THE ELECTRICAL ENGINEER'S REFERENCE BOOK

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EDITOR'S FOREWORD

THE Eleventh Edition of the Electrical Engineer's Reference Book should require no lengthy introduction. This book has now come to be regarded as the standard work of reference for electrical engineers in this country. It is a comprehensive exposition, arranged in thirty-three sections, of modern theory, practice and equipment, and a survey of the most recent developments, in all branches of electrical engineering. Each of the main sections is a self-contained treatise on a specific branch of the subject written by recognised authorities.

Electrical engineers are involved in many fields which are constantly expanding and rapidly changing. An extensive revision has been necessary so that the Reference Book should continue to give its comprehensive survey of electrical engineering.

All sections have been revised for this edition. In Section **2**, Energy Conversion, information has been added on new methods of producing electrical energy such as magnetohydrodynamic generation and fuel cells. Section **3**, Electrical Materials, now includes, in addition to an up-to-date survey of conducting and insulating materials, an account of the effects on materials of irradiation, and articles on printed circuits and encapsulation. Section **4**, Transformers, and **5**, Cables and Wires, have been largely rewritten to take account of new knowledge and development. Section **8**, Electrical Motors, contains a description of pole-changing motors, and Section **9**, Electric Motor Control, has been expanded so that electronic control methods might be satisfactorily covered.

Silicon controlled rectifiers are of increasing importance, and account has been taken of this in the revision of Section **10**, Rectifiers and Convertors. Plastic conduits and cold-cathode lighting are other subjects which have received particular attention, and the articles on bridge networks and potentiometers have been expanded.

The modernisation programme of British Railways, which has meant an increased emphasis on electrical equipment, is reflected in Section **18**, Electric Traction, which includes articles on the automatic warning system of train control, route-setting relay interlocking and automatic signalling as well as a description of

modern transport equipment on rail and road. The latest British Railways locomotives and signalling equipment are described also in Section **30**, Progress, which, as in each previous edition, has been completely rewritten to take account of recent developments in all fields of electrical engineering. Another industry which is in the throes of modernisation is coal mining, and the applications of electricity in mines for power and for communications are dealt with in Section **24**, Electricity in Mines.

Section **31**, Education and Training, has been expanded to give a more comprehensive coverage of opportunities for electrical engineering apprentices, graduates, etc., with a directory of selected organisations which can help the electrical engineer. A world-wide list of periodicals is given in Section **32**, Periodicals and Standards, which also includes a comprehensive classified list of British Sstandards.

The ELECTRICAL ENGINEER'S REFERENCE BOOK brings within the scope of one volume all the information required for reference by the electrical engineer in his daily work. He will find in it all the most recent information now available on new developments in all branches of his work other than radio. The power supply engineer will find a concise summary of modern power-house practice, together with detailed information on such subjects as switchgear, cables, meters and testing. Engineers concerned with transmission and distribution will find, in addition to the summary of standard practice, detailed information about transformers, rectifiers, protective gear and substation equipment. For the electrical engineering student reading for a degree, or studying for Graduate Membership of the Institution of Electrical Engineers, the Reference Book provides a valuable complement to standard textbooks.

Thanks are offered to those electrical engineers who, from time to time, have written to us suggesting improvements and additions. Each one of these suggestions has received careful consideration, and all practicable suggestions have been incorporated.

THE EDITOR.

Arrangement of the Reference Book

The Reference Book is arranged in thirty-three main Sections, each dealing with a specific subject, or group of subjects, or applications.

Section **1**: THEORY AND CALCULATIONS, gives an outline of the basic electrophysical principles which find their application in the many branches of electrical engineering, and deals fully with the subject of methods of circuit calculation.

Sections **2** to **29** contain expositions of the standard practice in the main subdivisions of the art of applied electricity.

Section **30**: PROGRESS, is devoted to matters of novel development, research, construction and design in all branches.

Thus for the subject of CABLES AND WIRES, the basic principles are given in Section **1**; a summary of standard practice in construction and operation in Section **5**; and a digest of the latest developments in Section **30.** Other subjects are dealt with on the same plan. Specific details can be found by reference to the Index, which gives the Section and page numbers relative to any selected item.

In addition to the technical Sections, there are Sections concerned with Education; Electricity Rules, Regulations and Supply Data; Periodicals and Standards. These are references that will normally be used individually.

KEY TO SPECIALIST CONTRIBUTORS

A. D. J. **A. D. JONES.** Associated with battery electric vehicles from 1932. Sales Engineer for Morrison and Electricar vehicles with The Corporation of Electric Transport, Ltd. Later controlled the interests of Midland Vehicles, Ltd., in London, Southern England and Scotland.

A. D. S. A. **A. D. S. ATKINSON,** A.M.I.E.E., F.I.E.S. Technical Editor of the British Lighting Council. Author of *Modern Fluorescent Lighting* (Newnes) and many of the Council's publications.

A E. G. **A. E. GRANT,** B.Sc., Grad.I.E.E. Studied at Lawrence Sheriff School, Rugby, and The University of Birmingham where he graduated with Honours, Class II, in Electrical Engineering in 1944. After two years' service in the Electrical Branch of the R.N.V.R. as Sub-Lieutenant, he was accepted as a Graduate Apprentice by The B.T.H. Co., Ltd. In 1956 he became Section Engineer dealing with the layout of High Voltage Switchgear. In 1962 he joined the C.E.G.B. as a Research and Development Engineer.

A. E T. **A. E. TATTERSALL,** M.I.E.E. Elected a Fellow of the Institute of Physics in 1933, in recognition of his pioneer work in railway signalling; President of the Association of Railway Companies' Signal Superintendents and Engineers, 1919; Member of the American Railway Association. Author of *Modern Developments in Railway Signalling.*

A. H. B. W. **A. H. B. WALKER,** B.Sc. (Eng.), D.I.C., A.C.G.I., M.I.E.E. After service with the Rectifier Engineering Department of the Westinghouse Brake & Signal Co., Ltd., he joined the Westinghouse Research Laboratory in 1938, and has since been concerned with the development of metal rectiners and electronic and magnetic servo controllers for large rectifiers. Other original work includes the Stabilistor, the Phase Convertor, and the Transbooster constant-voltage system. In 1952 he was appointed Joint-Chief of the Westinghouse Research Laboratory.

A. J. T. **A. J. TAYLOR,** A.M.I.Mech.E., A.M.Amer.I.E.E., Chief Technical Engineer (Winding Wires) of The London Electric Wire Co. and Smiths Ltd. He is a member of a number of committees of the Electrical Research Association and the British Standards Institution, and author of several technical articles dealing with winding wires.

A. L. M. **A. LANGLEY MORRIS,** M.I.E.E. Chief Transformer Designer at Johnson & Phillips, Ltd., from 1936 until 1944. Then joined the Telecommunications Research Establishment at Malvern (now R.R.E.) Ministry of Supply. Author of a number of technical articles.

A. L. W. **A. L. WHITELEY,** D.Sc., M.I.E.E. Graduated at the University of Leeds with 1st Class Hons. Post-graduate apprenticeship with The B.T.H. Co., and joined the staff of the Industrial Engineering Department to initiate work on industrial electronics in 1931. With the General Electric Company, Schenectady, U.S.A., 1932-3, working on industrial electronics, h.t. d.c. transmission, etc. Head of the Electronics Department of A.E.I., covering radar, industrial electronics, servos, etc. Author of several papers in the *Journ. I.E.E.*

KEY TO SPECIALIST CONTRIBUTORS

A. T. D. **A. T. DOVER,** M.I.E.E., A.M.Am.I.E.E. Formerly Head of the Electrical Engineering Department of Battersea Polytechnic, London. The author of books on *Electric Traction* and the *Theory and Practice of Alternating Currents.*

B. A. **B. ADKINS.** Reader in Electrical Engineering at the Imperial College of Science and Technology, London, since 1951. He was educated at Northampton School and Clare College, Cambridge. After a Graduate Apprenticeship with the B.T.H. Co., he entered their Design Department, working on the design of all types of electrical machine. From 1947 to 1951 he organised the Advanced Engineering Course at the B.T.H. Co. He is joint author of a book on *Polyphase Commutator Machines,* and has written several I.E.E. papers.

B. A. T. **B. A. TURNER,** B.Sc. (Eng.) (Hons.), A.M.I.E.E. A member of the Leading Scientific Staff of G.E.C. Research Laboratories.

C. A. B. **C. A. BURTON,** M.I.o.W., M.A.W.S., A.M.I.M.I., M.I.S.M.A. General Manager of A.R.O. Machinery Co., Ltd. Lecturer on Resistance Welding to Cranfield College of Aeronautics and School of Welding Technology, I.o.W. He is also a member of Briefing and Reporting Groups attached to the International Institute of Welding.

C. C. B. **C. C. BARNES,** M.I.E.E., Mem. Amer. I.E.E., A.B.I.M. After serving in the Cable Departments of W. T. Glover & Co. St. Helens Cable and Rubber Co., Ltd., and Scottish Cables, Ltd., he joined Standard Telephones & Cables, Ltd., in 1939, with responsibility for all problems relating to impregnated paper insulated power cables. In 1947 he joined the Central Electricity Board and has specialised in cable engineering problems. Is at present Cables Engineer of the H.Q. staff of the C.E.G.B. Author of *Power Cables : their Design and Installation* (Chapman & Hall) and many articles and pamphlets.

C. H. S. **C. H. SMITH,** M.I.E.E., A.M.I.Mech.E., served an apprenticeship in the locomotive works of the Lancashire & Yorkshire Railway Co., where he eventually took part in the development of the first 1,200 V d.c. third-rail system in this country. Later he joined a leading engineering insurance company becoming supervising engineer.

D. B. **D. BAKER,** Assoc.Brit.I.R.E. Educated at the Northern Polytechnic followed by development experience at the Decca Radar Research Laboratory. Engaged at Redifon Ltd. in the Industrial Electronics Laboratory as Senior Design Engineer concerned in the application and design of radio-frequency heating equipment.

D. C. **D. CARTWRIGHT.** Technical author employed by Automatic Telephone and Electric Co., Ltd. Educated at Liverpool Technical College. Joined the Company's Telephone Switching Systems Division in 1936.

D. F. W. J. **D. F. WYNNE JENKINS,** B.Eng., A.M.I.E.E., Mem.A.I.E.E. Graduated at Liverpool University. Joined Transformer Department of Johnson and Phillips Ltd. ; later became assistant to the Technical Adviser before joining the Contract Department on overhead line and cable work etc. Author of several papers on Transmission Lines, Welding, etc. Senior Contract Engineer specialising in Overhead Lines and Welding Schemes. Member of B.S.I. Technical Committee for Overhead Lines.

KEY TO SPECIALIST CONTRIBUTORS

D. G. **D. GABOR,** Dr. Ing. (Berlin), F.Inst.P. Assistant Professor and Mullard Reader in Electronics at the Imperial College of Science and Technology, London. Author of many papers.

D. H. T. **D. H. THOMAS,** M.Sc. (Tech.), B.Sc. Eng., M.I.E.E. Head of the Electrical Department, Rutherford College of Technology, Newcastle-on-Tyne. He studied in the Faculty of Technology, University of Manchester and under Barkhausen at the Technische Hochschule, Dresden, and was formerly Lecturer in Telecommunications at the University of Nottingham.

D. M. **D. MAJOR,** B.A., B.Sc. Educated at St. John's College, Cambridge; trained as research engineer at Metropolitan-Vickers Electrical Co., Ltd., and has since worked on electron accelerators in their Research Department. Joint author of paper *A 20-MeV Betatron for X-Ray Therapy* and papers on scattering of high energy particles in a cloud chamber.

D S. **D. SHOENBERG,** Ph.D., F.R.S. Educated at Latymer Upper School, W.6, and Trinity College, Cambridge. Fellow of Gonville and Caius College, a University Reader in physics, in charge of research at the Royal Society Mond Laboratory, where he has worked on magnetism and superconductivity since 1932. Author of various scientific papers and books.

D. S. J. **D. S. JEWELL,** B.Sc.(Eng.), A.M.I.Mech.E., A.M.I.E.E. Assistant Signal and Telecommunication Engineer (General) on central staff of British Railways.

E. A. N. **E. A. NEPPIRAS,** A.R.C.S., B.Sc. (Hons.) Received his technical education at the Royal College of Science, South Kensington. Since 1947, has been engaged in research in Electronics and Ultrasonics at Mullards Research Laboratory.

E. A. W. **E. A. WEBSTER,** B.Sc.(Eng.), A.M.I.E.E. On central staff of British Railways.

E H. W. B. **E. H. W. BANNER,** Major, T.D., R.E.M.E. (A.E.R.), M.Sc., M.I.E.E., M.I.Mech.E. M.Cons.E., Is now a consultant. Was instrument designer, Ferranti Ltd., and Salford Electrical Instruments Ltd., and has published several papers on instruments and other subjects. Until 1948, Advisory Electrical Engineer to the Armaments Inspection Department of the Ministry of Supply.

E .O. T. **E. O. TAYLOR,** B.Sc. (Hons.), A.C.G.I., D.I.C., M.I.E.E. M.Am.I.E.E., F.R.S.E. Has been lecturer in electric machine design at the University of Glasgow, and at the City and Guilds College and lecturer in electric power at the City and Guilds College. From 1939 to 1941 was on the Technical staff of the Central Electricity Board. Subsequently became Assistant Professor in Electrical Engineering at the Heriot-Watt College, Edinburgh. Chairman, South-East Scotland Sub-centre, I.E.E., 1954–5. President, Royal Scottish Society of Arts, 1956–8. Chairman, Scottish Centre, I.E.E., 1957–8. Author of *Utilisation of Electrical Energy* (English University Press), *Distribution and Utilisation of Electricity* (Blackie), *Nuclear Power Plant* (Newnes).

E. W. G. **E. W. GOLDING,** M.Sc., Tech., M.I.E.E., Mem.A.I.E.E. Senio. Lecturer in Electrical Engineering at University College, Nottingham. Head of Department of Rural Electrification and Windpower, Electrical Research Association. Research Scholar College of Technology, Manchester. Joined the Research Staff of the Metropolitan-Vickers Electrical Co., Ltd. Author of *Electrical Measurements and Measuring Instruments, Electrification of Agriculture and Rural Districts,* joint author of *Elementary Practical Mathematics.*

F. B. **F. BRAILSFORD,** Ph.D., Wh.Sch., M.I.E.E., Mem.A.I.E.E. Received his practical engineering training as an apprentice in H.M. Dockyard, Pembroke. Graduated externally in Engineering in the University of London with first class honours. He joined The Metropolitan-Vickers Electrical Co. Ltd. in 1926. After two years as a college apprentice and a period with Glovers Cable Co., Ltd., he returned to Metropolitan-Vickers, where he was for a time in charge of the Electrical and Magnetic Section of the Research Department. He is Professor of Electrical Engineering at University College, London.

F. N. B. **F. N. BEAUMONT,** B.Sc. (Eng.), M.I.E.E., M.I.Mech.E., Mem.A.I.E.E. Received his technical training at University College, Southampton. He spent one year on post-graduate research work at University College, London, under Sir Ambrose Fleming. He became a student-apprentice with The B.T.H. Co. In 1929 he joined the staff of the London Power Co., Ltd., and in 1947 he joined the Anglo-Iranian Oil Co., Ltd., becoming Chief Electrical Engineer in 1949. He was appointed Superintendent Engineer for Utilities in 1952.

F. P. B. **F. P. BENTHAM,** F.I.E.S. Director of The Strand Electric and Engineering Co., Ltd., and responsible for technical development. He has pioneered the one-man console remote control of stage lighting, both in the theatre and in television studios. He is the author of *Stage Lighting* (Pitman) and also lectures regularly on the basic principles of stage lighting.

G. B. H. **G. B. HARPER,** M.I.E.E. After serving apprenticeship with Dowding and Mills Ltd. joined Electric Construction Co., Ltd., as a Test Engineer transferring to transformer design in 1937, moving to Bruce Peebles & Co., Ltd., in 1948 as a Transformer Engineer. Late 1949 transferred to British Electricity Authority as Assistant Transformer Engineer being appointed Transformer Engineer in 1952, a post which was held first with the C.E.A. then with the C.E.G.B. until September, 1962. Present position Director and General Manager, British Electric Transformer Co., Ltd. Has served on many British Standard Committees dealing with transformers, insulating oils and insulation co-ordination, together with Code of Practice Committees on Maintenance of Insulating Oil and transformer loading, attending I.E.C. Committees as a British Delegate. Also served onE.R.A. Committees dealing with transformer problems. Author of C.I.G.R.E. and I.E.E. papers relating to transformers.

G. C. C. **G. C. CORR.** Served apprenticeship with the B.T.H. Company. Technical representative in the Industrial Heating Department, G.E.C. Ltd., 1954. Since 1957 Head of the Space Heating Section of the now Industrial Division of the Company.

KEY TO SPECIALIST CONTRIBUTORS

G. E. S. **G. E. SNAZELL,** B.Sc., A.M.I.E.E. Received practical training as apprentice in H.M. Dockyard, Devonport, from 1944 to 1949. Graduated at the University of Birmingham in Electrical Engineering. Following short training periods with A/S Norsk Electriske and Brown Boverie in Norway, Tube Investments Ltd. and English Electric Co., Ltd., joined The B.T.H. Co. (now the A.E.I. Heavy Plant Division) in 1954, and has been engaged ever since on the design and application of semiconductor rectifiers for heavy power duty. Has contributed articles and given lectures on topics connected with semiconductor power rectifiers.

G. F. G. **G. F. GRIBBIN,** B.Sc., F.Inst.P., A.M.I.E.E. He joined the Victor X-ray Corp. in1928 as a service engineer and, from 1938 to 1946, specialised in the industrial aspect of X-rays. He is now Manager, Technical Service Division, Newton Victor Ltd.

G O. W. **G. O. WATSON,** M.I.E.E., Fel.A.I.E.E., M.I.Mar.E. Is a Consultant, and was, 1933-56, Principal Electrical Engineer Surveyor of Lloyd's Register of Shipping. Past-President, Institute of Engineering Inspection, Past-Chairman I.E.E. Utilization Section, Chairman I.E.E. Committee on Regulations for Electrical Equipment of Ships and I.E.C. Committee on Ships, B.S.I. Committees on Cables and on Marine Motors and Generators, and Member Amer. I.E.E. Committee on Marine Transportation. Author of *Marine Electrical Practice* (Newnes) and I.E.E. Progress Reviews on the application of electricity in ships.

G. P. **G. PARR,** M.I.E.E. Technical Director of Chapman & Hall Ltd. He received his training in electrical engineering and physics at the Finsbury Technical College, and after research experience at the Admiralty, rejoined the staff of the College. In 1926 he was appointed radio valve engineer at the Edison Swan Electric Co., and later took charge of the Technical Service section of the Radio Division of that Company. Author of *The Cathode Ray Tube and its Application.* Hon. Sec. to The Television Society.

G. W. **G. WINDRED,** A.M.I.E.E. Formerly Electrical Development Engineer to The Sperry Gyroscope Co., Ltd. He specialised in switchgear and electric control. Author of *Electromagnets and Windings* (Newnes) and *Electrical Contacts* (Macmillan).

H. A. **H. ASTBURY,** M.I.E.E. Chief Engineer of Crompton Parkinson, Ltd., with direct responsibility for development and research, the Short-Circuit Testing Station and Research Laboratories. Late chairman of the Council of The Electrical Research Association and member of various Technical Committees.

H. A. S. **H. A. STEVENSON.** Managing Director and Founder of Ether Ltd. Served on Engineering Staff of The Marconi Wireless and Telegraph Co.; formerly chief of Lord Kelvin's Testing Laboratory, Glasgow, and spent many years on instrument design with The Cambridge Instrument Co. and W. G. Pye & Co. Author of a number of technical papers.

KEY TO SPECIALIST CONTRIBUTORS

H. J. N. R. **H. J. N. RIDDLE,** A.M.I.E.E., A.M.I.R.S.E. Member of the Engineering Staff of The Siemens & General Electric Railway Signal Co., Ltd., he was closely connected with traffic signalling at its inception in this country, being personally responsible for the design of Hand Controlled and "Fixed Cycle" Apparatus. Later, as Assistant to the Chief Engineer, he was directly concerned with the introduction, design and installation of Autoflex Vehicle Actuated Equipment.

H. G. M. **H. G. MANFIELD.** Received technical education at Croydon Technical Institution. 23 years' experience in radar engineering including four years as R.A.F. officer at home and overseas. Last 16 years at the Radar Research Establishment, where he is Head of Constructional Techniques Group. Chairman of two B.S.I. and an Inter-Services Committee for printed circuits. Author of many papers on printed and potted circuits, materials and, during last four years, microminiaturisation.

H. W. T. N. **H. W. T. NEIL,** A.M.I.E.E., A.M.I.Mech.E. General engineering training, and training as designer of electrical rotating machines, obtained with the Brush Electrical Engineering Co., Ltd. Subsequently Senior Design Engineer—Alternating Current Motors and Senior Development Engineer—Small Motor Division. Currently a Senior Technical Engineer with The Skefko Ball Bearing Co., Ltd.

H. Z. **H. ZEFFERT,** A.F.R.Ae.S., A.I.E.E., Mem.A.I.E.E. Chief Systems Engineer of Vickers-Armstrongs (Aircraft) Ltd. He has been closely associated with the aircraft electrical industry for more than 25 years. He has been responsible for the design of the electrical installations of many famous Vickers aircraft including the Valetta, Viking, Viscount, Valiant, Vanguard, V.C.10 and T.S.R.2. and has pioneered several aircraft electrical developments including the 112 V d.c. system and the extended use of heavy duty actuators. He is a member of the Aircraft Electrical Advisory Panel to the Ministry of Supply, S.B.A.C. joint I.E.E./R.Ae.S. etc., and author of *Principles and Practice of Aircraft Electrical Engineering* (Newnes).

J. A. C. **J. A. COWAN,** A.R.T.C., M.I.E.E., M.Am.I.E.E. Assistant Commercial Engineer at the Head Office of the North of Scotland Hydro-Electric Board. Formerly Senior Lecturer in Electrical Engineering at the Royal Technical College, Glasgow, where he specialised in electrical equipment of automobiles.

J. C. **J. COWAN,** C.B.E., M.I.E.E., M.I.Min.E. Formerly H.M. Principal Electrical Inspector of Mines and Quarries, Ministry of Power. Has served on various committees dealing with flameproof apparatus, including B.S.I., E.R.A. and B.E.A.M.A., joint B.S.I./I.E.E. Code of Practice and I.E.C. committees, Member of International conferences concerned with recommendations for the prevention of accidents due to electricity and fires underground. On other I.E.C. committees concerned with "increased safety", pressurisation, oil-filled apparatus and other methods of designing electrical apparatus for use where gas may be present. Member of working party on electricity of the E.E.C. Coal and Steel Authority.

KEY TO SPECIALIST CONTRIBUTORS

J. C. R. **J. C. RANKIN,** B.Sc., A.M.I.E.E. Received his training in Electrical and Mechanical Engineering at Glasgow University, and after service in R.E.M.E., completed a graduate apprenticeship with The B.T.H. Co. He is now a member of the Industrial Electronic Engineering Dept. of the Electronic Apparatus Division of A.E.I. Ltd., in charge of the section engaged in the development and design of Electronic Motor Control Equipment.

J. F. M. **J. F. MACKENZIE.** Member of the Engineering Staff of The Automatic Telephone & Electric Co., Ltd., and Editor of *A.T.E. Journal.* Has been in charge of specialist staff covering development and application of ripple control since 1938. Joint patentee of the " Rhythmatic " System.

J. H. C. (1) **J. H. CANSDALE,** M.I.E.E., M.I.Loco.E. Sales Manager of the Traction Division of A.E.I. Ltd., and has specialised on the design and application of electric traction equipment. Author of a number of technical articles and papers on this subject.

J. H. C. (2) **J. H. CURRY,** M.I.R.S.E., M.I.Loco.E. Assistant, Automatic Warning System, on Central Staff of British Railways.

J. H. R. **J. H. REYNER,** B.Sc. (Hons.), D.I.C., Educated Christ's Hospital, graduated City and Guilds (Eng.) College, joined Post Office Radio Section. Became Consulting Engineer and technical writer in 1925. Founded Furzehill Laboratories in 1927. Formed Limited Company in 1938, of which he is Managing Director, engaged in manufacture of high-grade electronic equipment for laboratory, industrial and aircraft applications.

J. M. **J. MAIR,** B.Sc.(Eng.). Graduated at Aberdeen in 1951, since when he has been with A.E.I. Ltd., Electronics Apparatus Division. He is mainly engaged in the design and application of electronic control gear for resistance welding machines.

L. D. A. **L. D. ANSCOMBE,** M.A., M.I.E.E., Assoc. A.I.E.E. Received engineering education at Emmanuel College, Cambridge, obtaining first-class hons. in Mech. Sciences Tripos. Student Apprenticeship with B.T.H. Co. followed by B.T.H. Fellowship to General Electric Co., U.S.A., in 1930/1 on Electrical Machine Design and Manufacture. Subsequent experience in design work on a.c. machines with B.T.H. Co., leading to present position as manager of large a.c. and d.c. machine design department, A.E.I.

L. R. B. **L. R. BLAKE,** Ph.D., B.Sc. (Hons.), M.I.E.E. Research Manager, U.K. Atomic Energy Authority, Dounreay. Bristol University, 1941–4; Birmingham University, 1946–8. Head of Electrical Section, Research Laboratory, B.T.H. Co., 1949–56, where interests included measurements, project engineering, transistor circuitry, spark-erosion machining, electromagnetic machines, including electromagnetic pumps. Author of a number of technical papers.

KEY TO SPECIALIST CONTRIBUTORS

M. B. **M. BARAK,** M.Sc. (New Zealand), D.Phil. (Oxon.), F.R.I.C. Rhodes Scholarship to Oxford 1926, Commonwealth Fund Fellowship to Princeton University, U.S.A. 1929. Demonstrator in Chemistry, University of London, King's College, 1931. Works Chemist, Chloride Electrical Storage Co., Ltd., 1934, Chief Chemist, 1941, Director of Research, 1953. External Examiner for Diploma of Technology, Salford Royal College of Technology, 1961. Author of articles in various journals and encyclopaedias.

M. G. S. **M. G. SAY,** Ph.D., M.Sc., A.C.G.I., D.I.C., M.I.E.E., F.R.S.E., M.Brit.I.R.E. Born in London 1902, received his technical education at the City and Guilds College, South Kensington. Graduated B.Sc. (Eng.) 1921, A.C.G.I., and D.I.C., with M.Sc. (Eng.) obtained by research. Student-Bursar, D.S.I.R., 1922–4. Ph.D. 1924. F.R.S.E. 1935. Industrial experience in contracting, machinery manufacture and design-office. Consultant in high-voltage design and machinery. Professor of Electrical Engineering, Heriot-Watt College, Edinburgh, 1933–63.

M. J. H. **M. J. HALL.** Academic education to Advanced Level Physics. Engaged overseas as radar technician. In 1954 employed as Works Chemist with Ionlite Ltd., subsequently becoming Technical Manager.

N. F. A. **N. F. ASTBURY,** M.A., F.Inst.P., A.M.I.E.E., F.R.S.A. Born 1908. Formerly scholar St. John's College, Cambridge. National Physical Laboratory 1929–39. Royal Naval Scientific Service 1939–45. Research Director of Joseph Sankey & Sons, Ltd., 1945–7. Research Director of the Guest Keen and Nettlefold Group of Companies 1947. Appointed to the Foundation Chair of Applied Physics in the New South Wales University of Technology, Sydney, 1949.

N. F. T. S. **N. F. T. SAUNDERS,** B.Sc.(Eng.), M.I.E.E., F.C.I.S., M.Inst.R Obtained his technical training and degree at the Royal Technical College and University, Glasgow. For many years was engaged in the design of small electrical machines and domestic appliances, and has published papers and articles on this subject, including a paper on *The Design of Fractional H.P. Induction Motors,* for which he was awarded the I.E.E. John Hopkinson Premium. Since 1938 he has been the General Manager of British refrigerator manufacturing concern.

R. C. W. **R. C. WALKER,** B.Sc. (Lond.), A.M.I.E.E., A.M.I.Mech.E Was a specialist in Applied Electronics. Published works include Newnes' *Aircraft Radio,* and *Electronic Equipment and Accessories, Photoelectric Cells in Industry* (Pitman), *Industrial Applications of Gasfilled Triodes (Thyratrons)* (Chapman & Hall).

R. D. K. **R. D. KNOTT,** B.Sc., M.Sc. Attended Selhurst Grammar School, Croydon, and Sir John Cass College, London. B.Sc. (Hons.), 1948, and M.Sc. (Mathematics), 1951, both of University of London. Member of the Principal Scientific Staff of The General Electric Co., Ltd., Hirst Research Centre, Wembley. Engaged for the past ten years on research and development of semiconductor devices.

KEY TO SPECIALIST CONTRIBUTORS

R. I. M. **R. I. MARTIN,** A.M.I.E.E. Engineer in the Insulations Standards Research Laboratory A.E.I., Rugby, and is a specialist in electrical insulating materials and processes. He received his engineering education at Finsbury Technical College, and was the first student-apprentice at the Rugby works of The B.T.H. Co. He is a member of numerous committees of the Electrical Research Association, the B.S.I. and the I.E.C. Technical Committee dealing with insulating materials, and is the author of technical articles and papers on this subject.

R. L. G. **R. L. GRIMSDALE,** M.Sc., Ph.D. Graduated at Manchester University with first class Honours in Electrical Engineering and was awarded the Fairbairn Prize. He subsequently received higher degrees for research work on digital computers and is at present Lecturer in Electrical Engineering at Manchester University, engaged in work on computers.

R. W. F. **R. W. FLUX,** A.M.I.E.E. After several years in the Transformer Design Department of the Metropolitan-Vickers Electrical Co., became Transformer Engineer to the Central Electricity Board in 1946, and after nationalisation Transformer Engineer in the Transmission Design Branch at B.E.A. Headquarters. In 1952 was appointed Chief Engineer, Transformer Department of Bruce Peebles & Co., Ltd., Edinburgh.

S. J. (1) **S. JEFFERSON.** Was educated at London University, and held positions with Siemens Bros., Massey Radio, and E.M.I. Served with the Air Ministry, M.A.P. and M.O.S. 1936–47 on Radar Research and Development. Joined the Atomic Energy Research Establishment, Harwell, 1947. Engaged on industrial electronics and applications of radioisotopes.

S. J. (2) **S. JAMES,** M.I.E.E. Formerly Chief Engineer of Chamberlain & Hookham Ltd. He has served on the Committee of the South Midland Centre and also the Instrument and Meter Section of the I.E.E. He has been a member of a number of technical committees dealing with electricity meters, instruments, and instrument transformers. Author of *Electricity Meters and Instrument Transformers.*

S. W. **S. WOODHOUSE,** A.M.I.E.E., Assoc. I.Mech.E. Joined the Ministry of Supply, Atomic Energy Research Establishment, Harwell, as Safety Engineer in 1948 and is concerned with all aspects of safety, apart from radiation hazards. Has been a Part-Time Lecturer in Engineering Subjects since 1942. He has also contributed articles to the technical press.

T. E. H. **T. E. HOUGHTON,** M.Eng., M.I.C.E., M.I.Mech.E., M.I.E.E. Past Chairman of the Mersey and North Wales Centre of the I.E.E. Power Department Manager, I.C.I. Ltd., General Chemicals Division.

T. H. C. **T. H. CARR,** M.I.C.E., M.I.Mech.E., M.I.E.E., M.Inst.F., M.A.Min.E.E. Area Manager, C.E.G.B. He has previously served with industrial firms, and with the Sheffield Corporation and Derby Corporation Electricity Depts., then Deputy Electrical Engineer and Manager, and then City Electrical Engineer and Manager at Bradford. Author of *Electric Power Stations* (2 vols.), *Sub-Station Practice, Electric Power Supply,* and *Electrical Engineering Practice* (Part).

V. E. M. **V. E. MILWARD,** B.A., A.M.I.E.E., Design Engineer, Power Rectifier Engineering Department, A.E.I. Ltd., Heavy Plant Division. Served student apprenticeship with B.H.T. Co., Ltd., followed by experience in the Research Laboratory.

KEY TO SPECIALIST CONTRIBUTORS

W. C. **W. CASSON,** M.I.E.E., is System Design and Development Engineer of the C.E.G.B. He is a specialist in transmission system design, protective gear and metering; is the author of several I.E.E. papers and was awarded the Silvanus Thomson premium in 1947. He is associated with several patents on metering and protective gear.

W. E. S. **W. E. STEWARD,** Associate I.E.E. Managing Director and Founder of William Steward & Co., Ltd. Is author of *Electricians' Maintenance Manual* (Newnes), articles on industrial installation work, and " Confessions of a Contractor " (*Electrical Trading*), *Modern Wiring Practice* (Newnes), and *Estimating and Casting for Contracts* (E. & F. N. Spon).

W. F. C. **W. FORDHAM COOPER,** B.Sc. (Eng.), A.K.C., M.I.E.E., A.M.I.Mech.E. Deputy Senior Electrical Inspector of Factories. Was for a short time engaged on circuit-breaker research with the E.R.A.; subsequently with the Yorkshire Electric Power Co. and the North Metropolitan Electric Power Co. Became H.M. Electrical Inspector of Factories for the North Midlands in 1931 and Deputy Senior Electrical Inspector in 1955. Chairman of the Sheffield Sub-Centre of the I.E.E. 1937-8; Chairman of the North Midland Centre 1942-3; ex-officio member of the Council 1942-4. Author of a number of papers read before the I.E.E., and received Students Premium 1926, Installation Premium 1944, Paris Premium 1947.

W. J. B. **W. J. BELSEY,** A.M.I.E.E. Member of the Institute of Naval Architects, late Manager of the Marine Department of The B.T.H. Co., was responsible for the turbine electric propelling machinery for the liners *Viceroy of India, Strathnaver* and *Strathaird,* and other vessels.

W. L. B. **W. L. BRIDE,** M.Sc. (Tech.), A.M.I.M.E. Assistant Professor of Engineering at Heriot-Watt College. Following engineering experience, and four years on the teaching staff of the Manchester College of Tchnology, became lecturer in Engineering at Heriot-Watt College. This was followed by nine years as Head of the Engineering Department at Sunderland Technical College. He obtained the M.Sc. Tech. for research on piston temperatures in a compression ignition engine.

W. R. **W. RENWICK,** A.M.I.E.E. Born and worked on farm until joining Royal Engineers in 1914. After three years at Regent Street Polytechnic, joined Upfield and Son, Agricultural Engineers, and then Mann Egerton and Co., becoming manager of Ipswich and London branches on general electrical contracting and country house and farm engineering. In 1934, joined L.C.C. Chief Engineer's Department, Hospital Division, dealing with installations in hospitals and their attached farms. He became Deputy Regional Engineer of the Welsh Regional Hospital Board. Is now with Ernest Griffiths and Co., Consulting Engineers for the new University Hospital for Wales.

W. W. **W. WILSON,** D.Sc., B.Eng., Hon. A.C.T. (B'ham), M.I.E.E., M.Amer.I.E.E., M.Brit.I.R.E., F.Inst.P. Was manager of the G.E.C. Development Laboratory, Witton, Birmingham. Author of *The Cathode Ray Oscillograph in Industry,* and *Calculation and Design of Electrical Apparatus* (Chapman & Hall), two other books, and many papers and articles.

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