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ACHIEVEMENTS OF FAMOUS NINETEENTH-CENTURY SILESIAN ELECTRICAL ENGINEERS

Key words: Georg Graf von Arco, Walter Reichel, Fritz Emde, Karl Ilgner and Emil Naglo

Introduction

At the beginning of the 80s. of the 19th century, light bulbs, invented and improved by Edison in 1878, appeared on the market. At that time they were one of the main electric energy receivers. In 1866 Werner von Siemens built self-excited electrical dynamos, the first fully-operable direct-voltage sources. Thus, the conditions were fulfilled to make use of electric energy on a larger scale. The oldest power network was designed by Edison in New York. Underground three-conductor cables were laid in this city to 1881. At the same time, Edison invented fuses, appropriate meters and improved generators. The first in the world public electric power station began to function in Pearl Street, New York on the 4th of September 1881. It had 6 generators driven by steam turbines and they weighed 27 tons and supplied power of 100 kW which at that time was enough to feed about 1100 light bulbs. On the 1st October 1882, electric energy was sold to 59 clients. There were already 513 customers the following year.

It may be said that those were the years when laboratory electrotechnics had been transformed into industrial one and not only in America but also in Europe. To the first electric energy receivers, i.e. arc lamps and light bulbs were soon added electric heaters and motors of various types. At the beginning of the 20th century, electricity found application in wireless communication, in the first place in radio communication and then in television broadcasting.

Many brilliant electrical engineers came from the Silesian Land whose activities, at the turn of the 20th century, brought about significant progress in many fields of this superb science. Below will be presented the profiles and achievements of some of them, who are already often forgotten and who in their times contributed to progress in electrotechnics.

1. GEORG GRAF VON ARCO, THE FATHER OF GERMAN RADIO BROADCASTING

Arco (Figure 1) was born on the 30th of August 1869 in Gorzyce, Wodzisław District in Upper Silesia (formerly: Groβgorschütz, Kreis Ratibor in Oberschlesien) [1, 2]. In the eighties of the 19th century he attended the Royal Evangelical Middle School in Racibórz. Already as a child Graf von Arco was interested in technology in the full sense of the word. After school-leaving examinations he graduated from Maria Magdalena Secondary School, an arts oriented school in Wroclaw in 1889. He was rather a mediocre pupil but showed the great ability to do geometry and physics. Immediately after graduating from the school, he began to study such subjects as mathematics, physics, mechanical engineering and electrotechnics at the Higher Technical School in Berlin Charlottenburg. However, he attended only lectures in mathematics and physics and after the second semester he stopped studying, joined the army and became an officer in the German elitist regiment of rifleman guard.

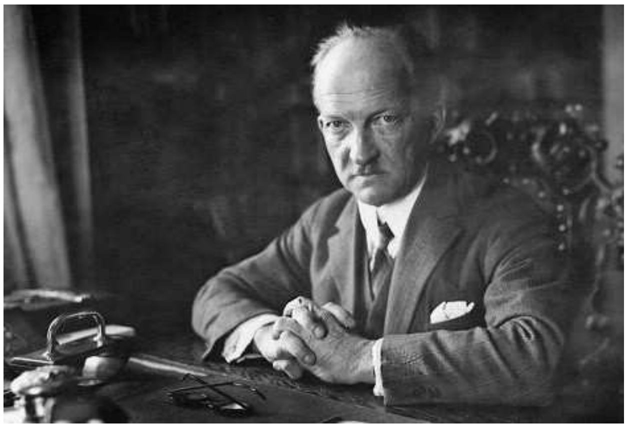


Fig. 1. Georg Wilhelm Alexander Hans Graf von Arco acc. [3]

Thanks to a special permission of the Emperor Wilhelm II issued in 1893, Graf von Arco was able again to resume his studies in the branches of mechanical engineering and electrotechnics at the Higher Technical School, which he had quitted earlier. That way his military episode had reached the end. Graf von Arco got excellent results in his studies and soon he became an assistant of Professor Adolf Slaby, the then head of the department of electrotechnology, in the today's meaning, and of wireless transmission of information (radio engineering).

Adolf Slaby was the only foreigner who was allowed to participate in the experiment conducted by Guglielmo Marconi, the famous Italian constructor, and concerning transmission of information by means of wireless telegraph. The attempt took place in 1897 on the English coast of the English Channel. Already four weeks after this event, on the 27th of August, Slaby and Arco repeated Marconi's experiment. For this purpose they used the bell tower of the Church of the Redeemer standing on the bank of the Hawela near the palace of Sacrow in Potsdam and they placed a transmitting antenna on it. A receiving antenna was located in the imperial naval base, Kongsnaes, 1,6 km away on the opposite bank of the Jungfernsee. The research was held under the patronage of the Emperor Wilhelm II himself who previously gave his consent to leave the army by Graf von Arco. On the 7^{th} of October the same year Slaby and Arco managed to establish wireless communication between Berlin - Schöneberg and Rangsdorf (the town located on the experimental route of the fast electric railway). The next distance record was set the following year. The signals transmitted in Berlin were received in Jüterbog 60 km away.

After graduating (1898) Arco found employment in Allgemeine Elektricitäts Geselschaft (AEG), a well-known German electrotechnical company, in a plant manufacturing power cables – At first he worked as a laboratory engineer and was responsible for qualitative and technical tests of various cable types. However, thanks to continued contact with Prof. Slaby, he was able to introduce a wireless telegraphy department into the company and to develop it fast. Consequently, AEG-Slaby–Arco-Gruppe would come into being later.

Continued patent disputes, concerning wireless communication, between AEG and Siemens & Halske (S & H) resulted in this that at the behest of the Emperor Wilhelm II both companies founded a common enterprise by the name of the Society for Wireless Telegraphy Ltd. This occurred in 1903 and Graf von Arco became its technical director. This Limited Company was a predecessor of later Telefunken, a firm of world-wide reputation.

Fig. 2. Transmitter TK 05 made by Telefunken Company from the years when Graf von Arco was its technical director acc. [4]

At the beginning of the company activity, Arco was able first of all to increase the power of transmitters as a result of this the range of transmitting stations was greater. In 1906, with this end in view he began to use transmitters developed by Prof. Max Wien who worked then at the Royal Higher Technical School in Gdańsk, at present Gdańsk University of Technology. Wien's transmitters eliminated a significant defect of Ferdinand Braun's transmitters consisting in loud shooting of an electric spark while transmitting, and they were much more efficient. It was also extremely important that they did rot interfere other transmitters working on a similar frequency band. The transmitters made by Telefunken, and making use of Wien's patent, were used until the First World War, maintaining transatlantic telegraph communication. The following years Arco himself patented many solutions of his own in wireless telegraphy. The end result of a number of his inventions was a high frequency machine transmitter introduced into use in 1912. It emitted non-decaying oscillation of a very long wave and it was primarily applied to send messages over the ocean. For implementing this solution, on the 29^{th} of February 1916 The German Reich University in Strasbourg conferred the title of Doctor Honoris Causa in philosophy upon Graf von Arco.

Figure 2 shows one of the transmitters made then by Telefunken, in this case it is TK 05. The greatest service of Graf von Arco was building a large transmitting station in Nauen, situated 18 km west of Berlin. The investment made this not big town (about 10 000 inhabitants) and Telefunken company famous all over the world. On the 6^{th} of December 1907 Arco carried out a successful experiment which concerned wireless transmission of a human voice. Enrico Caruso, the Italian „king of tenors" from the first twenty-years of the 20^{th} century, participated in this experiment. He sang an operatic aria at the Higher Technical School in Berlin-Charlottenburg and his voice was transmitted to Kreuzberg, a district in Berlin where an imperial pair, Augusta Wiktoria and Wilhelm II listened to him with great interest.

The height of longtime work of Arco in the field of wireless communication was the beginning of broadcasting the first radio programme in Germany on the 29^{th} of December 1923. In this creative period for him it was possible to see his likeness on the posters of Telefunken Company and in its journals (Figure 3).

Fig. 3. A poster with the likeness of Graf von Arco advertising Telefunken Company acc. [3]

It is truism that progress in the development of wireless telegraphy, as well as every other invention had to be tested first of all for military purposes. This fact primarily motivated the Emperor Wilhelm II to persuade him to support tests in the range of wireless communication financially and spiritually. Already during the First World War an opportunity arose to test communication with ships on the sea and with the remote German overseas colonies. Arco was opponent of every war. Together with contemporary for him such distinguished scientists as Albert Einstein, Wilhelm Julius Foester or Eduard Bernstein, he became involved in the activities of liberal and pacifist associations or organizations. His later political activity manifested itself in his explicit attitude towards the Weimar Republic. He clearly expressed his humanistic and cosmopolitan opinions. In the article entitled „Technology kills war" („Die Technik mordet den Krieg") from 1926, he expressed his hope that the development of technology, including the discipline in which he acted, and the human wisdom would prevent future wars.

„Red Graf" („Roter Graf"), his nickname used very often, has nothing to do with his political opinions. It only expresses his love for cars painted red. After a long and serious disease, the life of the brilliant Silesian constructor, technician as well as monist and pacifist came to an end on Bismarckallee 47 in Berlin on the 5th of May 1940. Arco was very famous in the whole of Germany and the inhabitants of Berlin called him their „Funk Graf" (Count – radio engineer). His co-workers addressed him as „Seine Hochfrequenz" (His High Frequency).

It is important to know that Arco together with Alexander Meissner constructed a superheterodyne receiver and introduced the technology of industrial production of vacuum tubes. It is possible to read about him in the study „The Inhabitants of Racibórz in Millenium".

2. WALTER REICHEL A PIONEER OF FAST ELECTRIC RAILWAY

Emil Berthold Walter Reichel (Figure 4) was almost a peer of Graf von Arco. He was born on the 27th of January 1867 in Siemianowice Śląskie (formerly: Laurahütte in Oberschlesien) [1, 5].

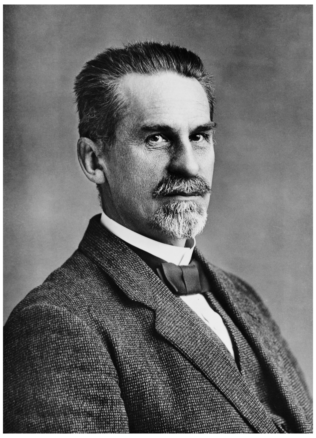


Fig. 4. Walter Reichel (the photograph from the Siemens Corporate Archives and with their consent)

After completing his electrical engineering studies (1889), he began to work in S & H Company in Berlin. In 1897 he became a senior engineer there and from 1908 the manager of a plant manufacturing electric machines. Later he was a director and an executive officer of the company board. He held these positions up to 1932. He was highly successful as an engineer, particularly in the construction of locomotives and large electric motors. He was regarded as an expert in testing fast self-propelled railway cars. Their speed exceeded 200 km/h on the military route between Marienfelde and Zossen. That occurred at the beginning of test rides between Dessau and Bitterfeld (1911), where single-phase electric traction with the voltage of 10 kV and the frequency of 16 2/3 Hz was used. He made use of his experiences in electrification of long-distance train routes not only in Germany but also in Sweden and Holland. He also built a large single-phase generator for power supplying traction and which functioned in an electric power station in Welchensee (1924). His other well-known achievements included the introduction of welded constructions of large electric machines and turbogenerators as well as the constructions of large electric motors utilized as drivers in rolling mills.

The application of three-phase asynchronous motors to traction drivers [6, 7] was above all connected with Walter Reichel. The beginning of those experiments, carried out by S & H Company, occurred in the 90s of the 19th century. However, the first tested genuine route was only used in 1899. It was in Teltower Straβe in Berlin. Two vehicles served then for test rides. A locomotive was one of them and the other was a railway car with a transformer, equipped with two three-pole pantographs collecting current (Figure 5).

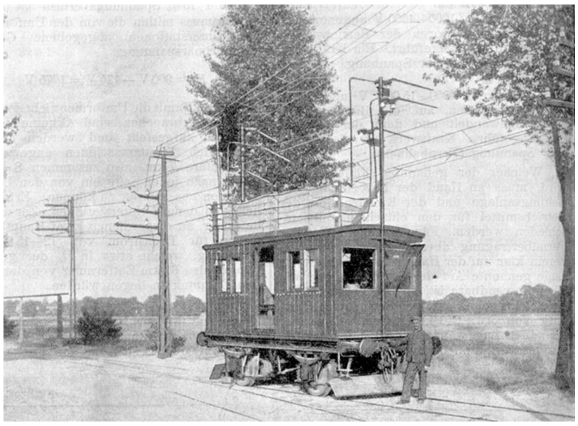


Fig. 5. A wooden transformer car in place of traction supply, two sets of pantographs collecting current from above can be seen acc. [8]

The pantographs made of aluminium wire, slided along conductors supplying from above. They were not able to touch the conductors from below (as it is nowadays) because insulators, which were then standing, hampered that. The transformer itself reduced the supply voltage from 10 kV to 750 V. Three copper traction conductors with the diameter of 8 mm were being hung in one skew plane.

During the first experiments a locomotive pulled a transformer car behind. It turned out that while supplying from such a made network, a ride at a speed of 60 km/h did not cause any problems, since current collectors were able to adjust to the vertical profile of the suspended conductors. Problems emerged when the speed was exceeded, because the pantograph, especially in the places where conductors were located extremely high, lost contact with them bringing about sparkling and power consumption cuts at the same time.

A locomotive was made of steel, after rebuilding the route and enlarging the experimental team in 1900. A transformer was placed within the locomotive and three-pole pantograph with a side contact for traction conductors was installed on the roof. Three traction conductors were then laid in one vertical plane and perfect contact with them was to be ensured by pantographs pressed by springs. The modernized locomotive and traction can be seen in Figure 5. During the conducted experiments, the values of supply voltage changed from 750 through 2 000 up to 10 000 volts. The first two of them were brought directly from a power station, the last one was obtained by means of a transformer.

It turned out at the same time that the pantograph operation and power consumption were the most efficient when voltage was the highest. It could be ascertained that after their rebuilding, the appliances and used technologies performed better than their predecessors. Accelerating a locomotive, loaded with 30 tons, with the supply voltage of 750 volts and with power consumption of the values of 190 amperes, ensued within 60 seconds.

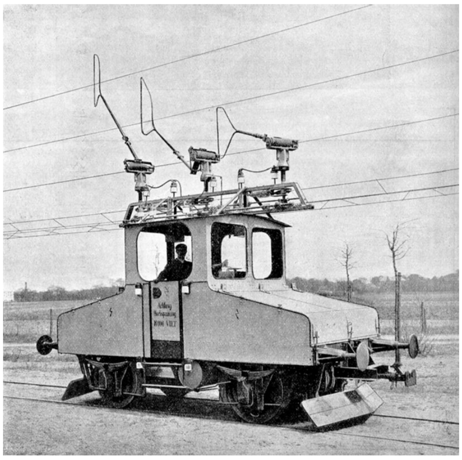


Fig. 6. A locomotive, modernized in 1900, for test rides, with a three-phase asynchronous motor acc [9]

At the end of test rides (1901), the locomotive, shown in Figure 6, was rebuilt in order to be supplied with direct current of the values of 220 volts and it was sold to a cement mill in Bad Berka in Thuringia. It served there up to 1972 and at present it can be seen in the Transport Museum in Dresden.

Soon Walter Reichel achieved the greatest success in his engineering work. His self-propelled railway car, marked „S", made in Van der Zypen & Charlier factory in Cologne and equipped electrically by S & H Company, reached a speed of 206, 7 km/h on the experimental military route between Marienfelde and Zossen [7]. The attempt was carried out on the 23rd of October 1903. Figure 7 shows the railway car „S" after the ride at the above-mentioned speed. The construction of its three-pole pantographs makes a great impression.

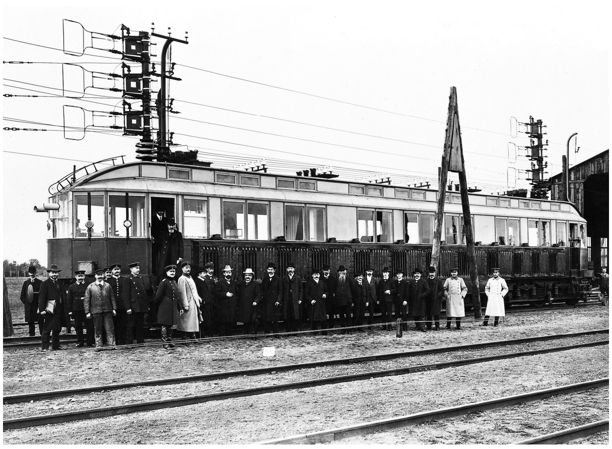


Fig. 7. The railway car „S" after its record-breaking ride on the route between Marienfelde and Zossen acc. [10]

In the central part of the car there was an engine room with a transformer of the ratio of 12 000 : 435. During the ride it was cooled with the air flowing into ventilating ducts whose entrance was on the roof. It should be mentioned that only two extreme axes were being driven and no transmission ratio was used. It meant that the rotational speed of a rotor was at the same time the rotational speed of wheels. Their diameter was 1 250 mm similarly to this one (still in use) on the present-day German railways. Rotors of the motors were placed on the same shaft as road wheels whereas stators constituted the elements of a running gear. In order to achieve the record-breaking speed the traction voltage was increased to 14 kV and the frequency to 50 Hz.

The railway car „A", equipped electrically by AEG, competed with the railway car „S". The latter rode at a speed of 210,2 km/h, breaking the Siemens record on the 28th of October 1903. It may be added here that the speed was record breaking not only on tracks but also it concerned all the other vehicles moving then. Only in 1931 a new record was broken by a rail Zeppelin driven by a propeller. The art of the then railway engineers and those who took up drivers was very great, which may be proved by the fact that during both record-breaking rides, not a single drop of water was spilled from a glass filled with water to the brim.

Similarly to the earlier famous electrical engineers, born in Silesia and Great Poland: Graf von Arco and Hermann Aron, also Walter Reichel was conferred a title of the government's secret adviser in 1917. The Higher Technical School in Munich conferred the title of Doctor Honoris Causa upon him in 1919 and the Higher Technical Schools in Karlsruhe and Berlin-Charlottenburg bestowed a title of the honorary citizen on him.

Walter Reichel had also been a university teacher for many years, after he was awarded his doctoral degree in 1902. In the years 1904-1926 he held a position of full professor at the Higher Technical School in Berlin-Charlottenburg (the predecessor of the present-day Technical University). From the most famous his publications one may mention the book entitled „The Application of three-phase current, in particular high-voltage three-phase current in electric railway drivers", Munich, 1903. The book consisted of 167 pages. His famous article, which appeared in „Elektrotechnische Zeitschrift" (ETZ) No. 51 (1930), was entitled „Erfahrungen mit elektrischen Wechselstrom-Lokomotiven der Deutschen Reichsbahn". It describes the experiments with electric locomotives supplied with alternating voltage and used in the German State Railways. This talented engineer, constructor and professor of a higher education institution, died on the 23rd of May 1937 in the capital of Germany. The ETZ No. 58 (1937) ran an article devoted to the seventieth anniversary of the birth of this eminent pioneer of three-phase drivers in electric traction and at the same time it placed his obituary.

3. FRITZ EMDE, A CREATOR OF ELECTROTECHNICAL VOCABULARY

He was born in Uszyce, Olesno District in Opole Province (formerly: Uschütz Kreis Rosenberg in Oberschlesien) on the 13th of July 1873 [1, 11]. He graduated from the Middle School in Białogard in Pomerania. It was then the equivalent to obtaining a certificate of secondary education. Immediately after school-leaving examinations, he began training as an apprentice fitter in a machine factory most probably in Słupsk. In 1895 he began to work in the AEG Company in Berlin. Two years later he went over to the competitive S & H Company, operating in the capital of Germany for a long time. In the years 1900-1911 he worked as an assistant manager in testing laboratories in Berlin-Charlottenburg (Figure 8). At that time he also studied the Maxwell's theory of electromagnetic waves both intensively and independently as well as he tried to fill in the gaps in his knowledge of physics and higher mathematics. In spite of the fact that a university degree had never been conferred upon him, in 1911 he was appointed to a position of full professor at the Academy of Mining (Bergakademie) in Clausthal in Lower Saxony. He lectured there on mechanics and electrical engineering. After a year spent at work in Clausthal, a town with over ten thousand inhabitants, he was again promoted. He was still professor and at the same time, the manager of the Institute of Electrical Engineering at the Higher Technical School (Technische Hochschule) in Stuttgart. He performed these functions till he went into retirement. He retired in 1938. However, he had not ceased his scientific activity and he continued to publish a great number of treaties and books.

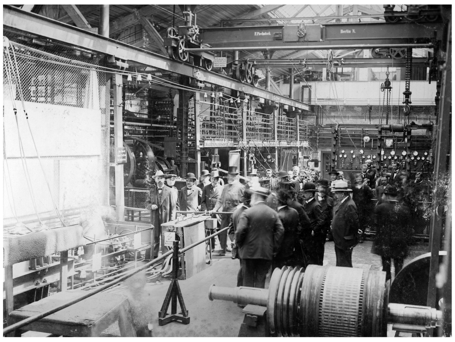


Fig. 8. The testing laboratory in Charlottenburg. Walter Reichel is on the left hand side and Fritz Emde is somewhere in the midst of the participants of a demonstration, (the photograph from the Siemens Corporate Archives and with their consent)

He spent the wartime and several postwar years in Upper Franconia. In 1950 he returned to Stuttgart, where slowly he began to lose his sight. He died on the 30th of June 1951. Figure 9 shows Fritz Emde as Professor at the Higher Technical School (THS) in Stuttgart and Figure 10 shows the building of this school at the end of the 19th century.

Fig. 9. Prof. Fritz Emde at the time he was the manager of the Institute of Electrical Engineering at the Higher Technical School in Stuttgart acc. [12]

The first publications of Fritz Emde appeared already when he worked in the testing laboratory in Charlottenburg and they were devoted to the working modes of alternating current machines. In them Emde made use of the circle diagrams introduced by Heyland. The well-know book was „Mehrfach geschlossene Anckerwicklungen". Svend Olsen was a co-author of the book whose English title was „Repeatedly closed armature windings". In 1909 Fritz Emde together with Eugen Jahnke published a big collection of tables containing mathematical functions. That was an extremely valuable publication for engineers and physicist. It was repeatedly published and it was translated into English. He was very successful in working out a great number of problems concerning, among other things, power of polyphase systems, the electric field distribution in transformers or a theory of power systems supplied with distorted currents. In 1915 he published some excerpts from Maxwell's works translated into German. Only two years before his death, his book came out entitled „Quirlende elektrische Felder", which he had written during the war.

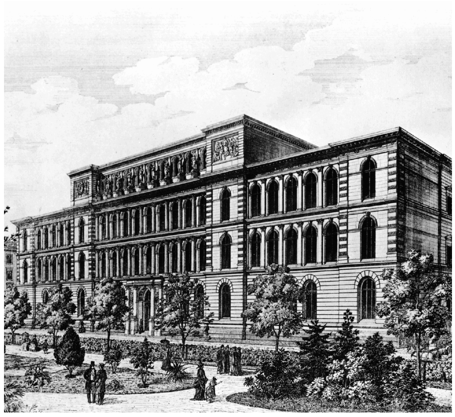


Fig. 10. The building of the Higher Technical School in Stuttgart, the predecessor of the present-day Technical University, at the end of the 19th century, the place where Fritz Emde worked acc. [13]

This may be translated into English as the rotating electric fields. The word „wirbel", i.e. „rotating" was the universally used in German literature. However, he regarded it as too little precise for defining fields of this kind.

Emde introduced many new definitions into the electrotechnical language. He originated, among other things, such expressions as flow, magnetic voltage, ampere-turn, rate of change (decay) in magnetic flux (the concept especially useful in a theory of stepwise motors), single-turn flux, coil flux, electromotive forces of transformation and rotation.

The well-known then higher education institutions conferred honorary doctorates on Fritz Emde. The following institutions acted in such a way including the Higher Technical School in Wrocław and the Confederate Higher Technical School in Zurich, in which Albert Einstein himself earlier studied and later worked. The Higher Technical School in Karlsruhe regarded Emde as its honorary citizen and the Union of German Electricians recognized him as its honorary member.

Fig. 11. The Assumption Church in Uszyce, the birthplace of Fritz Emde

Nowadays even the oldest inhabitants of Uszyce do not remember and do not know that Prof. Fritz Emde was born in their village. The local parish priest has not found the surname Emde in a baptism register from the years 1873 and 1874. Maybe he was baptized in one of the neighbouring parishes. Figure 11 shows a wooden historic church in the village centre, the birthplace of the brilliant electrical engineer.

3. KARL ILGNER A CONSTRUCTOR OF HOISTING DRIVERS OF MINING MACHINES

Karl Ilgner (Figure 12) was born on the 27th of July 1862 in Nysa (formerly: Neiβe in Oberschlesien). No accurate pieces of information about his secondary education have been preserved. He studied at the Industrial Academy in Berlin (Gewerbeakademie Berlin) in the years 1883-1886 as it is given in item [1] of references. However, as results from the history of the Technical University in Berlin, the institution was called the Royal Higher Technical School in Berlin-Charlottenburg in the years when Ilgner studied there and it was the predecessor of the great today's Technical University.

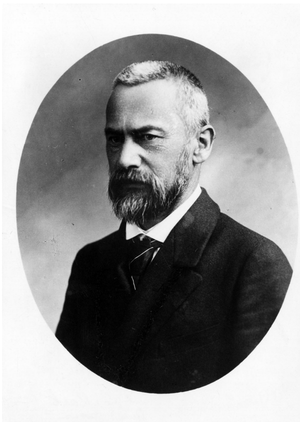


Fig. 12. Karl Ilgner (the photograph from the Siemens Corporate Archives and with their consent)

After completing his studies, he began to work in AEG, the company of electrotechnical industry already well-known not only in Berlin. In 1892 he was appointed department manager of „Kraftübertragung" (energy conversion and transmission network) in Körting-Werken in Hanover. His work there concentrated on the applications of direct-voltage free-running generators driven by gas engines. In 1895 Ilgner took over the office of the Elektrizitäts – AG Company, formerly Lahmeyer & Co. in Beuthen, i.e. in the present-day Bytom. Two years later he moved to Breslau, the present day Wrocław [1, 14].

From the circle of his clients representing predominantly the heavy industry of both Lower and Upper Silesia, he chose those who used, first and foremost, driving devices exposed to great shock loads bringing about significant perturbations in power supply networks. Already then he considered the solution of this problem.

The World Exhibition in Paris (Figure 13) in 1900 inspired him. There Ilgner observed the escalator, „trottoir roulant", in which the Ward Leonard system was used for controlling the rotational speed.

The Ward Leonard system was patented in Germany in 1891 as the so-called „Deutsches Reichspatent" (DRP) No. 77266. However, Leonard could not anticipate the importance of his invention for its practical use in large motors working in mines steelworks and after eleven years he resigned from his patent protection. Figure 14 shows the Ward Leonard classical system consisting of three machines.

Fig. 13. The World Exhibition in Paris in 1900 acc. [15]

Fig. 14. The Ward Leonard classical system acc. [16]

1. the main generator (separately excited generator),
2. a synchronous or asynchronous motor as a driving unit,
3. a shunt generator supplying excitation windings of the main generator

The Ward Leonard power transmission system was the invention which has been applied and which is still in use. It served for controlling the rotational speed of motors in the following way: a synchronous motor (2) or asynchronous one drives a DC separately excited generator (1) at constant speed, the control of rotational speed of a motor (it is not shown in the Figure), connected with the generator (1) is achieved by a change in exciting current and as a result of this a change in voltage of supply generator. A shunt generator (3) is the source of power for both excitation windings of the generator supplying the motor and working one.

Although a detailed principle of operation of this system can be understood only by technically-educated persons but it should be emphasized that lifts, escalators and other conveying devices, in which the Ward Leonard system was utilized, had conveyed many millions of people who were not related to technology at all. The Ward Leonard systems began to be applied in lifts both for people and goods in the 1920s and they were still universally utilized in the 80s of the twentieth century. Nowadays they are still in use. Although they were modified in various ways, however a skeleton of the system remained the same as at the time it was patented. Leonard himself and other constructors introduced some additional control systems which allowed to control rotational speed of a supplied motor with more precision and they protected those systems with patents. For instance, variable delivery pumps used for fast changes of flow or various hoisting devices need a very accurate and, at the same time, automated control.

In 1902, thanks to introducing a flywheel (DRP 138 387) into the Ward Leonard system, Ilgner succeeded in diminishing impacts occurring in a propulsion motor when abrupt changes in its load took place. The flywheel was mounted on the shaft right next to an asynchronous motor or on some other place of the shaft in the Ward Leonard-Ilgner system. Kinetic energy (rotational energy), stored in the flywheel, perfectly diminished impact loads of the motor. In the Ilgner system an additional resistor was also introduced in series with the rotor winding of a DC propulsion motor. It adequately reduced rotational speed under normal operating conditions. When impact loads occurred, a signal, received from the resistor, was transmitted to the shunt generator in order to stabilize revolutions. After making such improvements, it was possible to introduce the Ward Leonard system into heavy drivers in mines and steelworks. The Leonard-Ilgner system was applied for the first time in Zabrze Steelworks then called Donnersmarckhütte in Hindenburg, which is shown in Figure 15.

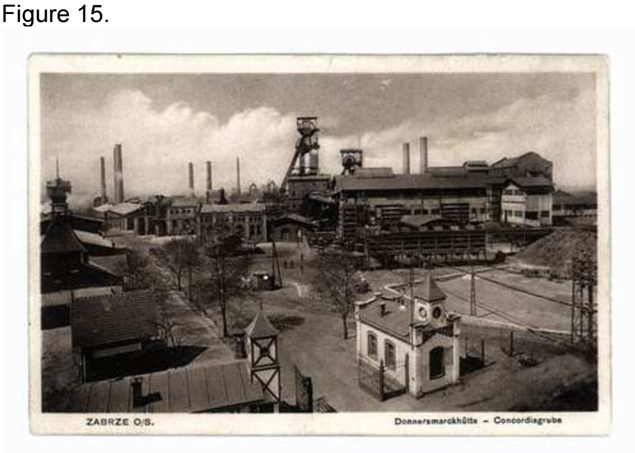


Fig. 15. The place where Ilgner's patent was applied for the first time, Donnersmarckhütte in Hindenburg, Zabrze Steelworks acc. [17]

That undertaking was carried out together with S & H Company from Nuremberg. A year later the main hosting machine in the Hohenzollern II mine in Dortmund was equipped with the Ilgner electromechanical transducer. One may be impressed by this system even today, since it has been included into the preservation of historical objects of technology.

It should be mentioned that apart from the solution of the problem concerning abrupt changes of load (a flywheel), the whole system also operated extremely economically in the full range of speed control. Its great advantage was also the fact that it was able to give electric energy back to the supply network. That usually happend when a hoisting machine was lowering some weight, and there was need to brake strongly.

By reducing the generator (1) excitation in such a way that its voltage became smaller than that induced in the working motor, in consequence, the motor took the course of the generator operation which was the course of braking at the same time. Under such conditions the machine (1) took the course of the generator action driving the motor (2). Regardless of that whether the machine (2) was a synchronous motor or asynchronous one, it returned electric energy to the network. Figure 16 shows the Ilgner electromechanical transducer preserved in a perfect condition even after a lapse of many decades.

In 1904 Karl Ilgner moved to Vienna and began to work in Siemens-Schuckert-Werke (SSW). Three years later he became independent and began to function as the so-called consulting engineer whose tasks concerned drives utilized especially in mines and steelworks. In 1912 the Higher Technical School in Wrocław although very young but holding a good reputation, conferred honorary doctorate on Ilgner.

Fig. 16. One of the Leonard-Ilgner systems preserved in a perfect condition in the Ruhr Basin. Sascha Kretzmann is the author of the photograph acc. [18]

After the First World War he became a member of the German Committeee for Damages' Affairs (Reichsentschädigungs-Kommission) in Brussels.

Karl Ilgner died on the 18th January 1921 at an old people's home in Bertelsdorf, at present Uniegoszcz, Lubań District in Lower Silesia Province.

3. EMIL NAGLO, A FAMOUS MAKER OF TELECOMMUNICATION DEVICES

He was born on the 15th February 1845 in Laurahütte in Oberschlesien, nowadays Siemianowice Śląskie. He was a son of the director of steelworks (Königs- and Laurahütte) in Siemianowice and Chorzów [1, 5]. Figure 17 shows a view of Siemianowice in the first half of the 19th century.

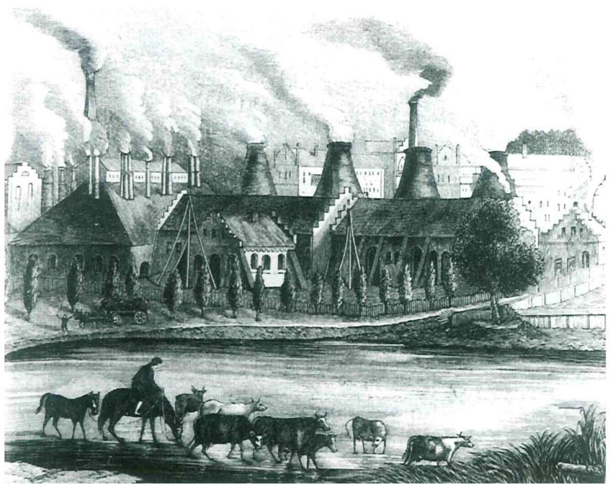


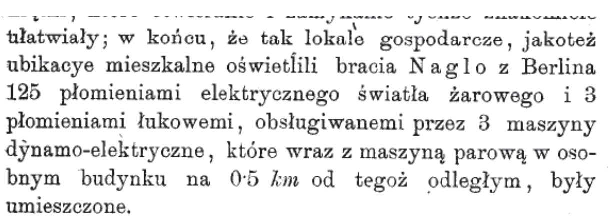
Fig. 17. Siemianowice Śląskie about 1840, the birthplace of two famous electrical engineers acc. [19]

Emil Naglo graduated from secondary school in Berlin and later from a school of mechanical engineering. In

1865 he began to work for a firm of the Siemens Brothers in London. Seven years later Emil together with his elder brother Wilhelm founded a company by the name of „Telegrapfanstalt Gebrüder Naglo". Its residence was at first in Mitte, a district in Berlin, and later it was transferred to Treptow. The leading products of their company were telephones, telegraphs and electric check meters. In the middle of 1883 Robert Stock, regarded as a pioneer of telecommunications in Germany, was employed in the company. That year was also very important for the company from maybe another indirect reason. Blankenburg, (then 6 000 inhabitants), a small town in the Harz Mountains, received electric lighting as the fourth town in the world. Only Paris, New York and Berlin had the honour to install it before. At first electric lighting was installed only at the railway station, however, both the inhabitants and municipal authorities liked the lighting very much, and in consequence, on the 14th September 1890 the mayor signet a contract with the ,,Gebrüder Naglo Co." to build machines for a power station. The following year Blankenburg was illuminated by electric lighting. At that time a firm of Naglo Brothers took up production of generators, tram-cars and some devices applied in electric lighting. The restructured production was very profitable for the company, because the demand for precisely such products was very great at that time. Soon the Naglo Brothers' Co. became the only major competitor of S & H, a firm already of good repute in Berlin. Figure 18 shows a logo of the Naglo Brothers' Co. put up for one of the Internet auctions. Such labels served then as flyers similarly to these used nowadays.

Fig. 18. A trademark of the „Gebrüder Naglo Co." acc. [20]

Fame of the company also reached Poland. Figure 19 shows a fragment of the text from „The Technical Journal" published in Lwów, in which one many read a short paragraph about the Hygiene Exhibition in Berlin.



ułatwiały; w końcu, że tak lokale gospodarcze, jakoteż ubikacye mieszkalne oświetlili bracia Naglo z Berlina 125 płomieniami elektrycznego światła żarowego i 3 płomieniami łukowemi, obsługiwanemi przez 3 maszyny dynamo-elektryczne, które wraz z maszyną parową w osobnym budynku na 0·5 *km* od tegoż odległym, były umieszczone.

Fig. 19. A fragment of the text from „The Technical Journal" No. 2 with information about the Naglo Brothers acc. [21]

„they facilitated; finally, both business premises and dwelling places were illuminated by the Naglo Brothers from Berlin, with 125 flames of incandescent electric light and with 3 arc flames, operated by 3 dynamo-electric machines, which together with a steam engine were located in a separate building at a distance of 0,5 km."

In 1897 Emil Naglo sold his enterprise to a firm of Schuckert & Company, which subsequently in 1903, founded a limited liability company together with the establishments of Siemens, and in such a way, Siemens-Schuckert-Werke GmbH came into existence, a company of high reputation all over the world.

Naglo was one of the co-founders of „Electrotechnical Association" („Elektrotechnischer Verein"), which was set up in Berlin on the 20th December 1879. It was transformed on the 22nd January 1893 into „The Union of German Electricians" („Verband Deutscher Elektrotechniker"), which has been and is still acting. Naglo was a member of its Board in the years 1895-1897. He was also its chairman in 1904. Whereas in the years 1901-1902 and 1905-1908 he was its vice-chairman. Emil Ottomar Naglo died in 1908.

6. CONCLUSION

Many eminent electrical engineers, born in the 19th century or at the beginning of the 20th century, came from the Silesian Land. For instance Leo Graetz from Wrocław, Eugen Goldstein from Gliwice or Georg Dettmar from Oława, a distinguished standardizer, could be included into more important electrical engineers in their times, although they are not mentioned in the paper.

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* Full data on the photograph from Figure 16: Foto: Ilgner Umformer – Bild von Sascha Kretzmann aus Zollverein – Tour [Essen] – Fotografie (2109200) - fotocommunity.de-Mozilla Firefox

SHORT ABSTRACT

The profiles and most important achievements of the famous nineteenth-century Silesian electrical engineers born in the present Opole and Silesia Provinces, have been presented in the article. Nowadays hardly anybody remembers that in their time they made a significant contribution to electrotechnical progress.

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