A CHRONOLOGICAL HISTORY OF ELECTRICAL DEVELOPMENT FROM 600 B.C.

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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

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PREFACE

IN presenting this Electrical Chronology, the National Electrical Manufacturers Association, which has undertaken its compilation, has exercised all possible care in obtaining the data included. Basic sources of information have been searched; where possible, those in a position to know have been consulted; the works of others, who had a part in developments referred to in this Chronology, and who are now deceased, have been examined.

There may be some discrepancies as to dates and data because it has been impossible to obtain unchallenged record of the person to whom should go the credit. In cases where there are several claimants every effort has been made to list all of them.

The National Electrical Manufacturers Association accepts no responsibility as being a party to supporting the claims of any person, persons or organizations who may disagree with any of the dates, data or any other information forming a part of the Chronology, and leaves it to the reader to decide for himself on those matters which may be controversial.

No compilation of this kind is ever entirely complete or final and is always subject to revisions and additions. It should be understood that the Chronology consists only of basic data from which have stemmed many other electrical developments and uses.

The National Electrical Manufacturers Association gratefully acknowledges the generous assistance and advice received from its many member companies, and others, and the research services of E. S. Lincoln, Consulting Engineer, in the preparation of this Chronology.

FOREWORD

WHETHER Hoang-ti, the mythical founder of the Chinese Empire, was, in 2634 B. C., the first to construct a magnetic compass; or whether such an apparatus was not invented until 1110 B.C. by Ki-tan, a Chinese minister of state; or whether this invention must be placed at a later date—it may, nevertheless, be accepted that to the Chinese belongs the honor of having made the first application of magnetism to a practical purpose, as well as having devised the first practical methods of inducing magnetism in iron and steel. The word magnet comes from the fact that lodestones were first found near Magnesia, a city in Asia Minor. The word lodestone, an abbreviation for "leading stone" comes from the fact, probably discovered by sailors in the northern countries of Europe, that this mineral would point to the north if suspended like a compass.

Whether Thales of Miletus, one of the Seven Wise Men of Greece, who lived in 600 B.C., was the first to observe the electrical effect produced when amber is rubbed with a nonconducting substance, or whether this knowledge is of an earlier date, the fact remains that no practical consequences came from the discovery for more than twenty centuries. It was not until after the systems of reasoning, which the Greek successors of Thales imposed for so many ages upon the intellect of Europe, began to be displaced by habits of thought that recognized nature herself as teacher and no longer rested content with the mere dicta of authority that electricity passed beyond the stage of metaphysical speculation and entered that of physical investigation.

There is one exception to this statement, for physicians, the only representatives of practical science in the days of Greece and Rome, seem to have applied electricity to their uses. We read that Galen and other physicians referred to the therapeutic value of the electric shock from the torpedo fish, which was considered efficacious in the cure of gout, inveterate pains in the head, and so forth. In this connection it is noteworthy that Gilbert, a physician, was the founder of modern electrical science, and that the discovery from which subsequently that science took its greatest impetus, was that of a physician, Galvani of Bologna.

To simplify the development and growth of electrical science and the electrical manufacturing industry, the subject may be

divided into its seven basic principles. This is essential as all electrical equipment, devices, and applications fall into one or more of these groups. These basic principles are as follows:

MAGNETIC
HEATING
ELECTROSTATIC
ELECTROCHEMICAL
ELECTROTHERMAL
PHOTOELECTRIC
ELECTRONIC

In other words, devices operating by means of magnetism, such as a generator, motor, transformer, induction furnace, and so on, come under the magnetic principle. Under the heading of electric heating would come such devices as welding, resistance furnaces, heating appliances, thermostats, and many other devices including the filament incandescent lamp where the light is a by-product of the heat generated in the filament. The electrochemical principle would include batteries, electroplating, metal refining, and so on. A list of these principles and the types of electrical devices operating on them appear in Table I.

TABLE I
OPERATING PRINCIPLES OF COMMON ELECTRICAL EQUIPMENT

MAGNETIC	HEATING ELECTROTHERMIC	ELECTRONIC
Motors	Incandescent lamp	Fluorescent lamp lighting by ionized gases
Generators	Heating appliances	Ultra-violet lamps
Induction heating furnace	Water heaters	X-rays
Transformers	Room heaters	Mercury vapor lamps
Magnets (of all types)	Space heaters	Mercury arc rectifiers
Lifting magnets	Resistance welding	Vacuum and gaseous tubes or valves
Magnetic separators	Arc welding	Cathode ray tubes
Solenoids	Fuses	Microscopes
Communication systems	Thermal circuit breakers	Oscilloscopes
Clocks	Arc furnaces	Radio
Measuring instruments	Resistance furnaces	Television
Magnetic circuit breakers	Radiant type furnaces	Radar
Magnetic brakes	Measuring instruments, (hot wire types)	
Annunciators	Branding irons	
Alarms	Lighters	
Contactors	Pyrometers	
Relays	Thermocouples	
Oscillographs		
Voltage regulators		
Telephone, wire systems		
Telegraph, wire systems		
Timing devices		
Signal systems		

ELECTROSTATIC	ELECTROMETALLURGICAL AND ELECTROCHEMICAL	PHOTOELECTRIC
Smoke prevention	Metal refining	Light meters
Dust filtration	Electroplating	Light sensitive tubes
Static voltmeters	Storage batteries	
	Primary batteries	
	Production of chemicals	
	Fertilizer production	
	Copper oxide rectifiers	
	Lightning arresters	

In this chronology the dates of discovery of the above principles are of interest. From those dates it is also interesting to note when that discovery led to its actual use by mankind in the form of some particular device such as a motor, lamp, toaster, or hundreds of other things in common use today.

It should be realized, moreover, that other discoveries and inventions in other branches of science, such as chemistry and metallurgy, were important factors in the development and success of the electrical manufacturing industry. Thus, the perfection of insulating materials, alloy steels, and other metals, modern plastics, and so forth, all help to make better electrical equipment, motors, and generators. Here again the electrical manufacturing industry is directly responsible for better metals, better chemicals, better and cheaper construction by means of such methods as electric welding. In fact, each and every branch of science and the industry that was founded on it depends on the other branches of science as progress and perfection are reached for the benefit of all.

Each science is a tree with a main trunk representing the fundamentals and the branches and leaves the development and application of these fundamentals. Each scientist and engineer has his own tree to work with, but civilization is interested in the largest tree of all made from the combination of principles taken from all the trees of science. Therefore, as far as practicable, discoveries and dates in other branches of science of importance to the development of electrical devices will be given. This chronology may be considered as a large picture puzzle with each piece representing some discovery or invention and the date it was placed in the picture. The size and shape of each part of the puzzle will be given as far as possible according to its value as a whole in the picture up to the present writing. No man who has seen the present picture will ever live to see it completed, since new pieces are being put in place and will continue to appear as long as civilization exists. In the following pages will be found a brief outline of an industry that has done more for mankind than any other industry in existence, the backbone of them all. Without electricity modern civilization could not exist.