THE MAGNETIC CIRCUIT

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V. KARAPETOFF

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BY

V. KARAPETOFF

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PREFACE

THIS book, together with the companion book entitled "The Electric Circuit," is intended to give a student in electrical engineering the theoretical elements necessary for the correct understanding of the performance of dynamo-electric machinery, transformers, transmission lines, etc. The book also contains the essential numerical relations used in the predetermination of the performance and in the design of electrical machinery and apparatus. The whole treatment is based upon a very few fundamental facts and assumptions. The student must be taught to treat every electric machine as a particular combination of electric and magnetic circuits, and to base its performance upon the fundamental electromagnetic relations rather than upon a separate "theory" established for each kind of machinery, as is sometimes done.

The book is *not* intended for a beginner, but for a student who has had an elementary descriptive course in electrical engineering and some simple laboratory experiments. The treatment is somewhat different from that given in most other books dealing with magnetic phenomena. It is based directly upon the circuital relation, or interlinkage, between an electric current and the magnetic flux produced by it. This relation, and the law of induced electromotive force, are taken to be the fundamental phenomena of electro-magnetism. No use whatever is made of the usual artificial concepts of unit pole, magnetic charge, magnetic shell, etc. These concepts of mathematical physics, together with the law of inverse squares, embody the theory of action at a distance, and are both superfluous and misleading from the modern point of view of a continuous action in the medium itself.

The ampere-ohm system of units is used throughout, in accordance with Professor Giorgi's ideas, as is explained in the

appendices. Those familiar with Oliver Heaviside's writings will notice his influence upon the author, in particular with regard to a uniform and rational nomenclature. The author trusts that his colleagues will judge his treatment and nomenclature upon their own merits, and not condemn them simply because they are different from the customary treatment.

In the first four chapters the student is introduced into the fundamental electromagnetic relations, and is made familiar with them by means of numerous illustrations taken from engineering practice. Chapters V to IX treat of the flux and magnetomotive force relations in electrical machinery, first at no load, and then under load when there is an armature reaction. The remaining four chapters are devoted to the phenomena of stored magnetic energy, namely inductance and tractive effort. The subject is treated entirely from the point of view of an electrical engineer, and the important relations and methods are illustrated by practical numerical problems, of which there are several hundred in the text. All matter of purely historical or theoretical interest has been left out, as well as special topics which are of interest to a professional designer only. An ambitious student will find a more exhaustive treatment in the numerous references given in the text.

Many thanks are due to the author's friend and colleague, Mr. John F. H. Douglas, instructor in electrical engineering in Sibley College, who read the manuscript and the proofs, checked the answers to the problems, and made many excellent suggestions for the text. Most of the sketches are original, and are the work of Mr. John T. Williams of the Department of Machine Design of Sibley College, to whom I am greatly indebted.

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CONTENTS