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C.E.L. BROWN.

Charles Eugene Lancelot Brown was born in Winterthur, Switzerland, in 1863, the son of Charles Brown, an engineer of exceptional ability. After a year's industrial apprenticeship at Basle, he organized an electrical department in the local locomotive plant, and in 1874 at the age of 20, entered the service of the Oerlikon Engineering Works, of which, two years later, he became director of the electrical department. In 1885, Mr. Brown conceived and applied the tunnel armature to the construction of direct-current machines which he was then developing. In 1886 he turned his attention to direct-current high-tension transmission problems, the initial experiment being the conveyance of 50 hp. of hydroelectric energy five miles into Solothurn, Switzerland. These undertakings involved the design of numerous special protective devices, arresters and circuit breakers, a feature of the latter being the reduction of the line current gradually by cutting down generator excitation. The 600 hp Schaffhausen plant at the Falls of the Rhine was his next installation, employing two 625-volt direct-current generators in series, and making use of a novel switching arrangement. To this period belongs the design by Mr. Brown of the modern type of slow-speed central-station generator, which eventually displaced throughout the world the high speed belted machine of small capacity. In 1888, Mr. Brown produced some exceptional electrolytic generators, each having outputs of 12,500 amp at 20 volts. His first vertical-shaft generator of this type delivering 12,000 amp at 36 volts when running at 180 r.p.m., was brought out in 1889. Mr. Brown also assisted in the development of electric traction motors about this time, in connection with which he introduced the barrel winding, and has since designed a number of important direct-current railway generators. Turning to alternating-current machinery, Mr. Brown began the study and development of single-phase transformers and generators in 1889, and when the



C.E.L. BROWN - sheet 2.

polyphase system was first brought out by Tesla in America, the Swiss engineer recognized its application to long-distance transmission problems at high voltages, and designed the first oil-insulated high-tension transformers. As early as 1890 he had a 40,000-volt test set in use, and was convincing others of the future possibility of transmitting at this pressure, and even higher. Recognizing the need for a generator which could produce single and polyphase currents equally well, he produced the Lauffen type alternator in 1890. Leaving the Oerlikon works in 1891, Mr. Brown organized his own concern, Brown, Boveri & Co., with extensive works at Baden, Switzerland, where he took up the development of the revolving-field type of alternator. The famous 1500-hp Frankfurt (Germany) machines, with flywheel-type fields, were among the early improved forms due to the Swiss designer. Next followed the so-called umbrella type of vertical-shaft generators, installed in the leading French and Swiss stations. The eight remarkable 1200 hp alternators at the Lyons plant had surface speeds of 7500 ft. per minute. Mr. Brown was first among designers to grasp the advantage of

working generators beyond the bend of the saturation curve, as performance tests of many of his machines prove. A famous station containing machines of his design was that at Aarburg, where six 300 hp two-phase 5000-volt alternators were operated at the surprisingly low rotative speed of 28 r.p.m. These units were first planned as induction-type generators, but their designer early saw their shortcomings as such, and quickly converted them to revolving-field machines. In 1890 Brown designed his first induction motor, being first to apply his tunnel winding to both stator and rotor in its present accepted form. Shortly after the Baden works began manufacturing commercial induction motors, and as early as 1892 their output was considerable. Besides developing a number of special machines, among them a low-speed type of motor, in 1892 he turned his energies to producing a commercial single-phase motor, developing one starting on the split-phase principle with water condensers. In 1894, he built the first three-phase surface railway at Lugano, Switzerland, following it with those on the Gorner Grat near Zermatt, the Jungfrau, and one near Thun. The locomotives of these roads embody a number of distinctive features in the design of their motors, controlling devices, etc. Mr. Brown is managing director of Brown, Boveri & Company, Baden, Switzerland. A series of articles written by Mr. B.A. Behrend, and entitled "The Debt of Electrical Engineering to C.E.L. Brown", appeared in the Electrical World in 1901 and 1902, beginning November 16, of the former year.