WATER-HAMMER ANALYSIS

Waterhammer Analysis

By John Parmakian. (Prentice-Hall Civil Engineering and Engineering Mechanics Series.) Pp. xiv+161. (Englewood Cliffs, N.J.: Prentice-Hall, Inc.; London: Longmans, Green and Co., Ltd., 1955.) 45*s*. net.

THE term 'water-hammer' is used to describe the pressure variations in water conduits due to a change in the rate of flow as the result of altering the opening of a valve or the gate of either a water turbine or a pump. The control of water-hammer is often a major problem in the design of those hydro-electric installations in which the turbines are fed from a head pond through closed conduits such as tunnels and pipelines. When a generator accepts or rejects load, the water intake by its turbine must be increased or decreased, respectively. The rate at which these changes of flow are allowed to take place is dictated by considerations of water-hammer, having regard to the strength of the water conduit for withstanding pressure variations and avoidance of the hazards attendant upon separation in the water column due to excessive reduction of pressure. It is not surprising, therefore, that impetus to the study of water-hammer was given by pipeline failures in some of the early Continental hydro-electric installations and it is to the Italian Allievi (1903) that the modern theory of water-hammer is due. More recently, Schnyder and Bergeron made an important contribution to the practical use of the theory of water-hammer by providing the graphical method with which this book, which is written for the student as well as the practising engineer, is mainly concerned.

The first chapter deals with the approximate theory of water-hammer in which the pipe and water column are assumed to be inelastic or rigid. This theory, which is of very limited utility, is followed by the more accurate elastic water column (pressure wave) theory in Chapter 2. The effect of the elastic properties of pipe materials upon the velocity of pressure waves, pressure wave reflexion and pressure variations caused by the extremes of rapid and slow regulation of flow are considered in Chapters 3, 4, 5 and 6, respectively.

The theory of the powerful and general graphical treatment of the water-hammer equations of the elastic theory is given in Chapter 7. This graphical approach, due to Schnyder and Bergeron, which brought the accurate analysis of water-hammer phenomena within the competence of the non-specialist, revolutionized water-hammer analysis. By its use, tedious calculations are circumvented by a simple, repetitive graphical process. Various applications of this method are dealt with in subsequent chapters. Thus, its use for the analysis of water-hammer due to both partial and complete closure or opening of the flow regulator during finite intervals of time and water-hammer in pump discharge lines due to various causes, such as failure of the pump motor and the presence of non-return valves, are considered in Chapters 8–12.

The effect of hydraulic losses on water-hammer is the subject of Chapter 13 (these losses reduce the magnitude of water-hammer effects), while application of the graphical method to the analysis of water-hammer in pipelines with branches is dealt with in Chapter 14. Finally, approximate methods of graphical analysis and the theory of surge chambers and air vessels for limiting water-hammer in turbine pipelines and pump discharge lines, respectively, are considered briefly.

There is, in addition to the eighteen chapters, a list of forty-seven references to previous work and a number of problems for solution, with answers.

The book is clearly written and illustrated and is a useful addition to the few existing books in English which deal with this aspect of engineering science.

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A MODERN PIDDUCK

Electricity and Magnetism

By B. I. Bleaney and B. Bleaney. Pp. xiv+676. (Oxford: Clarendon Press; London: Oxford University Press, 1957.) 63*s*. net.

AS a physics student at Oxford in the late 'thirties, the reviewer was advised to use the late Dr. F. B. Pidduck's "Treatise on Electricity". In the quite probable event that a modern Oxford student might be recommended to use the new treatise by Prof. and Mrs. Bleaney, the difference will illustrate how the subject—and undergraduate courses—have grown in twenty years. The authors have surely had to condense at least double the amount of matter into their book, and they have done it in about the same number of pages. Indeed, the first impression which I had of this book was that it was in many ways a modern Pidduck, with the supreme virtue of conciseness of that book. Every sentence counted in Pidduck (there were some examination questions which could be answered if one remembered the right few lines of Pidduck) and the same is even more true of Bleaney and Bleaney.

It seems inevitable that this will be the standard text for many years for undergraduate courses. It has the advantage over another good and much-used text, Harnwell's "Principles of Electricity and Electromagnetism", that it is nearly fifteen years newer, and there are few other serious competitors. The range covered is that of the modern honours course, treated fully and generously. But to say this is to miss the outstanding feature of the book, which is the way in which it has assimilated, selected and presented the developments of the past 20–30 years without losing the didactic virtues of classical methods of teaching electricity and magnetism. For example, in the same chapter there are described the quadrant electrometer and the Van de Graaff generator. In a chapter mainly devoted to a formal account of the magnetic effects of currents there are described the mass spectrograph and the cyclotron.

In later chapters dealing with the microscopic electrical and magnetic properties of matter very much of the material is new physics and it is in these chapters that the selection of matter is so good. It must have been difficult to decide how much to write about, say, magnetic resonance, but in almost every respect the authors have chosen well. Not only do they cover the range of a modern honours course but they seem to me to define what a good honours course should contain in this subject.

There are many pleasing details to notice. For example, there are a very good account of the design of magnets and a real explanation of how a cell works. At the end of each chapter there are good examples, both searching and relevant. Naturally there are some misleading points in the book, and others with