

Walking through the city of Brno in the footsteps of the world-known inventor

Viktor Kaplan

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Viktor Kaplan (1876–1934)

Two hundred patents in roughly twenty seven states – that's the balance sheet of international inventor Viktor Kaplan, who came up with his invention – the Kaplan turbine – in the early 20th century in Brno.

After his studies at the Technical University of Vienna, he arrived in Brno at the invitation of Alfred Musil, the Professor at the German Technical University Brno. He was interested in the more efficient exploitation of water energy to produce electricity, a very topical issue with the emergence of electrification. Doing research in modest and difficult conditions, he was the first in the world to come up with the idea of adjustable runner blades on a water turbine. Large international engineering companies came together against his patents, worried about the manufacture and future sale of their turbines. The exhausting legal dispute lasted twelve years, eventually ending in Kaplan's victory. He received a general patent on the basis of a ruling of the Imperial Court in Leipzig in 1923.

Water turbines are the oldest and most widespread renewable source of energy. They were formerly used for mechanical energy (e. g. driving mills), but today they produce electricity. Although hydroelectric power makes up a relatively small proportion of total electricity production in the Czech Republic, hydroelectric power plants play an essential role in regulating the electricity network and energy accumulation. Furthermore, hydroelectric power plants can boast zero emissions and minimal service and maintenance requirements.

Viktor Kaplan was born in 1876 in Müzzuschlag in Austria-Hungary. He died in 1934 in Unterach am Attersee in Austria. He spent almost thirty years in Brno – from 1903 until 1931 – almost his entire productive life. He performed experiments here and came up with the idea for high-speed turbines with adjustable runner blades. Let us follow in this inventor's footsteps across the city of Brno, an inventor whose birthday is included amongst the world's cultural anniversaries. But first...

Viktor Kaplan's Era

At the turn of the 19th and 20th centuries, electricity was forging a path into all areas of human life. Slowly and gradually, but surely. Consider just here in Brno today's Mahen Theatre, the first fully electrified theatre in 1882. Its construction aroused much controversy and debate, and even fear.

In 1918, around a third of the population had access to electricity. In 1919, the National Assembly of the newly established Czechoslovak Republic enacted the Electrification Act. Within a year, power companies had built up to 500 km of supply networks.

1.

Viktor Kaplan's home in 1918-1931 Úvoz 52, Brno

Upon his arrival in Brno in 1903, Viktor Kaplan lived at Panská 14 for a year. In 1904, he moved to Údolní 51, where he lived until 1909. He subsequently resided at Úvoz 62, moving in 1918 to an apartment at Úvoz 52, from where he returned to Austria thirteen years later. In 1909, he acquired the right to domicile in Brno, and that same year married the daughter of a Vienna clothing trader, Margarethe Strasser. A year later, their first daughter, Gertraud Karola Antonia, was born. The family then had a second child – Margareta Reinfrieda. During Kaplan's first years here, there was no laboratory in Brno for his research. Initially he did experiments not with water, but with air. As he wrote himself – he used ordinary household items for his experiments. A hot iron stove provided enough of an upwards air flow, and a wheel with paper blades was used to research high speed turbines. According to unconfirmed reports, he did his first experiments in his apartment.



2.

Viktor Kaplan's first workplace – German Technical University Komenského náměstí 2, Masaryk University building

At the end of October 1903, Viktor Kaplan began his professional work in Brno at the German Technical University, at the Department of Engineering and Kinematics. His superior, who invited him to Brno, Professor Alfred Musil, was supportive of the young assistant. Kaplan focused his research on the efficient exploitation of water power, a topic which was moving the world at that time. The building was built in 1860 for the Technical School in Brno (founded 1849) on the newly established Komenského square. In 1873, the school became a university, called the Imperial-Royal Technical University in Brno. After the Second World War, Czechoslovak President Eduard Beneš abolished the institution alongside other German schools and colleges in an 18 October 1945 decree.



3.

Viktor Kaplan's next workplace – German Technical University, annex building Joštova 10, Brno, today the Masaryk University Faculty of Social Studies

When the building on Komenského square was no longer suitable for teaching, university management decided to construct a new building on Joštova street. It was designed by then-rector at the German Technical University, architect Ferdinand Hrach. In 1910, Viktor Kaplan moved here.

With a deeper knowledge of the efficient use of water power, Kaplan was increasingly missing an experimental laboratory to check his results. In 1909, he asked his superiors about the possibility of constructing an experimental laboratory in the new building's basement. The university agreed that same year. With the help of Professor Alfred Musil, Kaplan made a great effort and managed to acquire the necessary funds for investment and overheads, and he was able to make his dream a reality in accordance with his own designs and calculations – resulting in a small research laboratory. The Masaryk University FSS Library is home to a commemorative plaque to Viktor Kaplan.



4.

Third window from left – Kaplan's laboratory, German Technical University annex building, today the Masaryk University Faculty of Social Studies

While around the world researchers had extensive well-equipped laboratories for turbine research with machinery of the necessary size, Kaplan worked in a small basement room with equipment many times smaller than necessary. He worked in his laboratory alone or with his assistant Jaroslav Slavík.

Water flowed from the main tank to the upper reservoir. From there, it flowed through the turbine guide and blade wheel and draft tube and into the lower reservoir, from where a centrifugal pump transported it back into the main tank. The draft tube was made of clear glass with hemp fibres inside it so that Kaplan could observe the flow of the water and shape the runner blades according to the bend of the fibres.

In 1913, he was the first person in the world to come up with the idea of putting adjustable blades into the runner, and so adapt the shape of the runner in accordance with the amount of water flowing, significantly improving options for turbine regulation.



5.

Brno company Ignác Storek – today Šmeral Brno a. s., Křenová 65c, Brno

Ignác Storek's company offered Viktor Kaplan support in his experimental research in return for preferential rights to use of his inventions.

Kaplan's first turbine was produced here in 1919, and it was installed in a laundry in Velm, Austria. It was a revolution confirming and validating the accuracy of Kaplan's research. More than 500 turbines were made here. As well as in Czechoslovakia, these were installed in Brazil, Denmark, France, Holland, Italy, Belgium and other states. The former Ignác Storek company ended production of Kaplan turbines in 1952 as the B. Šmeral United Engineering and Foundries national enterprise Brno. They continued to be produced at ČKD Blansko.

Company founder Ignác Storek built a metalworks in a wooden building containing a cupola furnace at the site of today's factory in 1861. The company's main growth began in the early 20th century when his heir expanded the premises and built a new steelworks, engineering works and other operations.

Ignác Storek successor organisations:

- 1949 Spojené strojírny a slévárny B. Šmerala, n. p., Brno;
- 1958 Šmeralovy závody, n. p.;
- 1965 Šmeralovy závody part of TST Praha trust;
- 1993 following privatisation Šmeral Brno, a. s.



6.

Small hydroelectric power plant, Svratecká street, Brno-Komín

In 1923 Ing. Rudolf Petr built a hydroelectric power plant utilising two horizontal Kaplan turbines made by Ignác Storek's company at the site of a mediaeval mill (one of the first installations of Kaplan turbines). The last extensive reconstruction of the power plant facilities took place at the turn of 2014/2015. One turbine was replaced by a new one, while for the second turbine, the original piece was renovated. Repair was also done to the mill race walls, sluice and drainage channel, and the electrical equipment was also replaced. One of the turbines is in almost the exact same state as it was when it was put into operation in 1923. The Brno Komín low flow hydroelectric power plant is used as a levelling point in the Brno cascades. Its job is to flatten out peaks of water flow coming from the cutting edge Kníničky power plant, and in particular to maintain remediation flow in the profile below Komín hydroelectric power plant. It is operated continuously and run by ČEZ.



7.

Kníničky Hydroelectric Power Plant below Brno reservoir dam

The Kníničky small hydroelectric power plant, located below Brno reservoir dam is fitted with a vertical turbo-generating set with one four-bladed Kaplan turbine made by the Ignác Storek company and given the serial number KT 317. It was put into operation in 1941 as a cutting edge resource for covering the increased electricity demand during morning and evening consumption peaks. The entire power plant underwent significant modernisation in 2009-2010. Building on this, repairs made six years later peaked in May 2017 with the installation of a new 35-ton quick closure, which serves to operatively close water flow to the turbine. It was the first time this had been fitted in 75 years of operation. The Kaplan turbine used today in Kníničky hydroelectric power plant does not look exactly the same as it did in the year it was launched, although it is very similar.

The power station is run by ČEZ.



8.

Viktor Kaplan monument Údolní street, Brno

A bust of Viktor Kaplan has stood on Údolní street since 1959. It was made by sculptor Sylva Lacinová Jílková (1923–2019). The Kaplan turbine is unique in the way you can regulate both the guide vanes and the runner blades by their adjusting (the previously used Francis turbine allows only the adjusting of the guide vanes). It is used in locations with low heads and relatively large flows. In the Czech Republic, probably its most well-known use is in the installation of four Kaplan turbines



at Orlík hydroelectric power plant. The turbine runner of one of these, made at ČKD Blansko, was a standout feature at the Czechoslovak pavilion at the world EXPO 58 in Brussels.

Orlík hydroelectric power plant has the highest head for a Kaplan turbine in the world: 70.5 metres. Other water turbines: The Francis turbine (1848), is suitable for medium stable flows and heads, and the Pelton turbine (1880) works with highest efficiency with high heads and low water flow.

9.

Kaplanova street, Stránice Brno centre

Kaplanova is also the name of a street in Brno. It is not a main road with a lot of traffic. Inconspicuous and tucked away – like his life – the street commemorates this great inventor who spent so many years in this city researching turbines. Although he could not make use of the laboratories of large companies, he came up with a solution here which helped introduce electricity to places which could not have made use of the turbines previously in use.

Kaplanova street is located at Žlutý kopec parallel to Barvičova street. It was named after the inventor in 1965 with the justification: "Viktor Kaplan, mechanical engineer, Professor of Brno's German Technical University and inventor of the high-speed water turbine known as the Kaplan turbine." Since 1976, the anniversary of his birth has been a UNESCO world cultural anniversaries.



10.

Kaplan building, Technology Park within the Brno University of Technology Campus, Technická 15, Brno-Královo Pole

The Viktor Kaplan Fluid Engineering Department is one of three departments of the Energy Institute at the Brno University of Technology's Faculty of Mechanical Engineering. The history of this department dates back over a hundred years. The department focuses on the design and construction of hydraulic machinery and equipment, designing water works, hydraulic machinery and equipment dynamics, and the study of fluid flow. The department's beginnings date back to the early 20th century. At that time, Professor Ing. Leopold Grimm (1862-1939) was invited to the Czech Technical School in Brno, and he became its rector in 1907-1908. He was an expert in water turbines who advocated for the use of Kaplan's turbine. The Kaplan Building, part of the Technology Park, was built in 1995.



11.

Technical Museum in Brno and the Viktor Kaplan memorial, Purkyňova 105, Brno – Královo Pole

The Viktor Kaplan Memorial is part of the Brno Technical Museum's Water Engines exhibition. This showcases not just the Kaplan turbine, but also individual parts of his experimental equipment which he used for his research, such as a glass tube with hemp fibres for observing water flow within the pipe. The exhibition also documents the issues Kaplan came up against in practical use of his turbines. Visitors can see water wheels here, which were used to drive mills, blowing engines, pumps, etc. Over time, these water wheels were replaced by water turbines. The TMB exhibition includes installations of the Kaplan turbine, but also Francis and Pelton turbines. The exhibition explains the principles of water engines, and their different types and uses. More at www.tnbrno.cz



Insight into the production of Kaplan's turbines

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