

THE ELECTRIC CIRCUIT

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The Electric Circuit by V. Karapetoff

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V. KARAPETOFF

**THE ELECTRIC
CIRCUIT**

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BY
V. KARAPETOFF

SECOND EDITION

REWRITTEN, ENLARGED AND ENTIRELY RESET
SECOND IMPRESSION

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1912

PREFACE TO THE FIRST EDITION

THIS pamphlet, together with the companion pamphlet entitled *The Magnetic Circuit*, is intended to give a student in electrical engineering the theoretical elements necessary for calculation of the performance of dynamo-electric machinery and of transmission lines. The advanced 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 theoretical relations rather than upon a separate "theory" established for each kind of machinery, as is often done.

The first chapter is devoted to a review of the direct-current circuit, the next four chapters treat of sine-wave alternating-current circuits, and the last two chapters give the fundamental properties of the electrostatic circuit. All the important results and methods are illustrated by numerical problems of which there are over one hundred in the text. The pamphlet 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 made as far as possible uniform, so that the student sees analogous relations in the direct-current circuit, in the alternating-current circuit, in the electrostatic circuit and finally in the magnetic circuit. All matter of purely historical or academic interest, not bearing directly upon the theory of electric machinery, has been left out. An ambitious student will find a more exhaustive treatment in the works mentioned at the end of the pamphlet.

The electrostatic circuit is treated in accordance with the modern conception of elastic displacement of electricity in dielectrics. No use has been made of the action of electric charges at a distance, or of the electrostatic system of units. The volt-ampere-ohm system of units is used for electrostatic calculations,

in accordance with Professor Giorgi's ideas (see a paper by Professor Ascoli in Vol. I of the *Transactions of the International Electrical Congress*, St. Louis, 1904). Those familiar with Oliver Heaviside's writings will notice his influence upon the author, particularly in Arts. 22 and 23,* where an attempt is made at a rational electrostatic nomenclature.

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.

CORNELL UNIVERSITY, ITHACA, N. Y.
August, 1910.

PREFACE TO THE SECOND EDITION

THE first edition of this book was issued as a pamphlet of some 85 pages which the author used for two years in his classes to supplement some other texts. In its present edition, the book is made independent of these texts, so that its size had to be more than doubled. The book has been practically rewritten, and completely reset in type. All the cuts are new. The topics are treated somewhat more in detail, and a large number of practical problems are provided. The new topics added are: the resistance of conductors of variable cross-section, the electrical relations in polyphase systems, performance characteristics of the transmission line, transformer and induction motor and the permittance (electrostatic capacity) of transmission lines.

In the treatment of alternating currents by means of complex quantities, particular attention is paid to the trigonometric form $E(\cos \theta + j \sin \theta)$ of the expression for a vector. In fact, the transmission line, the transformer, and the induction motor to some extent, are treated in this trigonometric form. The author trusts that the reader will find this somewhat novel treatment more convenient in numerical applications than the usual form $e + je'$.

* Chapter 14 in the second edition.

Since the appearance of the first edition, the author has been encouraged by some of his colleagues in his treatment of the electrostatic circuit in the ampere-ohm system of units, a treatment which involves the use of permittances in farads and elastances in darafs. He has extended this treatment to the calculation of capacity of cables and transmission lines. The students grasp this mode of presentation much more readily than the old-fashioned way; based upon the law of inverse squares and electric charges acting at a distance. The purpose of the present treatment is to impress them with the idea of a continuous action in the medium itself and with the rôle of the dielectric.

Mr. F. R. Keller of the electrical department of Columbia University has read and corrected the manuscript and the proofs of the second edition, and checked the answers to the new problems. The author wishes to express sincere appreciation of his painstaking, faithful and competent work. The author is also indebted to Mr. John F. H. Douglas for critically reading the galley proof of the second edition.

CORNELL UNIVERSITY, ITHACA, N. Y.
May, 1912.



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