

# BASIC RADIO

*The Essentials of*

**ELECTRON TUBES AND THEIR CIRCUITS**

*By*

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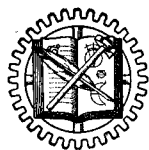
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## PREFACE

Electron tubes and circuits, with their wide ramifications in radio and line communications, in industrial production and in research work, are so numerous and complex as to bewilder the beginner. He needs a guide which will present the important items in orderly sequence from the simple to the complex.

Many special tubes and circuits have been tested and discarded during the past thirty years. Others have proven their merit and remain with us today, and will be used in the future. These are the ones to study. This book attempts to select the important and the tested, the *basic* tubes and circuits and to present both a simple explanation of how they work and where they are applied, together with sufficient numerical constants and other details to make them readily understandable.

The book is designed for the student with only a limited background in physics and mathematics. Only too often the design and principle of operation of radio gear is either oversimplified or is clouded in elaborate mathematical form. There is a happy medium, striven for in this book. The more involved material is presented graphically; the few simple, widely used equations are explained in detail.

This is a textbook. The subject is unfolded systematically from the simpler to the more complex ideas and equipment. The preliminary chapters cover the fundamental concepts of direct and alternating currents and of radiation and the propagation of radio waves. The elementary subjects, such as two-electrode tubes, gas-filled tubes, photoelectric cells, etc., are then examined in detail utilizing only the ideas and theories presented in the previous chapters. This procedure is continued throughout all of the elementary subjects. The student is then prepared for the more intricate conditions used in feedback amplifiers, transmitters and receivers, square-wave and pulse generators, television equipment, oscilloscope testing, superheterodyne circuits and alignment, frequency modulators, direction finders, and the like. To emphasize the comparative size of circuits and the length of radio waves, the succeeding chapters carry the subject matter from the long and

short transmission lines and antennas through ultra-high frequency transmitters and receivers into the realm of microwaves.

The book contains over four hundred problems of a practical nature designed to assist the student to apply and fix firmly in his mind the principles he has been studying. The problems for each chapter have been graded in order of difficulty. Some of them have been purposely designed so that the student will need to consult radio handbooks or more advanced texts in order to obtain all the data necessary for their solution. In a few cases, the problem can only be answered after practical experience with the equipment itself, or in consultation with someone who has had such training. It is hoped that the study of this book will be accompanied either by a laboratory course or at least with dimensions of the equipment, or with field tests.

Permission to reproduce numerous circuits and photographs has been generously granted by the Institute of Radio Engineers, Electronics, The Journal of Applied Physics, the Bell System Technical Journal, The "Radio" Handbook, The General Radio Experimenter, The RCA Review, The Western Electric Company and The National Bureau of Standards. This co-operation is greatly appreciated by the author. The abbreviation, "From E. and N. P.," on certain of the cuts refers to their source as coming from the author's book, "Electron and Nuclear Physics."

The author wishes particularly to thank Mr. E. B. Redington for his assistance in the preparation of the problems, and Lieutenants (j.g.) Norman Oleson (Ph.D.), Robert Reed-Hill, and Preston Taulbee of the Science Department of the United States Coast Guard Academy for their advice and co-operation during the preparation of the book. The author has drawn freely from many textbooks, scientific magazines, and trade journals of this and foreign countries from the time he first taught in the Army Radio School at Colorado College in 1918 up to the present. In particular, he appreciates the merit of the tried and tested circuits, their constants and constructional details as developed by the radio amateurs and presented in the "Radio Amateur's Handbook" and in The "Radio" Handbook.

J. BARTON HOAG

U. S. COAST GUARD ACADEMY,  
NEW LONDON, CONNECTICUT,  
April, 1942

*Special Acknowledgment*

A majority of the problems and questions  
at the end of this book were prepared by

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