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THE FIRST POLISH CABLEWAY KUŹNICE – KASPROWY WIERCH

PIERWSZA W POLSCE KOLEJ LINOWA KUŹNICE - KASPROWY WIERCH

Summary: *The article presents the process of establishing the first Kuźnice-Kasprowy Wierch cableway in Poland until its persecution in March 1936. It was then the first cableway in Poland and the largest of its kind in the world. It was also then the first investment of this type in Poland and the sixties in the world. Despite the passage of 80 years, the cable car still carries passengers.*

Keywords*: cableway, Kuźnice, Kasprowy Wierch, Tatra Moutains*

Streszczenie: *Artykuł przedstawia proces powstania pierwszej kolei linowej w Polsce Kuźnice-Kasprowy Wierch aż do jej otrwacia w marcu 1936 r . Była to wtedy pierwsza kolej linowa w Polsce i największa tego typu na świecie. Była to również wtedy pierwsza inwestycja tego typu w Polsce i sześćdziesiąta na świecie. Mimo upływu 80 lat wspomniana kolejka linowa wciąż przewozi pasażerów.*

Słowa kluczowe: *kolej linowa, Kuźnice, Kasprowy Wierch, Tatry*

Intruduction

The cableway Zakopane Kuźnice – Kasprowy Wierch, situated in the Middle Tatra Mountains, as being the first aerial cableway in Poland and the greatest one in the world, was opened to the public use on March, 15, 1936. It was the first investment of this type in Poland and the sixtieth one in the world. In spite of 80 years of time elapse, the mentioned cableway still transports the passengers.

Historical view

The contemporary President of the Polish Skiing Union and the vice-minister of transport, engineer Aleksander Bobkowski was the initiator of building the cableway. As early as in 1934, The Central Design Office of Polish State Railways (PKP) commenced, at the instruction of the Ministry of Transportation and Communication, the field studies and measurements with the aim to establish the run of the railway's route. The decision on the construction was undertaken in July 1935. The especially set up company under the name „Society for Building and Operation of the Cableway Zakopane (Kuźnice) – Kasprowy Wierch", with the seat in Warsaw, was the investor. The architect Aleksander Kodelski, Eng., became the President and Technical Director of the mentioned company. The shareholders were as follows: Polish State Railways, League for Support of Tourism, Polish Travel Office Orbis, and the Society for Skiing Promotion and Gdańsk Shipyard.

Fig. 1. Aleksander Bobkowski (in the middle)

On July 24, 1935, Engineer Medgard Stadnicki was appointed as the manager of the building site and Engineer Borys Lange became the deputy manager. The detailed timetable specified the extremely short building time for such investment – 7 months. It was decided to develop the discussed investment by the self-build method. At first, ca. 600 persons were employed. The qualified stone masons, sawyers and carpenters were recruited not only from the Podhale and Sądeckie regions, from Cracow and Tarnów but also from the very remote territories of Vilnius region. The field work was commenced on August, 1, 1935. During the last two months of construction, the employment was increased up to 1000 workers.

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The total length of the cableway is 4.2 km. Due to the impossibility to perform such long carrying ropes and due to the bending of the route visible on the project plan, the whole line was divided into two segments: 1) Kuźnice (1032 m above sea level) – Turnie Myślenickie (1360 m a.s.l.) with length of 1974 m and difference of the levels equal to 328 m and 2) Turnie Myślenickie – Kasprowy Wierch (1965 m a.s.l.) with length of 2290 m and difference of the level amounting to 605 m. the total difference of the levels from the initial to the final station is 933 m.

The ropes are suspended between the stations on 6 steel towers, being from 14 to 32 m high. The length of the spans varies from 123 to 998 m. The elevation of the lines above the Kasprowy Valley in certain places of the second segment is equal to several hundred metres. The buildings of the cableway stations were built from reinforced concrete and granite. All stations were equipped with the waiting rooms, cash desks, roofed platforms, sanitary facilities, central heating system, electric light, sewage and water pipeline systems and, even, small office flats and few rooms for tourists. The Turnie Myślenickie station (situated in the middle) contained: transformers, spare current-producing ggreagte and 2 engine rooms, serving independently the upper and lower segments. On the mentioned above station, the passengers from the lower segment move to the car of the upper segment and vice versa. Apart from the mentioned above facilities, the station Kasprowy Wierch has also glass-wall restaurant room 912 X 8 m) where there is a vast view of the wonderful panorama of the Tatry mountains.

Development of the cableway to the Kasprowy Wierch was the world record; not only in respect of the length of the route but also in respect of the speed its performance. The peculiarities of the construction – apart from the unusual event in Poland – include difficult communication and transportation (mountainous territory, steep and sloped rock hill sides, lack of roads), lack of water and sand in the site, etc., and very difficult climate conditions. The frequent and dense fogs,

Fig. 2. . Construction of the Kuźnice upper station

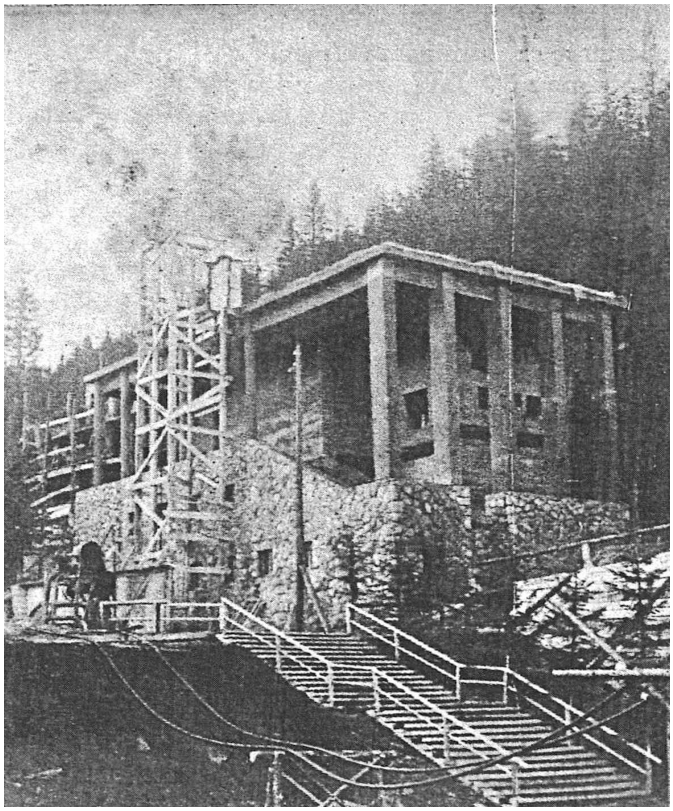
strong and often-occurring winds (18 foehn (in Polish: halny) winds during one winter – the record of the Tatry Mountains), snow and frost were many times the cause of inhibiting the work. The sand was delivered by railway from Nowy Targ to Zakopane and further, to Kuźnice and Myślenickie Turnie by cars, and finally, to Kasprowy Wierch; at the beginning in the bags, carried by the carriers and the Hucul horses and later on, by the auxiliary aerial cableway, suspended on the temporary wooden supports. The wagons of the mentioned cableway of 700 kg capacity performed 25 – 45 runs per day. The mentioned cableway worked all the time by day and night, stopping its work only during strong halny winds.

Almost all work with concrete, reinforced concrete and bricklaying was carried out in winter, usually on the quickly hardening concrete Alca-Electro, produced in Poland. Bricklaying and placing the concrete was performed at the open air and at the frost reaching up to – 14°C. After 24 hours, the boarding could be already taken off the concrete and the structure could be loaded as its endurance was equal to several-day strength of the concrete on the usual cement.

On the Kasprowy Wierch, the work with concrete and bricklaying was conducted in the exceptional way, in a special wooden temporary structure with dimensions 20 X 12 X 15 m inside which the central heating system and electric lamps, fed from the mobile current-producing aggregate were installed. The walls of the discussed structure were insulated with 5-cm plates of Heraklith (plate of wooden wool). The insulation itself, without heating, ensured the temperature by 10°C higher above the ambient temperature inside the discussed building. A part of water used for concrete was melted from the snow using a coil, connected with the heating installation.

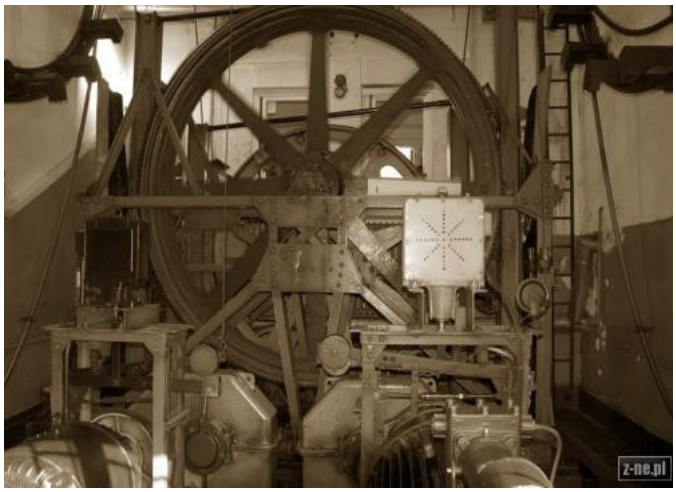
The most difficult operations included performance of the supporting tower no 5 and no 6, being found on the steep, craggy rock hillsides, over a few hundred meters abyss of Kasprowy Valley. The foundations of each tower consist of 4 concrete blocks of ca. 25 – 30 m^3 capacity each of them; their task is to counteract the reactions of wind, directed upwards and amounting to – according to statistical calculations – up to 50 tons. The foundations of the building situated on the Kasprowy Wierch were placed on the granite rock; the towers of the upper segment and of the station Myślenickie Turnie are situated on limestone and those ones of Kuźnice are found on hard clay. The excavations were performed in many places using pneumatic tools and dynamite. The riveting of the towers was also carried out mechanically, using pneumatic hammers with the application of mobile compressors.

Fot. 4. Construction of the Kuźnice bottom station

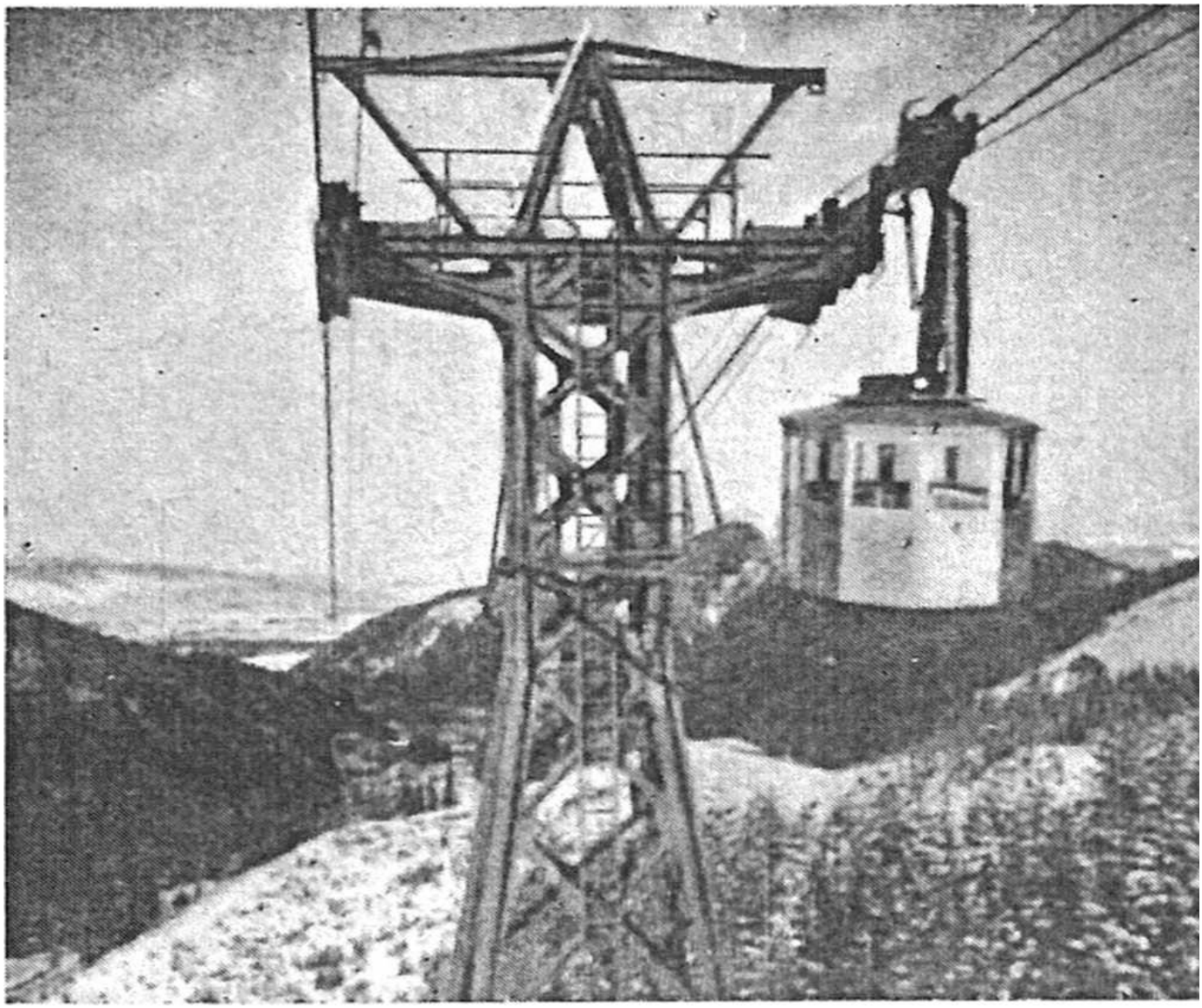


Fot. 3. Construction of the Myślenickie Turnie intermediate station

Fot. 5. Engine room on Kasprowy Wierch



Fot. 6. Historic car



For transportation of rope carriers with the diameter of 45 mm in the lower segment and of 48 mm in the upper one, and with the weight of 30 tons each of them, being wounded on the drums, there were used 4 conjugated tractors which transported the drums from the railway station Zakopane to Kuźnice; then, the ropes were rewound and overhauled further and higher using the so-called motor jacks. The tensile strength of the ropes' wires is equal to 100 – 180 kg/mm^2. The admissible loading of the ropes at the lower segment is 203 tons, of the upper one – 229 t. The weight of 1 current meter of the rope corresponds to 10.9 and 12.4 kg/m. the total cost of 4 rope carriers amounted to 180 000 PLN. The drive, main and auxiliary ropes have the diameter of 21 mm and 17 mm. All ropes were produced at the factory in Sosnowiec. The upper ends of the rope carriers were fixed on the reinforced concrete drum with diameter of 3.0 m on which 3 coils of the ropes on each were placed. The lower end of each rope was loaded with the counterweight, produced from the reinforced concrete, weighing 45.5 tons, and inserted to a special well, 10 m deep. Thus, the tension of the ropes remained unchanged, at any position of the car and temperature variations. The both mentioned reasons caused only elevation or lowering of the counterweight within the limits of 2.0 m.

Fot. 5. Minister Aleksander Bobkowski during the opening of the cablecar

Mechanical devices

The cableway was performed as double-track railway, so, each segment had 2 rope carriers. There were 4 wagons (cars), 2 for each segment. The cars were produced from a light metal and suspended on 8-wheel trolley. To increase the resistance of the wind strengths, the wagons had a shape of dodecagons. The capacity of one wagon was for 30 persons; including 8 seats. The glass of the windows was made from cellophane. 5the won weight of the car was equal to 1.5 t ; with the full load – 4.0 tons. The speed of the travel was 5 m/s that is, 18 km/hour. Each car was equipped with telephone, ring signalisation, 2 brakes (electric and mechanical0 and life-securing facilities, serving the evacuation of the passengers on the route using the hemp rope and canvas pants – in the case of a longer pause in travel. At the moment of pushing a red button in wagon, the electromagnetic brake at the station stopped the power supply and arrested the movement of both cars in a given segment. The mechanical brake could be applied by pulling down a hand and it acted directly on the ripe carrier, embracing it with the spring tongs; simultaneously, it switched the power supply off.

The both segments if the cableway were equipped with double electric drive: the main drive with the engine of 80 KM power, moving the cars with the speed of 5 m/s and the auxiliary one (spare) with the 35 KM power, developing the speed of 2 m/s. Each of the drives had a separate toothed gear and constituted a closed unit. In the case of damage of the main drive, the driver of the cableway switched the power supply to the auxiliary engine. All engines were placed in the separate engine rooms in the station Turnie Myślenickie where there was also found the three-phase transformer of voltage 5000/380/220 V, being supplied from the urban power station in Zakopane. In the case of the pause in the energy supply, e.g. caused by damage of the aerial cables, the Turnie Myślenickie station was furnished with the three-phase current-producing aggregate of 50 KW power with Diesel engine. The mentioned aggregate ensured a drive for the change of the upper or lower line with the speed of travel equal to 2 m/s.

The both cars of each segment were linked with one drive rope with a closed circle. For tensioning of the rope, a concrete block of 6 ton weight, attached to the sliding sledges of the lower line wheel was employed. Analogically, the auxiliary drive ropes were assembled. To switch the car onto the supporting drive, e.g. in the case of damage of the main drive, breaking the drive rope, etc., the car conductor left the wagon via the opening in the roof, climbed to the top, released the main rope and attached the holder to the auxiliary rope.

The safety facilities

Each drive was equipped with 3 brakes: one on a drive wheel, the second – on the motor shaft, being activated by electromagnetic device at the moment of pushing the button in the driver's compartment or in any of the wagons of a given segment. The third brake acted also on the motor shaft by automatic releaser if a normal speed of travel was exceeded due to inattention of the driver. The approaching of the drain and its entrance to a final segment was signalised automatically by a ring and red light on the cabin of the driver.

The situation of the wagons was visible on the "indicator of distance", being found before the driver of the cableway. Two graphic signs, denoting the wagons, were moved using the appropriate gears along the scale on which the supporting towers, stations and final segments were marked. To stop automatically the car on the station, the bumper was installed at the very end of rope carriers. The bumper had a spiral spring, the aim of which was as follows: mechanical resistance, switching the power supply off and activation of the brake. The drive ropes – both main and auxiliary – were simultaneously telephonic cables between the wagons and the driver's cabin. To this end, all rope wheels and rollers on the supporting towers were insulated.

On the tops of some towers, there were the anemometers of a special construction, linked with the electric cables (via the rope carriers) with a ringing device in the cabin of the driver. The mentioned ring became activated when the strength of the wind (in the direction perpendicular to the rope exceeded 38 kg/m^2 (20 m/s). then, the movement of the wagons should be stopped as the pressure of the wind on the empty wagon, constituting 1/16 of its weight, could cause the vertical deviation of the wagon by 10 degrees. Having such deviation, the wagon - when passing the towers – would have to touch the fender.

The steel constructions, mechanical and electric equipment were produced by Gdańsk Shipyard. The construction and reinforced concrete work and the walls were performed by the engineering company Oppman and Kozłowski from Warsaw and, partially, by the management of the building site in the self-build system. The project of the reinforced concrete constructions was developed by the Design Office of the Ministry of Communication and Transport, with the participation of the author. The architectonic project was developed by architect, Aleksander Kodelski, engineer. The construction was implemented by the Society of Building and Operation of the Cableway, Ltd., 51% of its shares were owned by Polish State Railways (PKP).

The majority of the work was carried out on the credit conditions. The long-term credit was granted by PK and the short-term (up to 3 years) was given by the Gdańsk Shipyard, engineers Oppman and Kozłowski and other national suppliers. The total cost of the construction amounted to ca. 2.8 million PLN and of a kilometre of cableway – 665 thousand PLN. In a very short time, a great engineering work was created; it placed Poland in the rank of the states with a high technical and touristic culture. If we anticipate only 200 „travels" per day (during the second Sunday after opening, the cableway transported 1000 passengers) and

Fig. 8. Contemporary car

expect the one-side travel (e.g. skiers) and assume the mean price of travel ticket at 6 PLN (the contemporary cost of the return ticket amounted to 8 PLN), the total cost of building the cableway should be amortised during 10 years.

The construction and start-up of the cableway caused the successive investments; observatory at the Kasprowy Wierch, the yellow route for pedestrians (the so-called „ceprostrada" in Polish) (leading from Morskie Oko to Szpiglasowa Przełęcz) and hotel at Kalatówki plain.

The first modernization was conducted in 1961; it included the exchange of the cars for the new ones. In 1985, on the occasion of the Jubilee of the 40th anniversary of the Cableway construction, Warsaw Documentary Film Studio produced film about the history of its building, entitled „Ku Szczytom Tatrzańskim" („Towards the Tatra Mountain Peaks"). On May, 6, 2007 there was the last course of the cableway, being the oldest one in Europe, before its complete renovation. The effects of the conducted renovation have included: the higher speed of the cars (8 m/s, and during passing the supports – up to 6 m/s); the sliding platform, serving for entrance at the particular stations instead of the traditional platform; the change of the wagon's drive from the weight tensioning into the constant tensing on the drums; instead of one rope carrier, two for each wagon (8 rope carriers in total); new, higher supports with a wider span of the rail tracks (instead of 4.5 m, they have 7 – 8 m, depending on the support); the change of the arrangements inside the stations. The new wagons have twice greater capacity (maximum 60 persons) than that one dating back to the seventies. In the cars, the double sliding manually opened door is installed on the both sides of the wagon's cabin. The cabins have the panoramic windows, manufactured from the darkened acrylic glass. The wagons are mounted on the rope carriers using 16-roller trolley. Instead of two drivers, setting up the wagons, the cableway is controlled by computer. According to the plan, the modernization was completed in December, 15, 2007. The President of the Republic of Poland, Lech Kaczyński opened officially the Cableway after the general reconstruction in January 18, 2008.

For 80 years, the Cableway has transported more than 40 million passengers.

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