THE ELECTRIC DISCHARGE IN ENGINEERING SCIENCE

Gaseous Electrical Conductors

By Prof. E. L. E. Wheatcroft. (Oxford Engineering Science Series.) Pp. xi+265+6 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1938.) 21s. net.

THE earliest industrial applications of the phenomena associated with strongly ionized gases, or 'gaseous conductors', appear to have been the introduction in England of the carbon arc for illumination in the early eighties, followed shortly by Moore's nitrogen and carbon dioxide discharge tubes in America. In the beginning of the twentieth century, electric discharges first began to be used on a considerable scale in chemical engineering, notably for the production of ozone in connexion with air and water purification, of nitric acid from the air, and of lubricants by the polymerization of light oils; about the same time discharges were also applied to the precipitation of dust and mist, and to the generation of high-frequency currents for radio communication. The phenomena associated with 'free' electrons in high vacua have been applied in the development of the present rich variety of X-ray tubes, wireless valves, and cathode ray tubes. The development of the transmission of electric energy has brought to light the importance of discharge phenomena in relation to the design of high-tension cables, insulators, condensers, and switchgear; and the physics and chemistry of the ionosphere are directly related to many problems of radio communication. Not the least important is the ignition system of all petrol-fed internal combustion engines, which depends on a gaseous electric discharge.

The comprehensive title, and the preface of Prof. Wheatcroft's book, which is the latest addition to a distinguished series, lead the reader to expect it to be the first English book dealing with gaseous discharge phenomena in relation to the rapidly growing applications in many branches of engineering; the author explains that his aim in expanding his lectures to undergraduates is to produce a book that will be useful to those who "embark upon research in this very interesting and important field". The book is in two parts: the first deals with the physical background; the second relates to applications, but of these the only ones considered are thermionic valves ('hard' and 'soft'), the mercury arc rectifier, circuit breakers, and discharge tubes as illuminants.

In giving the physical background in Part 1, the emphasis has not been fairly divided between 'pure' electron gas as a conductor, and electron

gas admixed with ion and neutral molecular or atomic gas, the former being allotted much the greater space; and a whole chapter is devoted to electrons in metals. For example, the motion of electrons in a 'dense' gas is dismissed in three pages with a few equations and without any reference to the experimental data of Townsend and others; the result is that the uninitiated reader would gain a totally false sense of simplicity and never realize the essential complexity of the phenomena. Townsend's coefficient of ionization is needlessly and erroneously renamed "the ionization constant α ". Also, there is no point in giving Townsend's early theory of this coefficient without indicating the unjustifiable assumptions now known to be involved in it, or to offer an alternative makeshift theory without referring to the detailed analyses of the problem which have been given both for atomic and molecular gases.

Part 2 opens with a long chapter on "Vacuum Electron Valves", which, however, contains much that is irrelevant to this book; for example, the discussion of high-vacuum valve design. The three following chapters on gas-filled valves, the mercury arc rectifier, and circuit breakers, are good, profusely illustrated, and bespeak an intimate acquaintance with these applications. It is this part of the book that the reader who seeks succinct but adequate information will find most useful. The last chapter, on luminous discharge tubes, is startlingly inadequate to a branch of gas discharge engineering which is of ever-increasing importance.

The attempt to introduce further complication and changes of convention in the nomenclature for units is to be deplored; for example, the electromagnetic unit of potential is termed the 'centimicrovolt', and engineers have long since decided that the microfarad is a more convenient and practical unit than the farad.

The presentation of the material in this book reflects too often those digressions which are illuminating in a lecture but distracting in a book. Despite the collation of much useful information, and the beautiful production to which we are accustomed from the Oxford University Press, the book falls short of the high standard set by the rest of the series. Nevertheless, for the reader who is willing to spend the time disentangling the information he requires (the joint author-subject index is too brief to be very helpful), there is much in this book which is worthy of attention.

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