Abstract

The operation of the induction machines with asymmetrical armature windings, which used to be studied with the "Symmetrical Component" method or to be studied by very complicated method such as "multi - loop" method, is analyzed with "Bi - directional Revolving - Magnetic - Field Theory" in this thesis. This analytical mathematical model with the inter - turn faults is established and its solution is proposed. Also, one of its especial cases, the analytical mathematical model with the inversely - connected faults is proposed. Experimental verification of the methods proposed is performed on an induction motor (1.5KW, 3 - phase, 1390 rpm, and 50Hz). The corresponding software packages have been developed by the Fortran (WATFOR - 77 V3.1)

This thesis details the analysis of the internal short - circuit (inter - turn) and inversely - connected fault, including the investigation of different number of turns and winding factors. Moreover, a method is suggested to separate the stator and rotor impedances. Under investigation, another method is performed for including the changes on the stator parameters during the inter - turn fault, approximately including the effect of harmonics.

Based on the results obtained by the proposed methods from the software developed, some experiments have been performed in order to verify their analytical mathematical models. Their results match with theoretical values.

Finally, some important points have been concluded in this master thesis:

1. During the internal fault, the stator effective resistances or leakage reactances of various phases, even if referred to the same number of turns, are still different from one another, which must be taken into account or a certain simulation error will occur.
2. Some testing results can be influenced by different structures (either mechanical or electrical) of machines.
3. If the phase sequence of input voltage is different, the fault parameters and characteristics are different, too.
4. During large fault current, the saturation effects on the machine parameters must be taken into consideration.
5. In view of International Relay Protection, the acceptable level of relative error is about ±10%, and the analysis of inter - turn fault and corresponding programs presented in this Master - degree thesis reach the accuracy level so are feasible and useful.

Key words: Induction Machines, Internal Fault, Inversely - Connected Fault, Parameters Of Electrical Machines, Bi - Directional Revolving - Magnetic - Field Theory, Parameters' Testing Methods, Motor Relay Protection, IEEE Std.