has been required for these systems, and higher reliability is also expected for sliding contacts mechanism.

This dissertation studies the effect of surface film formation on the sliding phenomena. Concretely, surface film conditions are estimated by measurement of contact voltage drop and chemical analysis. Further, relation between surface film formation and sliding contact phenomena are discussed.

This dissertation consists of 7 chapters.

Chapter 1 reviews the present working conditions and problems of sliding contacts mechanism.

Chapter 2 describes the basic phenomenon of current correcting mechanism and electrical sliding contacts.

In Chapter 3, an effect of ambient temperature and humidity on sliding contact is investigated. Especially, relationship between brush wear and

ambient humidity is examined experimentally. Consequently, low brush wear is realized in range of 40% to 60% relative humidity, and surface film formation is shown to be an important factor for the brush wears.

In Chapter 4, the sliding contacts phenomena at various air pressures is discussed. Oxygen concentration is changed by decreasing air pressure. Consequently, the brush wear is increased with decreasing air pressure. On the other hand, the contact voltage drop is decreased and V-I characteristics tends to be linear. Accordingly, an effect of oxide film conditions on brush wear and contact voltage drop is made clear.

In Chapter 5, the sliding contacts phenomena at various oxygen concentrations are investigated under a constant atmospheric pressure. In the pre-chapter, the sliding surface temperature is increased due to low cooling effect at low pressure environment. In this chapter, the oxygen concentration is changed at one atmospheric pressure condition, and nitrogen and argon gases are used as a mixture gas. Consequently, the brush wear is increased with decreasing oxygen concentration. In addition, the increasing contact voltage drop even in inert gas environment is observed.

In Chapter 6, the chemical analysis for sliding surface is carried out. Consequently, the surface film is formed about 35nm in thickness at oxygen concentration 20%, and about 10nm in thickness at pure nitrogen environment. Therefore, it is estimated that the increase of voltage drop in inert gas is caused by adsorption film, not the oxide film. The model of contact resistance is proposed as sum of constriction, oxide film and gas adsorption film resistance.

In Chapter 7, the study is summarized and future works for sliding contact phenomena are shown.

In this dissertation, the new findings on the effect of the oxide film and gas adsorption film on the electrical sliding contacts are obtained.