

ELECTRIC ARC PHENOMENA

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Electric Arc Phenomena by Ewald Rasch & K. Tornberg

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EWALD RASCH & K. TORNBORG

**ELECTRIC ARC
PHENOMENA**

ELECTRIC ARC PHENOMENA

BY *Ferdinand Wilhelm*
EWALD RASCH

TRANSLATED FROM THE GERMAN

BY

K. TORNBERG

GENERAL ELECTRIC COMPANY

82 ILLUSTRATIONS



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TABLE OF CONTENTS.

CHAPTER	PAGE
INTRODUCTION.....	v
I. GENERAL OUTLINE OF ELECTRIC-ARC PHENOMENA.....	1
§ 1. History of Development.....	1
§ 2. The Formation of Electric Arcs by Contact Starting.....	4
§ 3. Electrodes of the First and Second Class. Mixed-class Electrodes. Auxiliary Starting.....	6
II. THE TYPICAL CARBON ARC. EXTERNAL PHENOMENA.	
ARC ADJUSTMENT.....	13
§ 4. The Alternating-current Arc.....	13
§ 5. The Continuous-current Open Arc.....	14
§ 6. The Enclosed Arc.....	17
§ 7. Adjustment of the Arc.....	18
III. TYPICAL ELECTRODE MATERIALS AND THEIR PHYSICAL PROPERTIES.....	23
§ 8. The Physical and Chemical Properties of Carbon.....	23
§ 9. The Use of Electric Arcs for Pyrochemical Oxidizing Processes.....	26
§ 10. Electric Conductivity and Temperature Coefficient.....	29
§ 11. Heat Conductivity.....	33
§ 12. Heat Capacity and Radiation.....	39
§ 13. Carbon Electrodes and their Manufacture.....	44
§ 14. Rate of Consumption and Dimensioning of Carbon Electrodes.....	46
IV. THE THEORY OF ELECTRICAL DISCHARGES THROUGH GASES..	52
§ 15. The Ionization of Gases.....	52
§ 16. The Dynamics of Disruptive Discharges through Gases.....	54
V. SPARK DISCHARGES. EMPIRICAL RESULTS.....	62
§ 17. Spark Discharges between Electrodes of Various Shapes.....	62
§ 18. Symmetrical Arrangement of the Electrodes.....	63

CHAPTER	PAGE
VI. VOLTAGE AND CURRENT CONDITIONS IN THE ARC.....	70
§ 19. Volt-ampere Characteristic of the Arc.....	70
§ 20. Practical Derivation of Characteristics.....	82
§ 21. Characteristic of the Alternating-current Arc....	86
§ 22. Influence of the Surrounding Gases on Current and Voltage of the Arc.....	89
§ 23. Conditions Necessary for a Steady Arc.....	92
§ 24. Phenomena of Starting and Extinguishing of the Arc.....	104
§ 25. Theoretical Discussion of the Characteristic Equation.....	113
§ 26. The Resistance Effect (ρ) of the Arc.....	117
§ 27. Minimum Current. Saturation Current.....	125
VII. DISTRIBUTION OF THE ENERGY IN THE ARC.....	135
§ 28. Importance of the Anode Crater. Anode Rays. Emission of Electrons.....	135
§ 29. The Current Density (s) at the Anode.....	144
§ 30. Potential Drop at the Anode. Energy Radiated by the Anode Crater.....	149
§ 31. Hissing of the Arc.....	152
§ 32. Energy density (q) at the Anode Crater.....	156
§ 33. Cathodes and Anodes of Fluid Lamps. Mercury Vapor Lamps. Electrolytic Solutions as Current Bases for Electric Arcs.....	158
VIII. EFFICIENCY OF COMMERCIAL TYPES OF ARC.....	165
§ 34. Practical Standard for Light Measurements.....	165
§ 35. Direct-current Plain Carbon Arc.....	166
§ 36. Maximum and Hemispherical Light Intensity of Direct-current Carbon Arcs.....	169
§ 37. Alternating-current Plain Carbon Arc.....	170
§ 38. Colored Flame Arcs between Electrodes Containing Materials which are Conductors of the Second Class.....	174
§ 39. Radiation Collectors. Notes on Further Possible Applications of Electric Flames.....	178

INTRODUCTION.

A REMARKABLE revolution is taking place in the fundamental conceptions of Physics. The Electronic Theory is furnishing wholly unexpected answers to the inquirer into the cause of light. This fact (in conjunction with other modern changes, such as improvements in incandescent lighting, etc.) imposes on the arc-lamp engineer the task of making improvements in the very principles of light production — a task which during the last decade has found, in the development of flame arc lamps, a provisional rather than a very desirable solution.

One cannot be taught how to find — only how to seek. Whether we succeed or not depends largely on whether our aim has been in a negative or a positive direction with respect to the object.

It is not within the scope of the present monograph to give an exhaustive review of the extensive literature which has accumulated on the subject of the electric arc and in which one is likely, quite often, to meet with contradictory statements.

The author considers, rather, that it is of paramount importance to separate the essential from the nonessential and to assist the student as well as the practicing engineer in those mental operations and elements of knowledge which involve fundamental principles and the mastering of which is indispensable for an understand-

ing of the present state of the art as well as for the stimulation of independent practical work of a progressive kind.

On account of the revolutionary trend in physical speculations on the fundamental cause of light, a few general remarks may appropriately be advanced here. This seems all the more necessary since engineering schools do not specialize sufficiently on this subject. Thus, such scientific facts as are known have not been put in a form to make them technically useful, by facilitating practical developments.

A satisfactory solution of the problem of economical light production by electrical discharges through gases presupposes a thorough understanding of numerous phenomena derived from quite remote fields of knowledge. For instance, besides purely electrical relations, there are to be considered important practical questions pertaining to arc stream conditions, the characteristics of different forms of discharge and the requirements for equilibrium.

The nature of electric conduction through incandescent gases and the relation of conductivity and light intensity to temperature point to facts and theories which are part of modern physical chemistry, while the selective radiation of incandescent gases is a branch of spectrum analysis. The electrode phenomena depend on properties of materials, on high-temperature chemistry and on the laws of black body radiation.

The peculiar phenomena of cathode and anode rays imperatively direct the attention to Newton-Weber's corpuscular theory of light — now almost forgotten — and to the electrodynamic theory of matter. The latter has been resurrected in the modern electronic theory, which is destined to govern with the irresistible force of inflexible truth even purely technical progress.

Furthermore, a new consideration, which has little in common with the usual technical problems of production and distribution of energy, enters here: When we speak of light we refer to phenomena which take place on the retina of the eye, thereby exciting in the brain certain psychic sensations which fall under the domain of æsthetics. In this connection are encountered problems concerning the distribution of sensitivity on the retina, color sensibility and synthetic color sensations — all questions which possess decidedly practical importance for the efficient generation of light by means of luminescent gases.

Finally, the thinking student will surely want to know something about the real nature of that which he is to produce and the service of which he is to enter. And if to-day Maxwell's theory is inadequate to give an answer as to the real nature of light and, therefore, cannot be taught with the same dogmatic unassailability which has been attributed to it in the last decade, the student has a right to know the explanations furnished by the electronic theory, which occupy the present-day scientists and which, as far as human intelligence can predict, contain the germs of future progress in electric-light engineering.

The technology of light thus covers a large field of knowledge to which numerous branches of science contribute and which would well merit the careful attention, also, of the political economist.

It must not be overlooked that a great, if not, indeed, the greatest, part of all electrical engineering work, even though by circuitous routes, aims at the economical production of light. But neither technical schools nor practical experience point out a sure way.

Unfortunately, the arc-lamp industry is subdivided, one