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[Pic 13](#) [Pic 14](#) [Pic 15](#) [Pic 16](#) [Pic 17](#)

Nestled among the deep, majestic gorges and the beautiful greenery - three miles from the base of the misty Niagara Falls - runs a tramway car that has held a sense of mystique for over 80 years. Fourteen million visitors embark upon the Niagara Falls, Canada area each year, which spans some 35 miles. The Niagara River area alone encompasses 3,735 acres from Lake Erie to Lake Ontario. In modern times, visitors have been able to view the Falls from both sides of the border atop towers, such as the Skylon Tower and Minolta Tower, etc. on the Canadian side and Prospect Point Observation Tower on the American side (see ELEVATOR WORLD's 1969 Annual Study, "Towers") to which the equipment of our industry facilitates access. Those wishing to view the nearby Whirlpool from other than a people mover or electric train (later abandoned) can ride another form of short-range transportation - the Spanish Aero Car. This cableway has served as one of Niagara's favorite attractions for many years.

Credit is due to Chief Inspector Alf Moser, who brought this story to our attention and provided us with photos of the Aero Car, as it underwent inspection. Otis retiree Ted Tuff also submitted information and photos during its modernization in 1984-1985.

A History of the Aero Car

On December 24, 1868, the Canadian government - through a local agent - sold 2.8 hectares (seven acres) of the south side of the Whirlpool area to Samuel Colt for US \$250. However, the province of Ontario did not recognize this sale, claiming that this area had been transferred to them at the time of confederation in 1867. Even with this in mind, Colt built an incline railway from the talus at Colt's Creek to the bank of the Whirlpool along the Niagara River. The railway operated by a series of iron buckets that revolved around a water wheel and along an endless chain, which powered the railway cars at 5 horsepower. While a land struggle ensued between the Colts and The Niagara Parks Commission, two landslides severely damaged Colt's incline railway beyond all repair. In 1895, a settlement was reached, and The Niagara Parks Commission proceeded with construction of an electric railway. However, those wishing a clear view of the Whirlpool would have to wait.

In 1913, a group of 13 Spanish engineers and capitalists of the Niagara Aero Car Company Ltd., a Canadian corporation, using Leonardo Torres-Quevedo's Aero Car patent, proposed constructing a cableway 1,800 feet across the Niagara River's Whirlpool, which has a 210-ft drop to the surface of the water and 250-ft-high gorge walls. In fact, one-third of the drainage of the North American continent passes through this area, 2,200 feet across at the Falls, while water churns into a 180-ft deep basin.

Torres-Quevedo, a Spanish engineer who has some 20 inventions registered, modeled the Spanish Aero Car after a similar cableway at Mount Ulia San Sebastian in Spain. Prior to 1900, Torres-Quevedo designed a two-level car - called Ascensor de la Eiffel - incline lift which ascended on a vertical plane inside the Eiffel Tower in Paris, France. The incline had park-type benches in the interior of the car. He was involved in the design and construction of bridges, aerial tramways and other similar structures. In fact, including the Spanish Aero Car, Torres-Quevedo was involved with the design of four other transbordadors (tramways). In 1991, The Niagara Parks Commission received the Leonardo Torres-Quevedo Award - the first such award presented outside of Spain - on the 75th anniversary of the Aero Car. The Niagara Parks Commission received the award due to its commitment in preserving Torres-Quevedo's standard tram design.

Torres-Quevedo's Spanish Aero Car runs between both terminals, which are about 1,770 feet apart and 210 feet above water. The car, built in Bilbao, Spain with a capacity for 40 passengers, was installed at the Whirlpool at a cost of US \$120,000. The Aero Car runs entirely within Canada but crosses a corner of the New York state border at midpoint. Permission for construction had to be obtained from national authorities in Toronto and Washington, DC, as well as New York state.

With this accomplished, rock excavation and construction commenced in July 1915. The job was completed in a year without mishap, although the operators of the electric railway surrounding the Whirlpool would not allow the Spanish engineers to stretch ropeway across the tracks. This restriction forced a heavy unanticipated expense of building terminal towers on abutments secured to the solid rock of the underlying ledge. In fact, the first cable was towed manually around the edge of the Whirlpool. After the car was positioned onto the cable, the five remaining cables were transported via the Aero Car.

Finally, on August 8, 1916, in the presence of several hundred people, the Niagara Falls Evening Review reported: "Shortly after three o'clock, Mrs. J. Enoch Thompson, wife of the Spanish consul at Toronto, opened the cableway by breaking a bottle of champagne over the gate at the Thompson's Point landing. The car made its first public trip. It was a pleasant sight to watch the car which carried four flags - the Union Jack, the Stars and Stripes, the French and Spanish flags."

From its launch in 1916 until the late 1950s, passengers could board at either Thompson's or Colt's Point on a one-way trip. However, sometime in the late 1950s, the main terminal was moved to its present position at Colt's Point and became a round-trip from Colt's Point. Today, visitors can only drive to Thompson's Point by car or the Niagara Falls People Mover. A viewing post at Thompson's Point (located above the counterweight room) allows visitors to observe the Aero Car and take photos, looking back toward Colt's Point.

In 1961, A. Blake Robertson purchased the car from the Niagara Spanish Aero Car Company and added an electric braking system. In 1967, the Aero Car itself was redesigned similar to its original style by a local engineer. It was last modernized in October 1984 and upgraded to meet today's standards and codes by Von Roll Habegger AG of Thun, Switzerland. The complete overhaul included replacement of drive motors, cables and controls. The carriage was not altered; however, the wheels, electrical circuits, track cables and suspension system were all replaced. In May 1985, the renovation was completed, and the Aero Car has been running without complications since then.

Aero Car Specifications and Operation

The car is 10 feet x 10 inches wide, 24 feet long and 23 feet high. It has a standing room capacity for 20 passengers on the lower level and 20 in a central, raised aisle. Developers built a large arc atop the car for wind stabilization. When empty, the car weighs 3.5 tons; when fully loaded, 7 tons. The system is a single-reversible aerial tramway with six track ropes, and one haul cable propelled by a continuous line rope. Housed at Colt's Point, the drive is an electric, 50-horsepower, DC motor operating via a gear-reducer that drives the bullwheel. It runs on SCR solid-state controls and can be operated manually and automatically from the operator's booth at Colt's Point. The emergency drive is a diesel hydrostatic variable speed and has a hydraulic motor flanked to a planetary gear-reducer. The drive rope is 1.4 kilometers long, and its brake is controlled by an electro-hydraulic thruster. The auxiliary drive is used for emergency purposes only. The car travels at 2.5 meters per second at 1,800 RPM on motor power; plus, at a maximum travel speed of 2,500 RPM of diesel, it operates at 0.7 meters per second. A rescue car, powered by a Briggs & Stratton 10-horsepower motor, is located at Thompson's Point but has never been required for rescue purposes.

The track cables at Thompson's Point are attached to a 120-ton counterweight that adjusts up and down, compensating for the load as the car moves along the cables - which themselves support 50 tons or nearly six fully loaded cars. The track rope counterweight and the haul rope counterweight are located at Thompson's Point. The tensioning occurs in the "cave"(Thompson's Point), where the cables are properly monitored and lubricated. A transmitter for signals is located here, too. Recognizing the car would have to go up or down a grade, Aero Car engineer Torres-Quevedo placed excess stress on the drive cable and installed a weight for this cable to a wheel. This adjustment allowed the position of the car to adapt according to the car's load on a level grade. The car has 24 wheels (12 on each end) with a weight load of 6,800 pounds.

Before being pronounced fit for service, the system was subjected to a load test three times its maximum passenger capacity. The carrier is suspended from wheels traveling on the six parallel track cables which are permanently secured at the Colt's Point terminal. At Thompson's Point, each track cable is attached to a roller chain that connects to a counterweight, which keeps the cables taut. The counterweight dimensions are 8 feet x 12 feet x 16 feet.

The cable car is drawn across the span by means of a 7/8-inch plough steel haul cable attached to one end of the vehicle. This passes over a sheave at Colt's Point into the machine room and over another sheave running beside the car. Then, the cable runs to Thompson's Point over a deflector sheave down to the counterweights over a sheave, and then returns to the car. In this way, a tension is created in the cable which takes up any slack caused by the vertical motion of the car. A greaser lubricates the cable as it passes over the sheave back to the car.

The maximum speed of the car is 500 feet per minute; however, with half speed over the most spectacular portion and docking deceleration, the roundtrip takes about 10 minutes. Should there be any failure of electrical energy, a diesel engine can be brought into service. At Thompson's Point, an automatic control stops the car easily and without shock within a run of a little more than three feet. The stay is brief, and no exit of the car is possible. At Colt's Point terminal, gates are manually operated by the conductor. The system is maintained by Otis Elevator Co., Ltd. and The Niagara Parks Commission (the owners).

Rope Testing

Safety is a primary concern of the operators and maintainers and certainly a priority of The Niagara Parks Commission. Each year, Rotesco, Inc., a company specializing in nondestructive wire rope examination and testing, analyzes the Spanish Aero Car's wire ropes, testing for strength and durability. Inspecting engineers use a Rotescograph, an electromagnetic instrument which measures both loss of metallic cross-section due to corrosion or wear and localized fault traces (deterioration), which can be visually recognized by broken wires, lay distortion, interstrand nicking, etc.

The examination shows how much safe working life remains, and provides the technician with information on loss of breaking strength. Visual inspection results and a diagnostic report are verified and submitted to the client. Also shown are discontinuity traces, sensitivity percentages, area of change and degree of loss. These readouts help the examiner determine any loss of metallic area, severe wear, any large deflections due to corrosion and any variations in gap length separating the ends of a broken wire. The accompanying photos were taken during the most recent rope testing in the winter of 1996. They show the device visually inspecting the rope system and examining the Rotescograph's printed readouts.

EW Field Visit

En route to the 23rd Annual Canadian Elevator Contractors Association (CECA) Convention in Montreal, your reporter and ELEVATOR WORLD Publisher Ricia Hendrick stopped off in Niagara on a clear and sunny Memorial Day afternoon to meet John Hunt, lift device technician for The Niagara Parks Commission, and Scott Whitwell, P. Eng., director of Engineering and Maintenance for The Niagara Parks Commission. Hunt, a 13-year employee with the Niagara Parks Commission, oversees maintenance for the Aero Car, the Falls

Incline Railway and elevators located throughout the park.

Hunt conducts daily maintenance on the equipment, as he properly follows the manufacturer's recommended directions, recording his work in a maintenance log. Otis representative Gary Clifford stays in contact with Hunt, stopping by a few times each week, substituting for Hunt in his absence and remaining on standby should an emergency occur. Hunt estimates that the car averages 60 trips per day throughout the 100-day peak season (June through September). This equates to over 17,000 trips every year on the Aero Car! According to Hunt and Whitwell, maintenance is a top priority. In fact, Whitwell stated that between late April and the end of October, the Aero Car carries some 250,000 people each year. The guides escorted your reporters inside the machine and control rooms at Colt's and Thompson's points, where Otis service representatives were on hand to answer questions regarding the system. Whitwell noted that, although the Aero Car is not handicap accessible, The Niagara Parks Commission is exploring this possibility.

Then, a complimentary ride was offered to experience "an antique in motion." Climbing aboard, passengers are instructed to quickly find a standing spot (no seats present) and wait for the car to fill. Looking over the rail, one can see driftwood and white foam swirling beneath, as a strong, cool wind blows across the face. The conductor announces that the sliding doors will close and then, before the car begins to move, tells the crowd a brief history of the Aero Car's evolution, providing a few safe-riding rules as well. Next, the car begins to move along the cables, and the conductor explains additional facts about the Aero Car and dimensions of the gorge, Whirlpool and the Niagara River system. Gulls can be seen flying around the surface of the Whirlpool below - probably searching for food. The Whirlpool Jet speedboat below transports brave souls, with life jackets tightly fastened, through the rapids and around the Whirlpool. Coming into view is the large green Niagara Glen on the far bank behind Thompson's Point, where families eat picnic lunches and recreate together. A parent tries to raise his small child above the rail for a better view, but the operator quickly tells him "it's against safety rules to do so, sir."

Then, the car reaches Thompson's Point for a brief, 45-second stop while onlookers wave from above. The operator asks all aboard to please move in a clockwise direction to allow others another viewpoint. At Thompson's Point, riders have a better view of the upper and lower rapids, which travel at 35 miles per hour, and the hydroelectric station, which can be seen far in the distance. In case of an emergency, the operator has a manual emergency stop button handy, and a telephone to communicate with the main control operator at Colt's Point. Emergency stop buttons are also located at Colt's Point in the operator's main control room and below in the machine room where the drives are located, as well as inside Thompson's Point machine room.

During the ride back, some standing near the rail can feel the mist on their faces, as it drifts from the Falls some three miles away. The ride is very safe, and photographers find the choice of shots difficult - whether or not to take a picture of the 260-ft-high banks of the gorge or the turbulent water below, when the car is at the center of the span. Over the ages, the abrasive power of the vigorous Niagara River has cut a basin some 900 feet in diameter and 180 feet deep where the surging river turns back upon itself. The swirling water often holds within its grasp, for days, any floating objects, churning even huge logs until they are reduced to pulp!

The Aero Car is open mid-March to the end of November (weather permitting). Tickets are available from the Aero Car ticket booth: adults C \$5 (US \$3.85); children (6-12 yrs.) C

\$2.50 (US \$1.90); and kids, five years and under, are free. It is truly a unique wonder in the world and will long remain one of Niagara's famed attractions where visitors can "get up close and personal" with the mighty Niagara Whirlpool, courtesy of the Niagara Spanish Aero Car!

While visiting the Niagara Spanish Aero Car, Hunt and Whitwell escorted your reporters to the Falls Incline Railway (originally called the Horseshoe Falls Incline Railway) to observe how the last operating funicular railway of eight, that has served the Niagara area over the past 130 years, still runs today. The Niagara Parks Commission operates the railway, which serves primarily as a connector to the base of the incline across the Niagara Parkway to the Falls. After visitors view the Falls, the railway returns viewers back up the hill to the upper Falls viewing area (near Minolta Tower). The funicular has helped to ease traffic and parking problems that were increasing in Queen Victoria Park.

The Falls Incline Railway was constructed by the Swiss firm Von Roll with offices in Watertown, New York and opened on October 8, 1966. The railway utilizes two Plexiglass-roofed cars which counterbalance each other, traveling on separate tracks on a total length of 150 feet. Each car holds 40 passengers and travels on a 35% slope. Up to 1,600 people can be transported in one hour. At night, riders are treated to a multi-colored illumination show that lights up the Falls from behind.

Inside the machine room, a large bullwheel winds up and lets out the cables. Drives and controllers are located in the machine room near the bullwheel. The incline runs at 190 feet per minute - noted as the slowest incline in the world! Clamps secure the rails to avoid any slippage while the car is at rest. Otis Elevator Co. (Canada) has a full maintenance contract and visits on-site once a week.

Passengers enjoy an incredible view of the broad, upper Niagara River, as it plummets over the Falls into the gorge 170 feet below. The trip lasts about one minute and costs C \$0.85 (US \$0.65) one way. Railway operation is weather permitting. In the winter of late 1995 and early 1996, the incline's cars were removed for a third extensive overhaul, as the accompanying photos attest. Its doors were redesigned for improved passenger safety. The railway returned to full operation in April 1996 in time for the heavy tourist season. Approximately 675,000 people rode the Falls Incline Railway in 1996. In October 1996, the Falls Incline Railway completed 30 years of service.

The author would like to thank Mark Wright, assistant manager of the Falls Incline Railway and Scott Whitwell, director of engineering and maintenance with the Niagara Parks Commission, for contributing some of the background and technical information on the funicular.