

Preface

Modern high-power electrical machines differ in the increased electromagnetic, mechanical, and thermal levels from those of former years. This book will provide progress in the development of heavy electric machine building and raise technical and economic indicators and competitiveness of machines. This is true not only of machines operating in networks of industrial frequency, but also of those in networks with nonlinear elements (in nonlinear networks), for example, with frequency converters.

Practice makes great demands of professional knowledge from their creators, knowledge that should be useful at the modern level of the power industry. Profound academic knowledge only in any single engineering area, for example, in the field of heat transfer, will help an engineer only a little in his production activity. For the solution of a wide complex of problems, an engineer at work is required to have knowledge of electromagnetism, thermal problems of heat transfer and ventilation, durability of structures, insulation of windings, technology, and related areas, all of which are inseparably linked with production.

It should be noted that unfortunately production usually does not give much time to engineers for extensive bibliographic searches and investigations connected with the solution of problems.

For these reasons, an effective link of production with scientific organizations is extremely important (to universities, Russian Academy of Sciences, for instance). For ensuring this link, a factory engineer should be able to:

- formulate correctly problems together with scientists (for example, to be able to correctly formulate boundary conditions if the problem is solved using differential or difference equations describing an investigation process);
- estimate intermediate and end results of solutions and to actively participate in their discussion with experts from scientific organizations;
- use correctly and comprehensively solution results of all these problems in machine construction taking into account factory technological capability.

Let us note that with the use of the results of investigations, factory engineers can make a final decision on the selection of machine construction and its units following the specifications, requests by IEC, and so on.

One of additional peculiarities in the work of modern factory engineers in collaboration with scientists is the search for technological compromises in the solution of production problems, because physical processes are interconnected. The complex solution of engineering problems also has another peculiarity. It is based on the synthesis of factory experience and its use for the generation of uniform investigation, calculation, and design methods for machines of various types produced by a factory.

The contents of this monograph fully meet the requirements of science for engineers at work. The reason is that real problems are solved, connected with the generation and operation of large, modern A.C. machines, including their operation with nonlinear loads.

The monograph shows how to solve specific practical problems. Based on the production and scientific activities of the authors, these problems were solved to the extent they arose in practice. Those results were published in the past 10–15 years and in many articles in domestic [USSR (Russia)] and foreign (Germany, USA, Czech Republic, Poland) journals, and were discussed in a number of international conferences. Their generalization in the form of a monograph allows us to study, in strict and consecutive statements based on uniform positions, the complex problem of creation and operation of motors and generators.

In spite of the fact that many problems studied in this monograph are difficult, much attention is paid to physical processes, so that the contents are illustrated by examples from engineering practice. When writing this book, we have followed the fundamental idea by Dr. Ruedenberg by citing the sentences of the preface of his book (1950) because his intention is exactly the same as ours.

From experience of more than 30 years as an engineer and still longer as a teacher, I have learned that in the minds of students of engineering those methods of solution for intricate problems survive best, until an opportunity for application occurs, which are of the greatest possible simplicity. All the higher and more involved methods are more suitable for applied mathematicians and theoretical researchers than for engineers in practice, even if they are working scientifically. For engineers the physical understanding of the analysis of the example and the ease of discussion of the result are of greater importance than the mathematical rigor and generality of the method of solution.

Reinhold Ruedenberg, *Transient Performance of Electric Power Systems*. McGraw–Hill Book Company, Inc., 1950 (New York–Toronto–London).

All this allows recommending this monograph to a wide range of experts in the field of development, operation, and repair of heavy motors and generators, as well as in the field of study of physical processes in various modes.

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Large A.C. Machines

Theory and Investigation Methods of Currents and
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with Nonlinear Loads

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