

CONTENTS

CONTRIBUTORS TO VOLUME III	v
PREFACE	vii

Field Emission Microscopy

BY F. ASHWORTH, *Research Department, Metropolitan-Vickers Electrical Co. Ltd., Manchester, England*

I. Introduction	1
II. The Development of Field Emission Microscopy	2
III. Field Emission from Clean Metallic Surfaces	11
IV. Field Emission from Contaminated Surfaces	16
V. The Field Emission Microscope as a High Vacuum Gage	33
VI. The Resolving Power of the Field Emission Microscope	35
References	41

Velocity Modulated Tubes

BY R. R. WARNECKE,* M. CHODOROW,† P. R. GUÉNARD,* AND E. L. GINZTON†

**Laboratoires de Recherches de la Compagnie Générale de T.S.F., Paris, France*

†*Stanford University, Stanford, California*

I. Introduction	43
II. The Basic Forms of the Klystron	45
III. Theory of the Klystron	50
IV. Klystron Amplifiers	66
V. Reflex Klystrons	71
VI. Summary	78
References	81

Electronic Theory of the Plane Magnetron

BY L. BRILLOUIN, *International Business Machines Corporation, New York*

I. Introduction	85
II. Steady Case	89
III. Statement of the Problem: A Method of Integration Similar to Llewellyn's Procedure for a Diode	91
IV. Discussion of the Results: Standard Static Characteristic	92
V. Double Stream Solutions	97
VI. Transients and Oscillations—Keeping the Plane Symmetry: Principle of the Method	99
VII. Operation of a Magnetron with a Short Impulse of Current	104
VIII. Discussion of British Reports on Similar Problems	108
IX. A General Discussion of Electron Trajectories in a Plane Magnetron	114

X. Steady Problem: Negative Resistance for Very Low Frequencies . . . 116

XI. Small Oscillations of High Frequency: Fundamental Equations for the Trajectories. 117

XII. Characteristic Impedance of the Oscillating Plane Magnetron. 119

XIII. Magnetron Impedance for Low Frequencies 121

XIV. Magnetron Impedance for High Frequencies 122

XV. Discussion of Some Special Examples. 124

XVI. Double Stream Electronic Motions: General Formulas 128

XVII. Large Resonant Oscillations with Moderate Direct Current. 132

XVIII. Efficiency and Negative Resistance in One-Anode Magnetrons. 135

XIX. Physical Meaning of Conditions for Negative Resistance 139

Appendix. 142

References 144

Electronic Theory of the Cylindrical Magnetron

BY L. BRILLOUIN AND F. BLOCH, *International Business Machines Corporation, New York, and Stanford University, Stanford, California*

I. Summary and Introduction. 145

II. Basic Assumptions for Steady Conditions. 147

III. The Problem's Equations—Static Case. 148

IV. Fundamental Equation of Motion. 150

V. Discussion of the Fundamental Equation. 151

VI. Small Current, Small Oscillations 153

VII. Mathematical and Graphical Discussion of the Self-Consistent Trajectories. 155

VIII. Standard Static Characteristics of Cylindrical Magnetrons 159

IX. Physical Interpretation. 163

X. Cylindrical Magnetron under Variable Conditions 166

XI. Discussion of the Solution Obtained for Small Current 168

XII. Limits of Validity of the Single Stream Solution. 171

XIII. Small Oscillations in a Cylindrical Magnetron. 174

XIV. Calculation of the Anode Voltage 176

XV. Resistance and Reactance of a Cylindrical Magnetron 179

References 181

Tube Miniaturization

BY JOHN E. WHITE, *National Bureau of Standards, Washington, D. C.*

I. Introduction 183

II. Limitations in Miniaturization of Tubes 184

III. Noteworthy Features of Subminiatures. 189

IV. Summary State of the Art 192

References 194

Subminiaturization Techniques

BY GUSTAVE SHAPIRO, *National Bureau of Standards, Washington, D. C.*

I. Introduction 195

II. Design Philosophy. 196

III. Thermal Considerations 197

IV. Assembly Techniques	198
V. Subminiature Assemblies	201
VI. Components and Materials	208
VII. Outstanding Problems	217
VIII. Conclusions	218
References	218

Principles of Pulse Code Modulation

By H. F. MAYER, *School of Electrical Engineering, Cornell University, Ithaca, New York*

I. Introduction	221
II. Short Survey of Noise-Cleaning Methods	222
III. The Sampling Theorem	226
IV. Quantization	229
V. Encoding	233
VI. Principal Operations at the Transmitting End	237
VII. Principal Operations at the Receiving End	243
VIII. Fidelity in PCM Transmission	247
IX. Rate of Transmission	256
References	260

A Summary of Modern Methods of Network Synthesis

By E. A. GUILLEMIN, *Massachusetts Institute of Technology, Cambridge, Massachusetts*

Introduction	261
I. Analytic Form of an Impedance (Resp. Admittance) and Its Real Part	262
II. Conditions and Tests for Positive Real Character	263
III. Some Important Properties of Hurwitz Polynomials and Positive Real Functions	264
IV. Special Forms of $Z(\lambda)$ in the Two-Element Cases	265
V. Some Remarks Relevant to the Brune Process	267
VI. The Darlington Procedure for the Solution of the Brune Problem Skeletonized	271
VII. Synthesis of the Single-Loaded Lossless Coupling Network for a Prescribed Magnitude of Transfer Impedance	275
VIII. Cauer's Method of Synthesis from a Specified $ Z_{12}(j\omega) ^2$	276
IX. Complementary Impedances; Constant-Resistance Filter Groups	279
X. Another Way of Designing for Finite Resistances at Both Source and Load	281
XI. The Constant-Resistance Lattice	283
XII. An Alternate Realization Procedure for Transfer Functions	286
XIII. Synthesis of a Lossless Two Terminal-Pair Network through the Ladder Development of z_{22}	286

ILLUSTRATIVE EXAMPLES

XIV. Brune's Synthesis Procedure	290
XV. Darlington's Procedure Applied to the Same Problem	292
XVI. An Alternative Method of Synthesis that Avoids Mutual Coupling	293
XVII. Darlington's Procedure Applied to the Synthesis of a Transfer Impedance	295
XVIII. Cauer's Method Applied to the Same Problem	296
XIX. A Constant-Resistance Filter Group	297

XX. The Same Transfer Function Realized through a Lossless Network with Resistance Loading at Both Ends	298
XXI. Realization through a Cascade of Amplifier Stages	299
XXII. Further Illustration of the Ladder Development Procedure	300
References	303

Communication Theory

BY MEYER LEIFER AND WILLIAM F. SCHREIBER, *Sylvania Electric Products Inc.*,
Bayside, New York

I. Introduction	306
II. The Development of the Theory	307
III. The Synthesis of the Theory	320
IV. Applications to Television	339
References	343
Author Index	345
Subject Index	348