

# FUNDAMENTALS OF ENGINEERING ELECTRONICS

BY

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## PREFACE

It has for some time been a conviction of the author and his associates that, no matter how facile an engineer may be in the manipulation of electronic circuits, his effectiveness is distinctly limited unless he has a satisfactory understanding of the operating principles of the electronic circuit *elements* that he uses. The ability to grasp readily the reasons for the behavior of new devices as they appear is especially important. The relative ease with which electronic devices can be made to order to accomplish specific purposes is an added reason for placing initial emphasis in electronics instruction on internal operating principles. These considerations have been the basis for the method of instruction in electronics at the University of Michigan ever since courses in the subject were introduced about eight years ago.

In the preparation of this book, which is an outgrowth of the author's teaching experience, an attempt has been made to maintain a proper balance between two underlying objectives:

(1) To give the reader a realistic and quantitatively usable conception of the principles that govern the internal behavior of electronic devices (this is the primary objective); and

(2) To familiarize the reader with methods of circuit analysis customarily employed in connection with the most common engineering applications of electronic devices.

Accordingly, the chief emphasis in this book is placed on internal operating principles. A large part of the text is devoted to a study of the effects of the use of various geometries and materials in electronic devices, and a relatively small part to circuit studies.

The point of view is that of an engineer: Principles of importance in engineering work are selected for study; illustrations of these principles are drawn from engineering practice; and physical concepts are so treated as to permit ready determinations of *magnitudes*. Familiarity with relative magnitudes is of course essential to a satisfactory engineering understanding of any scientific subject-matter.

Reasoning from purely physical concepts has been used rather than mathematical formulation, wherever the latter could be avoided without loss of definiteness. However, a large part of the subject-matter requires mathematical analysis for the establishment of proper quantitative concepts, and wherever that is true, mathematical methods have been used freely.

It is perhaps unfortunate that one of the most difficult subjects treated falls naturally very early in the text, in Chapter II. However, in his work with undergraduates the author has tried teaching triode electrostatic field analysis later in the course, and has also tried a qualitative treatment, involving a statement of the general results with little attention to the mathematical formulation. Such methods have not proved satisfactory. The conclusions reached by means of field analyses are rather striking, and class enthusiasm is dampened if denied satisfaction of the curiosity that naturally arises as to how these conclusions are arrived at.

This book has been especially designed for use in full-year courses for undergraduate or graduate students; however, the content is so arranged that it is readily adaptable, with certain omissions, for one-semester courses. It is hoped that the book will also find a place as a reference work for engineers in industry.

The author wishes to acknowledge gratefully the encouragement and active assistance rendered during the entire period of development of the electronics work by Professors A. D. Moore, S. S. Attwood, and L. N. Holland, all of the Electrical Engineering Department of the University of Michigan; also to express appreciation of the care and thoughtfulness with which portions of the manuscript were reviewed and ably criticized by Professor Attwood, and by Professor Samuel Goudsmit of the Physics Department of the University of Michigan. The author is indebted to all other members of the staff of the Electrical Engineering Department, and to many of those in the Physics Department, especially to Professor O. S. Duffendack, for ever-ready advice and counsel; also to Messrs. Ralph Bodine and John Lopus for the thoughtful and careful draftmanship exercised during the preparation of the original drawings for the figures.

W. G. Dow

*March 20, 1937*

# CONTENTS

## PART I

### ELECTRONS

#### INTRODUCTION

##### HIGH-VACUUM THERMIONIC TRIODES

SECTION	PAGE
1. A Triode in a Simple Amplifier Circuit.....	1
2. Electrostatic Control of Plate Current by Grid and Plate Voltages.....	2
3. Organization of Text Material.....	6

#### CHAPTER I

##### POTENTIAL DISTRIBUTION DIAGRAMS

4. Units and Conversions.....	7
5. Electric Intensity and Potential; Force on an Electron.....	8
6. Poisson's and the Laplace Equations; Potential Distribution Diagrams in One and Two Dimensions.....	9
7. Surface and Space-Charge Density in Potential Diagrams.....	13
8. Potential Diagrams for One-Dimensional Fields in Regions Containing Space Charge.....	15
9. Spherical and Cylindrical Coordinates.....	17

#### CHAPTER II

##### THE ELECTROSTATIC FIELD OF A TRIODE

10. Conformal Transformations.....	20
11. Conformal Transformation of a Parallel-Plane Triode.....	24
12. Placement of Charges to Satisfy Triode Boundary Conditions.....	25
13. Equations for Space-Charge-Free Potential Distribution.....	31
14. Charge Magnitudes.....	33
15. Space-Charge-Free Off-Cathode Field Intensity.....	34
16. Dependence of $F_0$ on an Equivalent Voltage.....	35
17. Electrostatic Coefficients; Cathode Charge Always Proportional to an Equivalent Voltage.....	36
18. Amplification Factor $\mu$ in Terms of Dimensions.....	39
19. Spacing of Equivalent Space-Charge-Free Diode.....	43
20. Parallel-Plane Grid and Plate Structure with Filamentary Cathode.....	44
21. Conformal Transformation of a Cylindrical Triode.....	45
22. Amplification Factor and Spacing of Equivalent Diode, for a Cylindrical Triode.....	49
23. Limitations to the Validity of Triode Geometrical Relations.....	51
24. Mapping the Fields.....	52

## CHAPTER III

SECTION	ELECTRON BALLISTICS	PAGE
25.	Acceleration Due to an Electric Field . . . . .	56
26.	Velocity and Potential; the Electron Volt . . . . .	57
27.	Directed Energies; Velocity Measurable in Square Root Volts . . . . .	58
28.	Electron Deflection in Passing Through Grids . . . . .	60
29.	Force on an Electron Moving in a Magnetic Field . . . . .	61
30.	Path Circular or Helical in a Uniform Magnetic Field; Superposition of Magnetic Motions . . . . .	62
31.	Opposing Electric and Magnetic Fields; Moving Magnetic Fields . . . . .	64
32.	Cycloidal and Trochoidal Motion in the Presence of Uniform Electric and Magnetic Fields . . . . .	66
33.	Motion between Concentric Cylinders with Magnetic Field Parallel to Axis	70
34.	Mass: a Property Due to Electric and Magnetic Fields . . . . .	75
35.	"Rest Mass" of an Electron; Increase of Mass at Large Velocities]. . . . .	75
36.	"Transverse Mass" and "Longitudinal Mass" . . . . .	77
37.	Relation of Velocity and Mass to Accelerating Potential . . . . .	78
38.	Motions in Irregularly Curved Fields . . . . .	79

## CHAPTER IV

## CATHODE RAYS

39.	Cathode Ray: a Name for a Beam of Electrons . . . . .	84
40.	The Cathode-Ray Oscillograph . . . . .	84
41.	Voltage Sensitivity . . . . .	85
42.	Magnetic Sensitivity . . . . .	87
43.	Measuring-Circuit Relations . . . . .	88
44.	Photographic and Visual Sensitivity; Penetration of High-Velocity Elec- trons . . . . .	89
45.	Production and Focusing of the Beam . . . . .	90
46.	Time-Axis Motion . . . . .	93
47.	Cathode Rays as Current Carriers; Television . . . . .	95

## CHAPTER V

## SPACE-CHARGE FLOW

48.	Equilibrium between Energy, Flow, and Poisson's Equations . . . . .	97
49.	Zero Gradient at the Cathode: a Condition for Maximum Space Charge Consistent with Steady Current Flow . . . . .	98
50.	Space-Charge-Limited Current Proportional to the Three-Halves Power of the Voltage . . . . .	99
51.	Space-Charge-Limited Volt-Ampere Relation, Parallel Plane Electrodes . . . . .	100
52.	Space-Charge-Limited Current in a Parallel-Plane Triode . . . . .	102
53.	Magnitude of the Spacing-Factor $s$ , Parallel-Plane Triode . . . . .	103
54.	Space-Charge-Limited Volt-Ampere Relationship, Concentric Cylinders . . . . .	106
55.	Space-Charge-Limited Current in a Cylindrical Triode . . . . .	109
56.	Effect of Potential Variation along the Cathode on Space-Charge-Limited Current . . . . .	112
57.	Capacitance between Electrodes Carrying a Space-Charge-Limited Current	116
58.	Energy Dissipation at the Plate . . . . .	117

## CONTENTS

vii

### CHAPTER VI

SECTION	TRIODES, TETRODES, PENTODES	PAGE
59.	Grids Permit Electrostatic Control of Space-Charge-Limited Triode Current	121
60.	Current-Voltage Relations in Triodes	121
61.	Grid Current	124
62.	Tetrodes or Screen-Grid Tubes	126
63.	The Various $\mu$ 's for a Tetrode	129
64.	Analysis of Screen Grid Characteristics; Secondary Emission	130
65.	Shielding of Screen by Oscillating Space Charge	134
66.	Pentodes, Beam Power Tubes, and Critical Distance Tubes	135
67.	Oscillating Space Charge	141
68.	Coupling between Internal and External Oscillations	143

### CHAPTER VII

#### THERMIONIC CATHODES

69.	Electron-Emitting Efficiency of a Cathode Surface	148
70.	Dushman's Equation Relating Thermionic Current Density and Temperature	149
71.	The Voltage Equivalent of Temperature	150
72.	Energies of Escaping Electrons	152
73.	Graphical Evaluation of Emission Constants	153
74.	Cathode Power Dissipation	155
75.	Heat Transfer by Radiation; Emissivity Coefficients	156
76.	Temperature Measurements; Lead Losses	159
77.	Overall Relationship between Thermionic Current Density and Power	159
78.	Inward-Radiating Cathodes	160
79.	Low-Work-Function Surfaces	161

### CHAPTER VIII

#### WORK FUNCTIONS OF HOMOGENEOUS SURFACES

80.	Ionizing Potentials of Atoms	163
81.	Free Electrons in Metals	164
82.	Work Function	164
83.	Energy-Level Diagrams; Gross and Net Work Function	165
84.	Normal (Low-Temperature) Distribution of Kinetic Energy	166
85.	Thermionic Emission	167
86.	Why Kinetic-Energy Levels have Finite Spacings; the "Quantum" of Action	168
87.	Why Each Kinetic-Energy Level Can Accommodate Only a Limited Number of Electrons; the "Exclusion Principle"	170
88.	Electron Spin	172
89.	Actual Energy of the Normal Maximum Level	173
90.	Normal Average Energy	174
91.	Normal Energy Distribution	175
92.	The Outward Flight of an Electron; the Image Force	176
93.	Relation between Potential-Energy Curve and Force Curve	178
94.	Potential-Energy Diagrams vs. Potential Distribution Diagrams	180
95.	Gross Work Function Inversely Proportional to Atomic Spacing	182

## CHAPTER IX

SECTION	ENERGY-LEVEL DIAGRAMS OF METALS	PAGE
96.	Purposes for Which Energy-Level Diagrams are Useful . . . . .	188
97.	Valve Action Outside a Thermionic Cathode Surface When Current Is Space-Charge-Limited . . . . .	188
98.	Magnitude of the Negative Potential Dip Outside the Cathode . . . . .	190
99.	Conditions in a Triode at and Near Cut-Off . . . . .	191
100.	Reduction of Work Function by Strong External Fields . . . . .	192
101.	Contact Difference of Potential . . . . .	194
102.	Effect of Contact Difference of Potential on Triode Plate Current . . . . .	196
103.	Thoriated Tungsten Cathodes . . . . .	197
104.	Oxide-Coated Cathodes . . . . .	199
105.	Potential-Energy Diagrams for Polarized Atomic Layers . . . . .	201
106.	Transmission of Electron Waves Through Potential-Energy Humps . . . . .	204
107.	"Saturation"; Failure of Composite Surfaces to Saturate; Grid Control of Temperature-Limited Currents . . . . .	204

## CHAPTER X

## DISTRIBUTIONS OF RANDOM VELOCITIES OF GAS PARTICLES

108.	Dependence of Average Energy on Temperature, for Ordinary Gases and Electronic Gases Within Metals . . . . .	208
109.	The "Most Probable" Energy Distribution . . . . .	210
110.	Symbols and Terminology for Distribution Curves and Equations . . . . .	212
111.	Maxwellian Distribution Curves for Total Velocities in an Ordinary Gas . . . . .	215
112.	Equations for Total-Velocity Maxwellian Distribution Curves; Average Total Velocity and Energy . . . . .	217
113.	Equations for Total-Velocity Maxwellian Integrated Distribution Curves . . . . .	219
114.	Curves and Equations for $x$ -Directed Maxwellian Velocity Distributions . . . . .	220
115.	Relations between Total and $x$ -Directed Maxwellian Distribution Equa- tions . . . . .	222
116.	Total-Velocity Distribution Curves and Equations for a Degenerate Gas . . . . .	224
117.	$x$ -Directed Velocity Distribution Curves and Equations for a Degenerate Gas . . . . .	227
118.	High-Velocity $x$ -Directed Distribution for the Electrons within a Metal . . . . .	230

## CHAPTER XI

## ELECTRICAL EFFECTS OF RANDOM MOTIONS

119.	Rate at Which Gas Particles Arrive at a Boundary Wall . . . . .	233
120.	Derivation of Dushman's Equation for Thermionic Current Density . . . . .	234
121.	Distribution of Initial Velocities Among Electrons Emitted from a Ther- mionic Surface . . . . .	236
122.	Equations and Averages for the "Time-Exposure-over-a-Surface" Velocity Distribution of Escaping Electrons . . . . .	238
123.	Average Energies of Arriving Maxwellian Particles and of Escaping Elec- trons . . . . .	241
124.	Effect of Initial Velocities on Space-Charge-Limited Current Density, Plane Cathode . . . . .	242

## CONTENTS

ix

SECTION	PAGE
125. Effect of Initial Electron Velocities on Space-Charge-Limited Current Flow from a Cylindrical Cathode . . . . .	246
126. Shot Effect and Voltages within Conductors Due to Random Motions; Noise Level . . . . .	248
127. Random Current Density in an Ion or Electron Gas . . . . .	250
128. Boundary Currents in a Conducting Gas; Sheath Penetration . . . . .	251
129. "Time-Exposure-over-a-Surface" Distribution of Penetrating Electrons . .	252
130. Richardson's Equation for Thermionic Emission . . . . .	253
131. Equilibrium between Different Potentials in an Enclosure; the Boltzmann Relation . . . . .	253
132. Free Paths of Gas Particles . . . . .	256

## CHAPTER XII

### AMPLIFIER CIRCUIT PRINCIPLES

133. Plate Resistance and Grid-Plate Transconductance of High-Vacuum Thermionic Tubes . . . . .	263
134. The Amplification Factor . . . . .	264
135. Evaluation of Tube Constants . . . . .	266
136. Simple Amplifier Circuits; the Load Line . . . . .	266
137. Point of Zero Excitation; Current-Voltage Locus; Dynamic or Tube-and-Circuit Characteristic . . . . .	268
138. Relations between Alternating-Current and Direct-Current Components of Voltage and Current . . . . .	270
139. Elliptical Current-Voltage Locus with Reactive Load . . . . .	272
140. The Alternating-Current Equivalent Circuit; Phase Reversal in an Amplifier . . . . .	275
141. Slope of the Dynamic Characteristic . . . . .	280
142. Uses and Limitations of the Equivalent Circuit; Harmonic and Frequency Distortion . . . . .	281
143. Choice of Tube and Load Resistances . . . . .	283
144. Maximum Undistorted Power Output . . . . .	284
145. Plate Circuit Efficiency and Power Dissipation . . . . .	286
146. Use of Chokes and Condensers to Provide "Parallel Feed" of Direct-Current Power to the Plate . . . . .	288
147. Frequency Limitations of Parallel-Feed Amplifiers . . . . .	290

## CHAPTER XIII

### HARMONICS; CLASS B AND PUSH-PULL AMPLIFIERS

148. Straightness of the Dynamic Characteristic a Criterion of Freedom from Harmonic Distortion . . . . .	296
149. Parabolic Dynamic Characteristic Introduces a Second Harmonic . . . . .	298
150. Third Harmonic Introduced by Dynamic Characteristic of Cubic Form . .	300
151. Class B Amplifiers . . . . .	303
152. Class B Push-Pull Amplifiers . . . . .	305
153. Dynamic Characteristics and Equivalent Circuits for Push-Pull Amplifiers	307

## CHAPTER XIV

SECTION	AMPLIFIER COUPLING; OSCILLATORS	PAGE
154.	Cascading of Amplifiers; Voltage Gain and Decibel Gain . . . . .	314
155.	Direct Coupling between Stages . . . . .	315
156.	Transformer and Condenser Coupling . . . . .	316
157.	Voltage vs. Power Amplification . . . . .	318
158.	Resistance-Condenser Coupling . . . . .	318
159.	Transformer Coupling, Infinite Output Resistance . . . . .	320
160.	Transformer Size and Turn Ratio . . . . .	323
161.	Transformer Coupling to a Finite Load Resistance . . . . .	324
162.	Regeneration . . . . .	326
163.	Tuned Plate Oscillator . . . . .	326
164.	Other Regenerative Oscillator Circuits . . . . .	330
165.	Tuned Amplifiers . . . . .	330
166.	Dynatron Oscillators . . . . .	331

## PART II

## ELECTRONS, ATOMS, AND RADIATION

## CHAPTER XV

## ATOMIC ENERGIES

167.	The Function of Positive Ions in Gaseous Conducting Devices . . . . .	338
168.	Energy Required for Ionization; Energy-Level Diagrams . . . . .	339
169.	Excited States of Atoms . . . . .	340
170.	Transitions between Levels . . . . .	341
171.	Electron-Volt Measure of the Color of Light . . . . .	343
172.	Scales on Energy-Level Diagrams . . . . .	346
173.	Resonance Radiation; Photoelectric Action . . . . .	346
174.	Spectral Symbolism and Electron Configuration . . . . .	347
175.	Atomic Number; Isotopes . . . . .	347
176.	Energy Levels As Related to Electronic Motions . . . . .	348
177.	Energies of the Levels; One Electron in a Nuclear Field . . . . .	349
178.	Limitations of the Orbital Physical Picture . . . . .	351
179.	Three-Dimensional Quantization . . . . .	351
180.	The Exclusion Principle; Grouping of the Levels . . . . .	353
181.	Shells . . . . .	354
182.	Relations between Electron Arrangement and Chemical and Physical Properties of the Elements . . . . .	355
183.	Magnetic Quantization: $2n^2$ . . . . .	355
184.	Action and Angular Momentum . . . . .	358

## CHAPTER XVI

## ENERGY LEVELS FOR PARTICULAR ELEMENTS

185.	Identification of Levels . . . . .	360
186.	Energy Levels for the Arc Spectrum of Sodium . . . . .	360
187.	Term Values . . . . .	360
188.	Configuration . . . . .	361

## CONTENTS

xi

SECTION	PAGE
189. Symbols . . . . .	361
190. The Meanings of Symbols . . . . .	361
191. Symbols for Sodium . . . . .	363
192. <i>J</i> -Values . . . . .	363
193. Selection Principles . . . . .	363
194. Series of Levels in Sodium . . . . .	364
195. Mercury . . . . .	364
196. Mercury Metastable States . . . . .	365
197. Negative Term Values . . . . .	367
198. Light from Mercury Vapor and from Sodium Vapor; Fluorescence . . . . .	367
199. Neon . . . . .	369
200. Copper . . . . .	371

## CHAPTER XVII

### PHOTOELECTRIC EMISSION AND ELECTROMAGNETIC WAVES

201. Photoelectric Emission . . . . .	376
202. Propagation of Radiant Energy . . . . .	380
203. A Plane-Polarized Electromagnetic Wave; the Radiation Vector . . . . .	380
204. The Mechanism of Propagation . . . . .	382
205. Details of the Field around a Radiating Energy Source . . . . .	384
206. Polarized Light . . . . .	386
207. Composition of Light from Various Source Particles . . . . .	387
208. Interference . . . . .	387
209. Reflection; Standing Waves and Nodal Layers . . . . .	388
210. Light Penetration and Absorption . . . . .	391
211. Mechanism of the Photoelectric Ejection of Electrons . . . . .	391
212. Color Sensitivity; Selective Photoelectric Emission . . . . .	393
213. Energies of Escaping Electrons . . . . .	396

## CHAPTER XVIII

### PHOTOSENSITIVE DEVICES

214. Volt-Ampere Response of a Vacuum Phototube in Which the Electron Receiver Surrounds the Emitter . . . . .	399
215. Effects of Contact Difference of Potential in a Phototube . . . . .	399
216. Volt-Ampere Response of a Vacuum-Type Tube in which the Emitter Surrounds the Receiver . . . . .	400
217. Use of Gas to Amplify Photoelectric Currents . . . . .	401
218. Mechanism of Gas Amplification; Elastic and Inelastic Collisions . . . . .	402
219. Dependence of Amplification on Electrode Spacing and on Ionization Rate . . . . .	406
220. Dependence of Ionization Rate on Gas Concentration and on Field Strength . . . . .	406
221. Gas Amplification Limited by Space Charge . . . . .	410
222. Volt-Ampere Properties of Gas-Filled Phototubes; Phototube Circuit Analysis . . . . .	413
223. Rectifier-Type or "Sandwich" Photocells; Semiconductors . . . . .	416
224. Photoconducting Cells . . . . .	423
225. Time-Lag in Photosensitive Devices . . . . .	423

## CHAPTER XIX

SECTION	ELECTRIC ARCS AND GLOW DISCHARGES	PAGE
226.	Appearance . . . . .	426
227.	Definite Values of Arc Current, not of Arc Voltage, Required by Circuits . . . . .	426
228.	Plasmas and Plasma Boundaries . . . . .	427
229.	Properties of a Plasma . . . . .	429
230.	Recombination Occurs in Boundary Regions, Not in Plasmas . . . . .	430
231.	Scattering of Electron Energies; Electron Velocity Distributions . . . . .	432
232.	Plasma Cross Section; Equilibrium, Pinch Effect, and a Least-Energy Requirement . . . . .	434
233.	Ion and Electron Mobilities; Drift Currents in a Plasma . . . . .	435
234.	Drift Velocities of Plasma Electrons . . . . .	438
235.	Proportionality of Drift Velocities of Electrons and Ions to the Electric Field Strength or Its Square Root . . . . .	441
236.	Drift Velocities of Plasma Ions and Electrons . . . . .	442
237.	Mobilities of Townsend Current Ions and Electrons . . . . .	444
238.	Rate of Ion Production and Ion Loss in a Plasma . . . . .	444
239.	Energy Transfer in Low-Pressure Plasmas . . . . .	446
240.	Energy Input to the Plasma . . . . .	448
241.	Static Arc and Glow Volt-Ampere Curves; Empirical Relations . . . . .	449
242.	Arc and Glow Stability; Oscillating Arc Circuits . . . . .	449
243.	Voltage and Current Variations in a High-Frequency Pulsating Arc . . . . .	451
244.	Voltage and Current Relations in Alternating-Current Arcs; Reignition . . . . .	453

## CHAPTER XX

## PLASMA BOUNDARY REGIONS

245.	The Cathode Spot and Cathode Fall Space of a Glow Discharge . . . . .	458
246.	The Effect of Changes of Gas Concentration in a Glow Discharge; Similitude . . . . .	460
247.	Sputtering of Cathode Material . . . . .	463
248.	The Cathode Spot and Cathode Fall Space of an Arc . . . . .	463
249.	The Anode Fall Space . . . . .	466
250.	Sheaths ("Inactive Boundaries") . . . . .	466
251.	Current-Carrying Sheaths; Probes . . . . .	467
252.	Current Densities in Current-Carrying Sheaths . . . . .	472
253.	Measurement of Electron Temperature . . . . .	473
254.	Sheath Thickness; Shut-Off Grids . . . . .	474
255.	Measurement of Ion Concentrations . . . . .	477
256.	Insulating Sheaths . . . . .	477
257.	Flaming Sheaths around Unrestricted Plasmas . . . . .	478

## CHAPTER XXI

## MERCURY-VAPOR RECTIFIERS

258.	Mercury-Vapor Rectifiers Essentially High-Speed Switching Devices . . . . .	480
259.	Classification as to Types and Uses . . . . .	481
260.	Commercial Classification . . . . .	483
261.	Rectifying and Filtering . . . . .	486

# CONTENTS

xiii

SECTION	PAGE
262. Alternating-Current Switching; Control of Average Current . . . . .	487
263. Inverse Voltage Rating of Rectifiers; Arc-Back . . . . .	488
264. Forward Voltage Rating . . . . .	489
265. Current Ratings . . . . .	490
266. "Clean-Up" of the Conducting Gas . . . . .	491
267. Concentration of Mercury Atoms in Mercury-Vapor Rectifiers . . . . .	492
268. Grid Control of Arc Initiation . . . . .	494
269. Mechanism of Arc Initiation; Grid Control Curves . . . . .	496
270. Current-Limiting Grid Circuit Resistors . . . . .	499
271. Shield-Grid Thyratrons . . . . .	499
272. Igniter-Rod Control of Arc Initiation . . . . .	500
273. Statistical Variation of Firing-Time in Ignitrons . . . . .	501

## CHAPTER XXII

### SINGLE-PHASE CIRCUITS CONTAINING RECTIFYING ELEMENTS

274. Filters for Full-Wave Single-Phase Rectifiers . . . . .	506
275. Per Cent Ripple . . . . .	508
276. Single-Phase Filter Circuit Behavior: (I) Filter with Choke Only . . . . .	509
277. Single-Phase Filter Circuit Behavior: (II) Filter with Condenser Only; "Cut-Out" and "Cut-In" Points . . . . .	511
278. Single-Phase Filter Circuit Behavior: (III) Choke and Condenser both Present . . . . .	514
279. Selection of Circuit Constants for a Choke Input Full-Wave Single-Phase Filter . . . . .	515
280. Repeating Transients . . . . .	521
281. Phase-Shift Control of Thyratrons . . . . .	522
282. Inversion from Direct to Alternating Current . . . . .	526
283. Parallel-Type Single-Phase Inverters . . . . .	527
284. Failure of Commutation in Inverters . . . . .	530
285. Series-Type Single-Phase Inverters . . . . .	531
TABLES (See list on next page) . . . . .	535-556
BIBLIOGRAPHY . . . . .	559
INDEX . . . . .	571

## LIST OF TABLES

	PAGE
I. Dependence of $\beta^2$ on $r/r_c$ , in expressions for space-charge-limited currents from cylindrical cathodes. . . . .	535
II. Function relating plate current to voltage drop along filament. . . . .	536
III. Electron emission constants. . . . .	537
IV. Ratio of hot to cold resistances of filament materials. . . . .	538
V. Properties of the atoms of the elements. . . . .	539
VI. Quantum-number combinations for rectangular quantization. . . . .	543
VII. Gross work functions of the alkali metals. . . . .	544
VIII. Integrals containing $e^{-r^2}$ . . . . .	545
IX. Potential distribution function outside a plane electron-emitting cathode	547
X. Quantum-number combinations for polar quantization, also, groups and subgroups of electrons in shells around atomic nuclei. . . . .	548
XI. Term values for the arc spectrum of sodium. . . . .	549
XII. Term values for the arc spectrum of mercury. . . . .	550
XIII. Term values for the arc spectrum of Neon. . . . .	551
XIV. Term values for the arc spectrum of copper. . . . .	552
XV. Electron mean free paths. . . . .	553
XVI. Mercury vapor pressure as related to temperature. . . . .	555
XVII. Values of the fundamental physical constants. . . . .	556