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Generalized Root-Loci Theory For The Static Scherbius Drive

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Experimental Investigation of the Field and Stray Losses of the End Bells of an Induction Motor

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The stray losses of squirrel-cage-rotor induction motors have a considerable effect on the energy efficiency and temperature rise of the machine. The accuracy in determining the total stray load losses may be improved by developing techniques to measure each component separately. This paper deals with an attempt to measure losses in the end bells due to the end-region leakage flux, through an experimental approach.

The text motor was a 10-hp, 2 pole induction motor. The magnetic field on the interior surface of end bell was measured by search coils and Hall-effect probes under four different conditions: 1) full load, 2) short circuit, 3) reverse rotation, and 4) rotor removed. The results show that the peak flux density in the end bell ranges about 20–54 G at different points under full load. The flux density will increase about 3.8–13 percent with the rotor removed test, which shows the rotor current effect. The saturation of stator core has little effect on the end bell field.

Rotor-removed tests were made under two conditions: with end bells and without end bells. The input power difference between these two tests is considered to be the losses in end bells. This method gives pessimistic results, and the deviation is estimated from the field deviation. The surface eddy current losses were also calculated from the surface flux density. Both the experimental and calculated results show that the end bell losses are less than 1 percent of the total losses, so they have little effect on the performance of the machine.

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Power Frequency Performance of Transmission Line Structure Grounds

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Transmission line structure grounding systems consist of the following.

1) All metallic elements of the structure in the soil or in the concrete of the foundations.
2) Any supplemental grounding electrode such as ground rods, horizontal rings, counterpoises or any combination of these ground conductors.

A generalized method to analyze transmission line grounding is described. Structure grounding models such as concrete encased foundations, vertical rods encased in an elliptic shell, and counterpoises are developed.

A versatile interactive computer program GTOWER capable of handling complex grounding scenarios is introduced. User oriented graphic design techniques for typically occurring situations are described.

Finally computation results are in good agreement with actual 500 kV staged fault test measurements. Fig. 1 illustrates the potential profile measurement results in percent of the tower ground potential rise (GPR). The measurements are compared to the theoretical computation results.

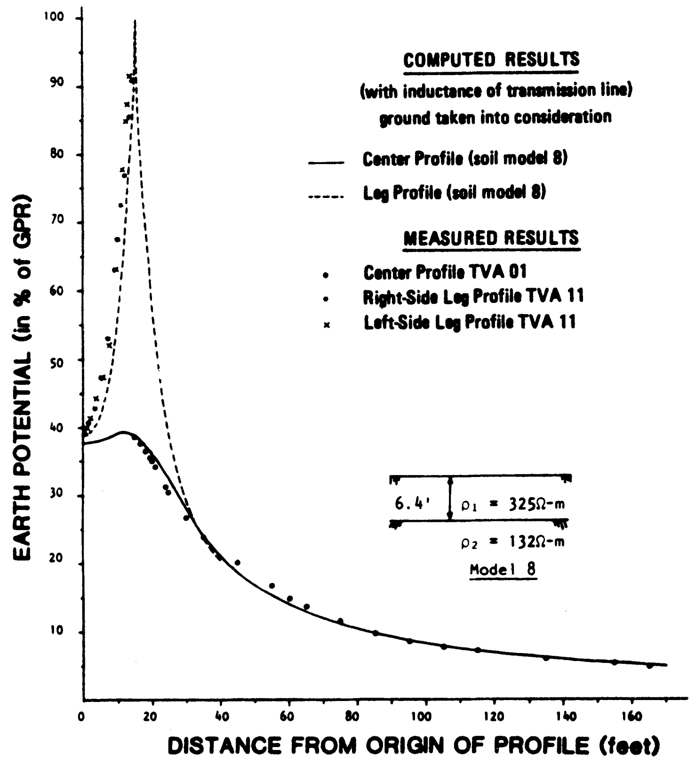

Fig. 1. Measured and computed potential profiles (ground wires connected to tower).

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Generalized Root-Loci Theory for the Static Scherbius Drive

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Introduction

The static Scherbius drive is well-known for its adjustable speed characteristics and performance efficiency. A review of its excellent operational characteristics and moderate cost suggests that it is still very much favored for very large drives on the order of 50 MW.

This paper addresses the operation of the drive when its voltage source type of inverter is in both the steady state and dynamic state. Emphasis is placed on the latter condition with the aim of extending the so-called generalized root-loci theory to this type of drive. Only open-loop operation has been considered to date, but work is underway to include closed-loop feedback situations. The full fifth order model for the motor is used, and due account is taken of the motor leakage reactances. Switching of the power electronics is considered ideal. The system is illustrated in Fig. 1.

The Generalization Scheme

A set of nondimensional parameters composed of a number of machine parameters having a narrow range of variation is used to generalize the analysis. Only the middle portion of this narrow range is needed to make an accurate assessment of the dynamics.

Typical Loci

The general form of the root-loci is shown in Fig. 2. As in previous work, a general nondimensional parameter, $\tilde{K}$, is used as the gain along the loci. These eigenvalues are then denormalized to obtain rad/s.

Discussion

The loci are similar to those used for a squirrel cage. They essentially allow a machine designer to evaluate several design alternatives in a matter of minutes, because he only has to recast the new parameters and/or steady-state operating condition into nondimensional parameters and consult the appropriate curve. Situations similar to those for a squirrel cage emerge, because there is little change in the dynamics when some of the nondimensional parameters change. Consequently, only a relatively small number of loci need be used in the designer's handbook.

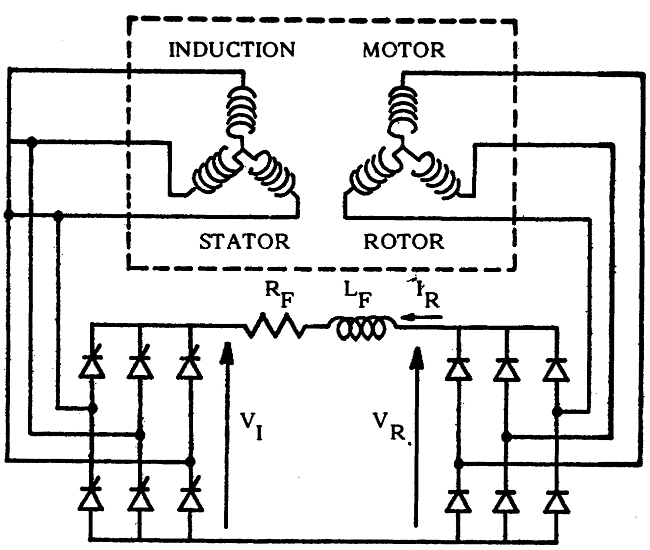

Fig. 1. System configuration.

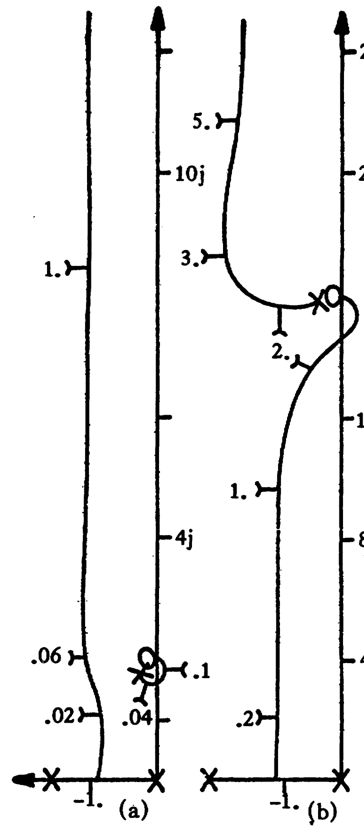

Fig. 2. General form of the root-loci. (a) High normalized frequency. (b) Low normalized frequency.

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Analytical Modeling of Grounding Electrodes Transient Behavior

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The problem under consideration is that of the transient response of grounding systems under current lightning impulses, for example: the transient impedance and/or impulse voltage distribution of counterpoises buried along transmission lines, long conductors buried around the basement of buildings for lightning protection purposes and lightning arrester grounds at substations or distribution networks.

The effectiveness of the tower grounding as a lightning protection element depends upon other parameters on the impulse behavior of grounding electrodes. The lack of adequate data on this phenomenon for different soil parameters has in turn made it impossible to judge surge-reduction factors to account for the reduction of the impulse resistance observed at high surge current magnitudes (compared with the value obtained with a low frequency ac test). The determination of values by extrapolation from meager experimental results inevitably contributes to inaccuracies and uncertain-