
Contents

Preface	<i>page</i>	ix
1. Introduction		1
1.1 Brief historical review		1
1.2 Fundamental data		3
1.2.1. Conventions.	1.2.2. The electron beam.	1.2.3.
Some properties of waves.		
2. Propagation of Space-Charge Waves on Mono-Velocity Electron Beams		8
2.1 General remarks		8
2.2 Propagation in infinite or very high longitudinal magnetic fields		9
2.2.1. Assumptions.	2.2.2. Beams of finite cross-section drifting in a coaxial conducting cylinder.	2.2.3. Beams of infinite cross-section.
2.2.4. Plasma frequency reduction factors.	2.2.5. Properties of longitudinal space-charge waves.	
2.3 Propagation in Brillouin longitudinal magnetic fields		38
2.3.1. Definition of Brillouin field and Brillouin flow.	2.3.2. Assumptions.	2.3.3. The analysis.
2.3.4. Discussion.		
2.4 Propagation in arbitrary longitudinal magnetic fields		48
2.4.1. Assumptions.	2.4.2. The analysis.	2.4.3. Plasma frequency reduction factors.
2.4.4. Discussion.	2.4.5. The complete set of modes.	
2.5 Final comments		65
2.5.1. Applications of longitudinal space-charge-wave theory.	2.5.2. Experimental work.	

3. Increasing Space-Charge Waves	68
3.1 General remarks	68
3.2 Increasing space-charge waves on single electron beams	68
3.2.1. Increasing space-charge waves on accelerated or retarded electron beams.	
3.2.2. The transmission-line analogy.	
3.2.3. The rippled-wall amplifier (the reduction-factor amplifier).	
3.2.4. Scalloped-beam amplification.	
3.2.5. Increasing space-charge waves in an electron beam in non-propagating structures.	
3.2.6. The resistive-wall amplifier.	
3.2.7. Inductive-wall amplification – The Easitron.	
3.2.8. Final discussion.	
3.3 Increasing space-charge waves on two electron beams	120
3.3.1. The work of Pierce and his group.	
3.3.2. The work of Haeff.	
3.3.3. The work of Nergaard.	
3.3.4. Discussion and comparison of the work of the three groups.	
3.3.5. The latest developments.	
3.4 Final Comments	155
4. The Propagation of Space-Charge Waves on Multi-Velocity Beams	157
4.1 General remarks	157
4.2 The first attempt to consider the effect of velocity distribution	158
4.3 The development of the theory	159
4.4 The experimental work	162
4.4.1. The apparatus.	
4.4.2. The results.	
4.4.3. Comparison with theory.	
4.5 Final Comments	167
5. Power Flow and Space-Charge Waves	169
5.1 The work of Pierce, Walker and their co-workers	169
5.1.1. The work of Pierce.	
5.1.2. The work of Walker.	
5.1.3. Discussion.	
5.2 The latest developments	179
5.3 Final comments	183

6. General Conclusions	184
Appendixes	
1. Maxwell's equations	187
2. The electronic theory of space-charge waves	189
3. Derivation of the equations used for the analyses of a beam in a finite longitudinal magnetic field	193
4. Analysis of the Brillouin flow case	197
5. Analysis of the arbitrary field case	200
6. Higher-order space-charge waves	203
Principal Symbols and Notation	206
References	212
Index	218