

The contribution of Galician engineers and entrepreneurs to the development of oil drilling methods

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Abstract: Ignacy Łukasiewicz's development of a method for distilling crude oil caused the resource, long known in the Subcarpathian region, to be exploited for industrial purposes. In order to meet the rapidly growing demand for oil, it was necessary to develop effective methods of discovering oil deposits. In Galicia, since the early 1860s, the so-called free-fall drilling method was used for about 20 years. But it wasn't until the introduction of the Canadian method in the early 1880s that the richest deposits were discovered in the Borysław and Tustanowice areas. Galician engineers and technicians made enormous contributions to improving this system. Independently, they developed designs for modern structures suitable for mud drilling. Among them, world fame was won by the "ram" – Waclaw Wolski's drilling apparatus. Technical progress in the Galician oil mining industry was possible thanks to the high professional standard of those deciding on the development directions of this new industry.

Keywords: Galicia, oil industry, technical progress, free-fall, Canadian, mud, drilling methods

Introduction

People living in the Subcarpathian region had used oil in various ways for centuries, including for lubricating carts, but also for treating people and animals (Sulimirski 1913: 480). Attempts were also made, albeit unsuccessfully, to use oil for room lighting. Only the achievements of Ignacy Łukasiewicz made it possible to successfully overcome the gloom of darkness. It was thanks to him that they learned to obtain kerosene from oil, used for lighting rooms and streets (Franaszek et al. 2021).

Oil collected in natural seepage areas, especially on the surfaces of water bodies and in pits. When the need for oil exploitation arose, shafts began to be dug by hand (Jabłoński 1885: 1-21; Szajnocha 1881: 3). However, this new branch of production on an industrial scale could begin to develop only after drilling methods were introduced into oil exploration. This took place in the late 1850s and early 1860s. The so-called Pennsylvania drilling method was first used in August 1859

by Captain Edwin Drake near Titusville, in the Pennsylvania oil fields. Not much later, a similar event took place in eastern and western Galicia.

Depending on how the rock is crushed, one speaks of percussion and rotary drilling. In Galicia, percussion drilling methods were used when conducting drilling operations. This type of drilling was free-fall drilling, commonly used in Galicia until the early 1880s, as well as – used after it – the Canadian drilling method. Depending on how the bottom of the borehole is cleared of borings, mud drilling and dry drilling methods are distinguished. Both the free-fall method and the Canadian method are among the so-called dry drilling methods, as a bucket, a pipe ending in a valve at the lower end, was used to remove spoils from the bottom of the hole, allowing the borings to be picked up. Another way of cleaning boreholes is mud drilling, which involves cleaning the drilled hole with a pumped liquid called mud. The mud method allows drilling work to be done much faster.

Free-fall drilling and attempts to improve it in Galicia

Galician oil drilling began with drillings made in the early 1860s using the free-fall system with Fabian's shears. During the downward movement of the drill pipe, the auger hooked into the so-called Fabian shears and was lifted with the movement of the drill pipe. At the highest position of the auger, the driller made a sudden rotary motion with the drill pipe, which caused the release of the auger's hooks in the shears and its free fall to the bottom of the drilled hole from a height of about 1-1.5 metres. The auger hitting the ground with the blade caused the rocks to crumble. The next task was to pick out the crushed rocks with the auger, that is, to clean the hole, called spooning (Franaszek 1991: 57). The first shaft with this system was drilled by Robert Doms in Borysław in 1861. The following year, using the same system, Henryk Walter drilled the well in Bóbrka, the most important Galician oil mine at the time, whose director was Ignacy Łukasiewicz. This event marked a breakthrough and an important caesura in the development of Galician oil mining. The free-fall method was widely used in Galicia over the next 20 years (Kuźniarski 1973: 7; Fabiański 1929: 326-329). A major improvement to this method was the introduction of a steam engine to drive the crane, thus eliminating manual labour. In Galicia, this occurred in the late 1860s, early 1870s. This was accomplished independently by Albert Fauck, drilling in Kłęczany, and William Schütte in Męcina (*Wiertnictwo* 1912: 5; Rosenberg 1924/25, no. 28: 11-12, no. 29: 10-11, no. 30: 11-12, no. 31: 11-12, No. 32: 11-12). Subsequently, Albert Fauck introduced machine drilling in Bóbrka (Cząstka 1973: 271-272; Wais: 2014: 6).

In the late 1870s-early 1880s, Fauck made the most serious attempt to modify the free-fall system. He intended to remove the most serious drawback of the Fabian's shears, which was the need to manually drop the auger when it was in its highest position in the hole being drilled. This activity required a lot of effort on the part of the driller and was not always effective. Fauck, using what is known as the Degouse

manifold, developed a shear that automatically released the auger at its highest position in the hole being drilled. The progress of the work with Fauck's shears was about 25% greater than the results achieved with Fabian's shears (Olszewski 1884: no. 17/18: 117-122, no. 19: 129-130; Brunicki 1884: 42-43). Unfortunately, Fauck's innovations coincided with the appearance in Galicia of the Canadian drilling method, which soon completely ruled the Galician oil fields, displacing the free-fall system.

The Canadian crane and its improvements under Galician conditions

The Canadian drilling method was brought to Galicia by William Henry Mac Garvey, a Canadian entrepreneur who was married to Helena Wesołowska, the daughter of Polish emigrants ("Nafta" 1904: 177-179). In 1881, as manager of the "Continental Oil Company," Mac Garvey conducted drilling work in search of oil in Germany. It was there that he met John S. Bergheim, a Viennese banker whose capital enabled him to form a company called "Bergheim and Mac Garvey". The company was further cemented by the marriage of Mac Garvey's son to Bergheim's daughter ("Ropa" 1912: 104). In 1883, the company came to Galicia and in Uherce, in a mine owned by the Berlin Society, Mac Garvey used the Canadian method for the first time in the history of Galician drilling. The very good results obtained with the Canadian system aroused great interest among local entrepreneurs ("Górnik" 1883: 166-167). However, the design of the Canadian crane was closely guarded by Mac Garvey, eager to maintain a monopoly on this type of drilling operations. Thanks to their operability, Galician technicians, engineers and drillers learnt the secret of building the Canadian crane relatively quickly. Soon the new system became widespread throughout the oil basin, helping to reduce the cost of ongoing work. Mac Garvey himself also understood that it was more profitable for his own interests to cooperate with domestic companies than to compete.

The Canadian method was perfectly suited for drilling in the geologically difficult Galician deposits. It also intrigued Galician oilmen from the beginning, including a group of skilled mining engineers. Successive improvements were made to the so-called "old crane", as the design with which Mac Garvey came to Galicia was called. Soon there was no longer talk of a Canadian system but of a Galician-Canadian or even a Polish-Canadian system. This emphasised the improvements made in Galicia to the Canadian crane (Bielski 1927: 385-390).

Thanks to the improvements, it was possible to reach oil seams located at levels of 1,000 and even more than 1,500 metres below the surface. The improvements were aimed at strengthening the crane's design, better, more efficient power transmission, and, most importantly, at replacing tedious spooning (clearing drill holes) on poles, with much simpler and faster spooning on a line. The widespread shift to line spooning was closely linked to changes in the drilling technique itself, particularly the ability to move so-called casing pipes directly behind the auger to protect the drilled hole from backfilling and flooding by groundwater. The use of casing pipes was made possible by the widespread use of the so-called eccentric auger of Mac Garvey's patent, although in 1897 the Polish company "Wolski

i Odrzywolski" also obtained a patent for the eccentric auger type from the Austrian Ministry of Trade ("Nafta" 1907: 247).

The old Canadian crane used only one cable to lower the drill pipe with the auger or bucket. The improved designs use two lines. This required extending the crane with a second drum, designed for the bucket line. A number of solutions emerged, differing in where the bucket drum was mounted and how the drive was transmitted to it. One of the first to try to introduce line spooning in the second half of the 1880s was Mac Garvey himself. In his design, the bucket drum was at a high height, making it very uncomfortable to operate.

From 1891, the Schodnica workshop produced a structure designed by Waław Wolski and Kazimierz Odrzywolski, with a line spooning system developed by Felicjan Łodziński, based on solutions used in the so-called Pennsylvania crane (Klebert 1907: 17-20, 25-27, 29-31, 37-41, 45-46). A similar design was developed in 1899 by W. Wolski and Władysław Pruszkowski. Wolski was the co-developer of yet another design, developed by the "Wolski, Weydlich, Korsak i Ska" company. From 1903, the "Perkins, Mac Intosh and Perkins" factory in Stryj produced a model of crane, which was often used to drill wells in Galician oil fields. Władysław Włodarczyk's crane, developed in 1907, was also an original design. It allowed drilling operations to be carried out both on a rigid pipe and on a line. Also new in Włodarczyk's design was a crank, providing the ability to adjust the amount of auger lift. Another solution for the Canadian crane was introduced by Julian Timoftievich, who placed each of the two drums on one level, on separate stands, on either side of the rocker arm. To emphasise the native origin of the structure, its creator called it "a Polish drilling crane with an accelerated spooning device".

Strengthening of the entire structure was achieved by replacing spruce wood with oak wood, wooden parts with metal parts, and by increasing the dimensions of the various assemblies. In the tappet of the old Canadian crane, the gear wheel was locked by a spring-loaded metal pawl. The friction of metal against metal caused sparks, the cause of many fires. Therefore, mining and police regulations issued by the Drohobych Mining Authority prohibited the use of this mechanism. It was replaced by other types of tappets – such as the Zdanowicz, Perkins and Mikutski designs. To weaken the internal tension of the rod, elastic, spring-loaded buffers were incorporated between the drill pipe and the balance beam. For the same purpose, Fred, son of William Mac Garvey, mounted a balance mounted on springs to cushion its sudden jerks. The manila line used for spooning was replaced with steel, and cast-iron cranks were replaced with steel ones. Wooden wheels and drums were reinforced with tin fittings, and soon replaced with iron wheels (Okólnik 1907: 55-58; Katalog 1911: fig. no. 113; Petit 1900: 293-297).

The improvements made to the Canadian crane allowed the development of Galician oil mining on an unprecedented scale. On the one hand, much deeper oil deposits in the western part of Galicia were reached, and, much more importantly, the richest Galician deposits were discovered in eastern Galicia, in such places as

Słoboda Rungurska, Schodnica, Borysław and Tustanowice (Olszewski, 1902: 133-137; Długosz 1929: 329-332).

Work on the application of mud drilling apparatus in Galicia

Two drilling mud structures were developed by Albert Fauck. One of them was the "Rapid" crane and the other was the "Express" crane. Test drilling with the "Rapid" crane was carried out by Fauck in June 1896 in Marcinkowice near Kłęzany (*Rezultaty* 1899: 309-310; Fauck 1900: 99-102). In 1901-1906, Fauck drilled with an "Express" crane in Borysław on behalf of the "Towarzystwa Akcyjnego dla Przemysłu Naftowego" (Bielski 1904: 129-134). Both trials performed below expectations and the designs did not find wider use. Drilling by the "Austro-Belge de Petrol" joint-stock company in Schodnica in 1897 performed similarly poorly. Drilling works were carried out by the mud method using the "Raky" crane (J. D. 1900: 385-386).

In the field of mud drilling, a number of constructions were born in Galicia, on the one hand as outstanding as Waclaw Wolski's ram, others less well-known, and also those, as Wolski wrote, that had only "museum value" (Wolski 1901: 1-4, 17-21). In 1901, a major revelation was the drilling of a 510-metre deep shaft in Borysław by Leon Mikutski, using a crane of his own design, in just two months. Wiktor Petit, on the other hand, conducting trials in 1909 with a mud apparatus of his own invention, obtained results 50% better than the Canadian method (*Nowy system* 1901: 130-134; Petit 1911: 278-284; Petit 1914: 278-282, 297-300). In 1899, Józef Howarth and Władysław Pruszkowski first built a mud drilling rig with the engine located in the hole, directly above the auger. In addition to them, Bonifacy Wiśniewski, Stanisław Janiszewski, Walery Siferski and Waclaw Wolski worked on similar structures in Galicia.

A complete innovation was the attempts to use the phenomenon of the water hammer in drilling structures created by the sudden stopping of an accelerated stream of water pumped under high pressure. The water hammer technique was used by Waclaw Wolski in his design, for which the name – "drilling ram" – was adopted. It was during this period that Wolski's "ram" was the pinnacle of technical advances in improved mud drilling designs. It has been recognised by many professionals, including those from other countries, as one of the best ideas in global drilling technology. In 1903, the "ram" participated in a kind of race organised in Westphalia for the speed of drilling boreholes. Nearby, two German companies were drilling with mud systems. Despite the difficult geological conditions, the results obtained by the "ram" were significantly better than those of the German companies. However, as early as 1902, two German companies bought the right to use the "ram" patent for the dizzying sum of 600,000 marks. To keep up appearances, they pledged to continue improving the system and advertising it. In fact, fearing competition, they did not allow its use to continue (Plutinsky 1966: 397-416; Fauck 1911: 421-423).

In the search for a modern drilling system that could effectively replace the "Canada" method, a mud rotary system was brought to Galicia. In May 1913, the company "Galicyjskie Karpackie Naftowe Towarzystwo Akcyjne, dawniej Bergheim i Mac Garvey" began drilling the "Wageman III" well in Tustanowice with a rotary drilling apparatus named the "Karpath Rotary." The drilling results confirmed the great capabilities of the rotary drilling method. However, the outbreak of World War I halted further experiments and progress in this area (*Wiercenie rotacyjne* 1913: 218-221; *System rotacyjny* 1913: 168-170).

Conclusion

The magnificent flowering of Galician technical thought in oil drilling would not have been possible without the proper theoretical and practical preparation of the people giving direction to the changes in drilling technology. A unique opportunity to present the theoretical achievements and practical technical solutions in the oil industry was provided by international oil congresses. By 1914, three such congresses had been held – the first in 1900 in Paris, the second in 1905 in Liège, and the third, in 1907, in Bucharest, i.e., in the capital of a major oil-producing country (*O kongresie naftowym* 1907: 301-305; *Sprawozdanie z działalności* 1909: 33). Economic oil activists from Galicia actively participated in all these congresses. Galician oil drillers represented a high standard of knowledge of oil drilling and an excellent mastery of the drilling craft. Therefore, Galician engineers, technicians, drillers and oil workers became a sought-after professional force for oil mining work in all countries where oil was exploited (Sulimirski 1929: 330-331; Sulimirski 1913: 479-485, 502-507; Strzetelski 1902: 79-81; "Nafta" 1907: 172).

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