



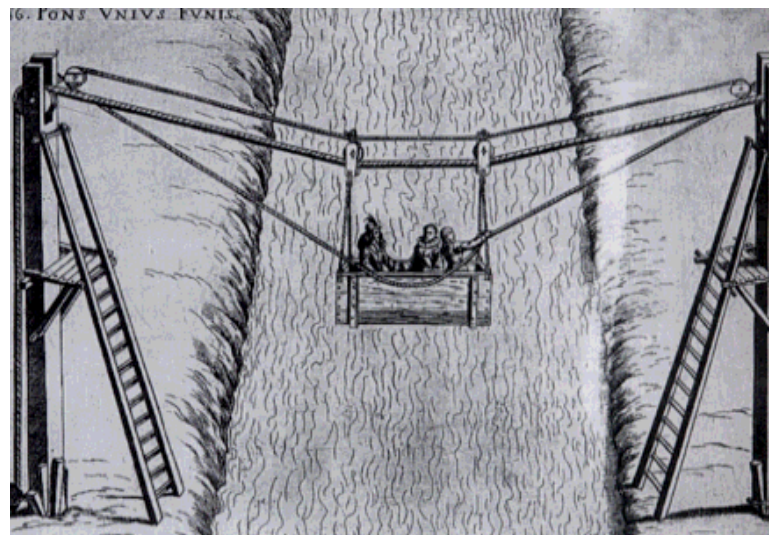
Italy: the first 100 years. Ropeways from 1850 to 1950

Giuliano Zannotti



Italy, a country with an ancient tradition of ropeways

Bozen/Bolzano 6 - 9 June 2017



*Design for an aerial lift by Fausto Veranzio
(Machinae Novae - Venice 1615 or 1616)*



Land of pioneers, scientists and innovators...



Tommaso Agudio
1827 - 1893



Alessandro Ferretti
1851 - 1930



Giulio Ceretti
1868 - 1934



Dino Lora Totino
1900 - 1980



Ugo Carlevaro
1897 - 1993



*With the availability of reliable and convenient steel ropes,
many industrial and transportation applications are
developed in Italy in the second half of 1800.
Like in other industrialized countries, the first applications
of steel wire ropes were on land transport systems.*



THE FUNICULARS

Two types of ropeways systems are developed:

- With the rope wound on board drive pulleys, telodynamic system or Agudio's system;*
- With the rope permanently attached to the vehicles, classic funicular.*



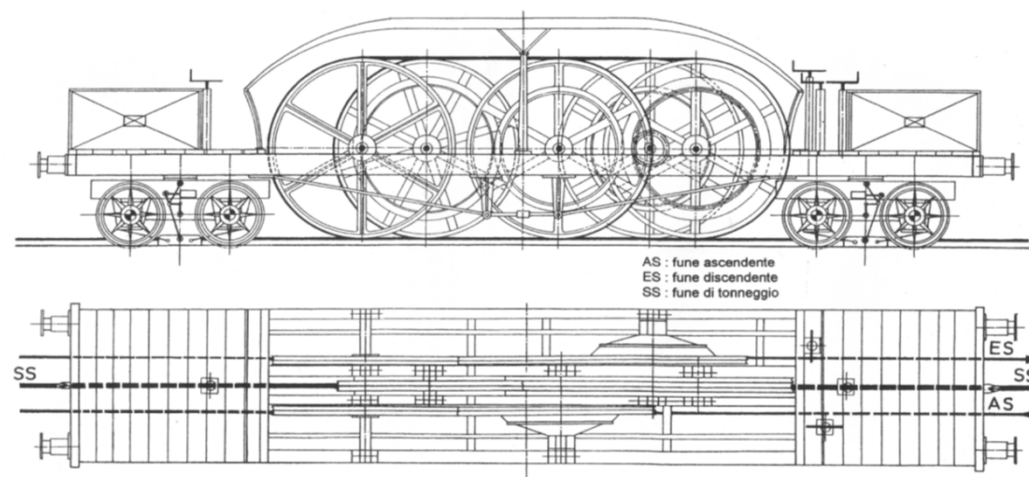
Tommaso Agudio

Mechanical engineer, born in Malgrate (LC) in 1827, famous are his “Agudio Patents” for climbing the slopes with fixed machinery plants. The first significant Italian experimental ropeway in Dusino 1861-1865, has to be attributed to him.

The main difference between the Agudio’s system (he himself called "telodynamic") and the classic funicular system is that the rope was not connected to the vehicle.

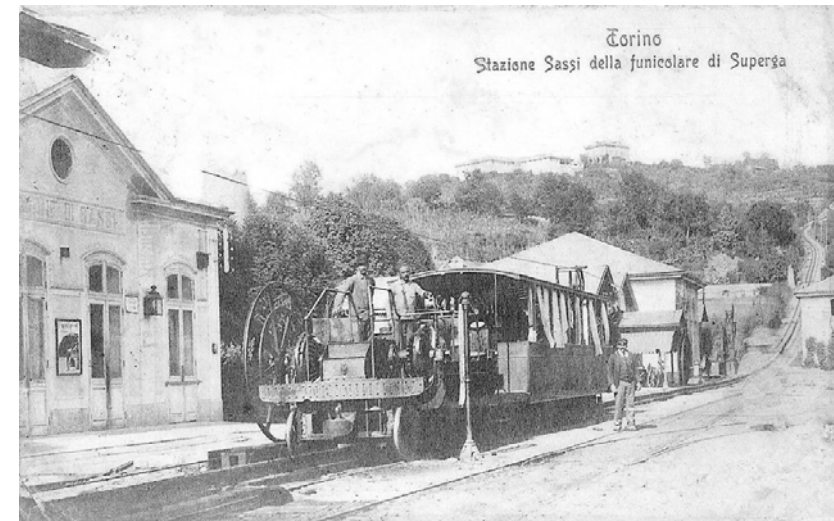
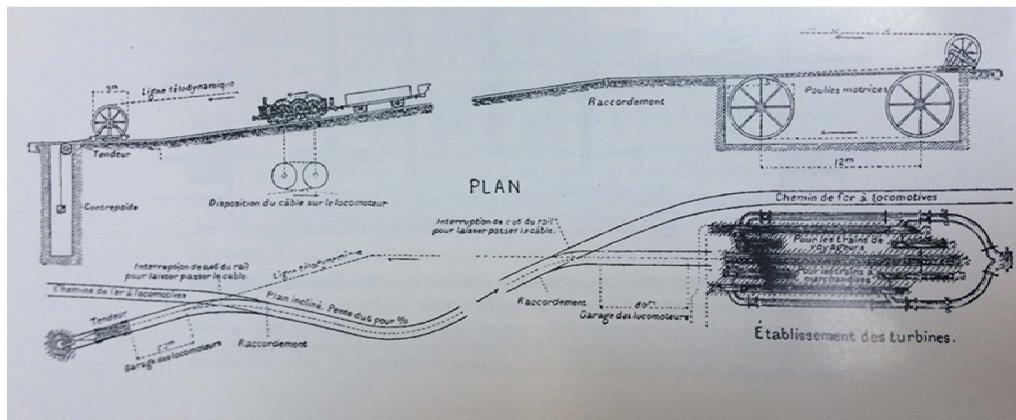
The ropes (AS and ES) wind up on two or more drive pulleys which, by grip, transmit the motion to the internal mechanisms of the vehicle.

A fixed rope (SS) wound on other drive pulley (Dusino) or later (Lanslebourg 1868 - 1871 and Superga 1884) a toothed rake, allowing overcoming slopes not to be overcome in natural grip.





The Agudio vehicle is virtually a locomotive that, with pushing maneuver, allows trains (Dusino 1861 and Lanslebourg 1870) or tramway (Superga 1884) to overcome strong slopes.
With the Agudio system, the motion control is totally on board the locomotive and is independent of the rope that is small in diameter and can therefore be moved continuously: with steam engines (Dusino and Superga); Or with hydraulic turbines (Lanslebourg); at enormous speeds up to 12.5 m / s.

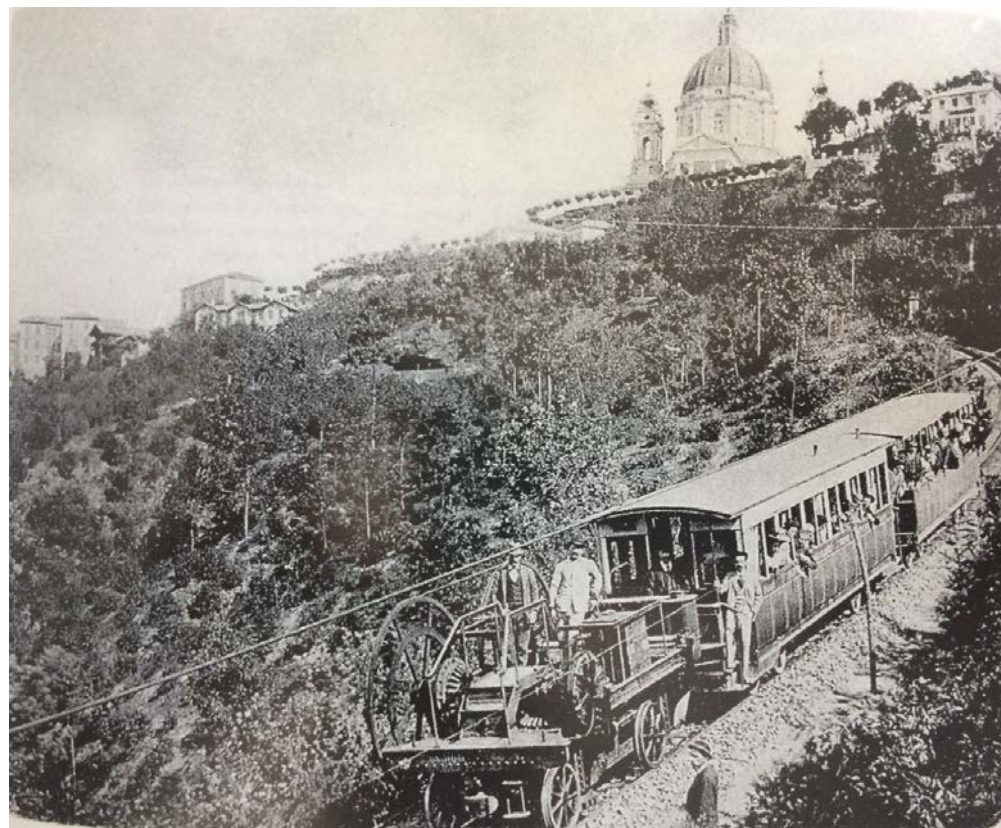




The historical rack tramway Sassi – Superga is unique in its kind in Italy. The line was later transformed by his son Paolo Agudio, in 1934, in a rack tramway, maintaining the concept of the central rail traction.

In 1878 on a inclined section of the new Transandina railway line, between Santa Rosa and Mendoza, was equipped with an Agudio locomotive.

The company founded by him in 1861 is still operating in the ropeway field, merged in 2015 with the Leitner brand.

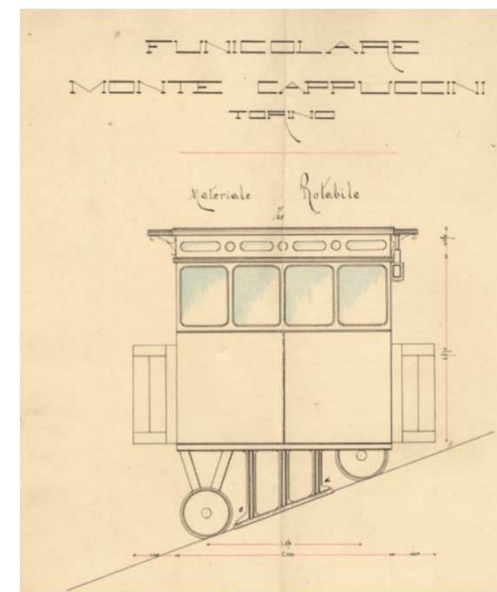
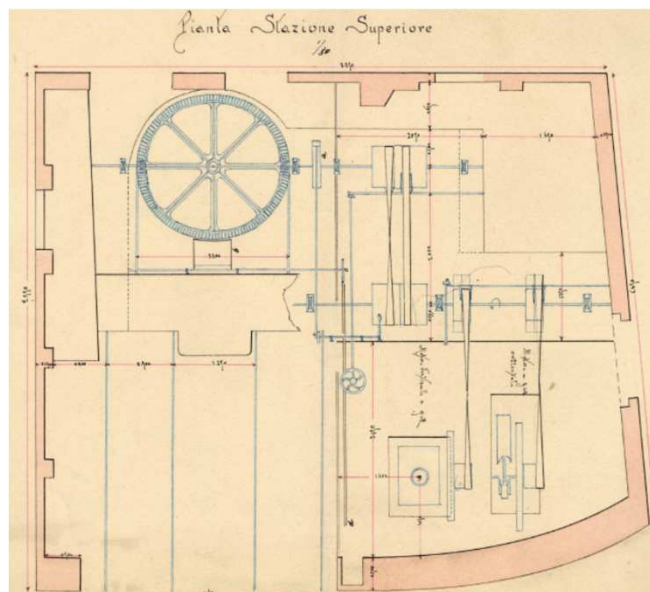


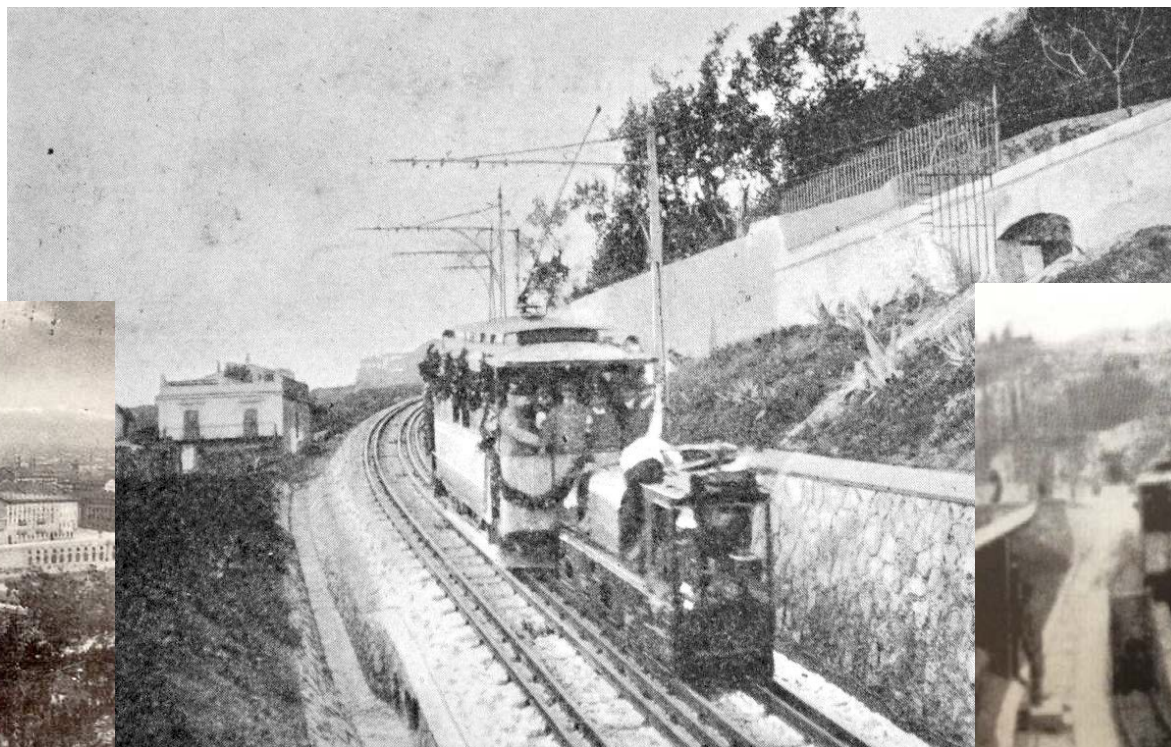


Alessandro Ferretti

Mechanical engineer, born in Fabbrico (RE) in 1851, He was a great inventor and entrepreneur, precursor of modern project finance. He has designed and built many classic funiculars by introducing some basic safety concepts such as: on-board automatic brakes. The his main ropeways project are:

- 1885 Funicular Monte dei Cappuccini, Torino*
- 1886 Funicular Breo-Piazza, Mondovì*
- 1887 Funicular Città alta, a Bergamo*
- 1888 Funicular S. Luca and S. Michele in Bosco, Bologna*
- 1888 Funicular di Orvieto*
- 1889 Material Ropeway Valestra - Oca*
- 1891 Funicular Ortona mare*
- 1892 Funicular Expo, Genova*
- 1894 Funicular Sorrento*
- 1898 Funicular Montecatini Terme*
- 1898 Funicular Salsomaggiore Terme*
- 1908 Funicular – Tramway Monreale, a Palermo*
- 1914 Aerial Tramway Expo Genova*
- 1929 Aerial Tramway di Cassino (his son Pericle)*



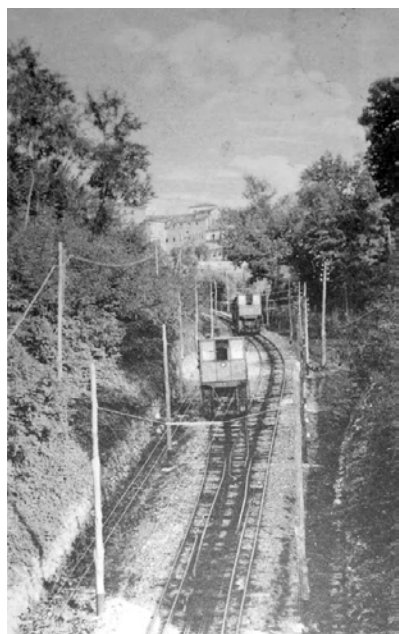


1908 Funicular / Tramway Monreale

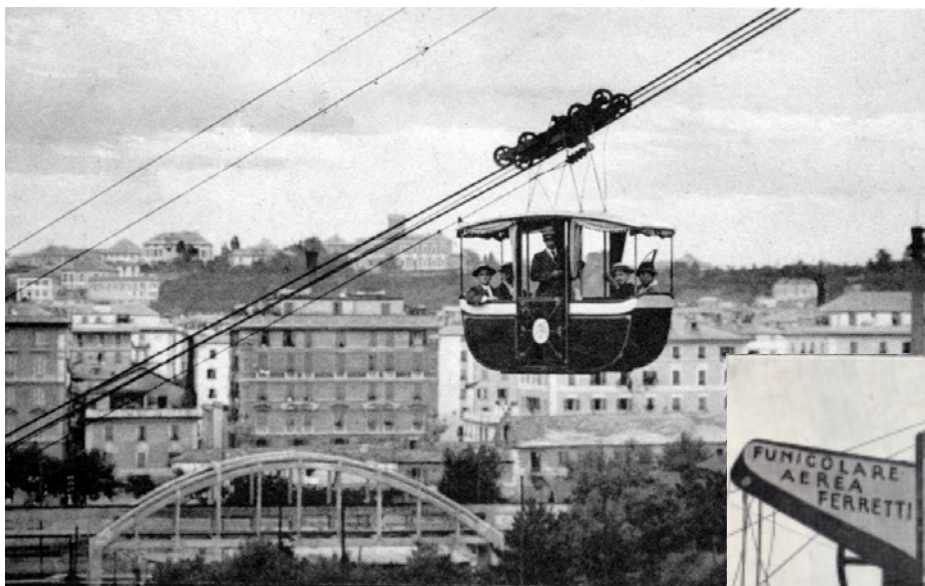


1888 Funicular Cappuccini Torino

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1886 Funicular Mondovì

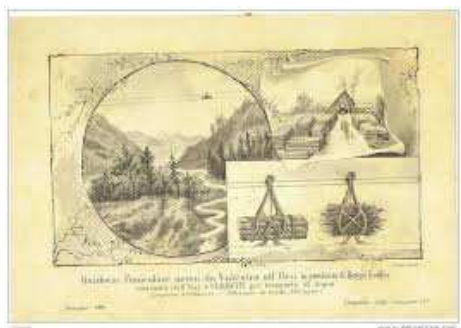


1914 Aerial Tramway Expo di Genova





1889 Material ropeway Valestra – Oca
(Tree trunks – Length 5 km)



1888 Funicular Orvieto



1929 Aerial Tramway Montecassino



1888 Funicular Montecatini





Giulio Ceretti



Born in Bologna in 1868, mechanical engineer graduated at Zurich polytechnic, He founded with his colleague Vincenzo Tanfani, the company Ceretti & Tanfani for many years one of the largest ropeways companies in the world.

The his main italian project are (1850 – 1950) :

1894	Aerial Tramway	Expo - Milano	Milano	Ceretti & Tanfani
1908	Funicular	Antignano - Montenero	Livorno	Ceretti & Tanfani
1909	Funicular	San Pellegrino - Vetta	San Pellegrino (BG)	Ceretti & Tanfani
1909	Funicular	Del Sacro Monte	Varese	A. Ferretti / Ceretti & Tanfani
1910	Funicular /tramway	Sala - Città	Catanzaro	Ceretti & Tanfani
1912	Funicular	Gries - Gucinà	Bolzano	Ceretti & Tanfani
1912	Aerial Tramway	Lana - San Vigilio	Lana (BZ)	Strub/L. Zuegg Ceretti & Tanfani
1924	Aerial Tramway	Champlong - Colonna (Mining)	Cogne (AO)	Ceretti & Tanfani
1926	Aerial Tramway	Cortina - Pocol	Cortina (BL)	Ceretti & Tanfani
1928	Funicular	Centrale	Napoli	Ceretti & Tanfani
1929	Aerial Tramway	Depot - Ospedale Agnelli	Fenestrelle (TO)	Ceretti & Tanfani
1931	Funicular	Mergellina - Posillipo	Napoli	Ceretti & Tanfani
1934	Aerial Tramway	Fonte Cerreto - Campo Imperatore	Assergi (AQ)	Ceretti & Tanfani
1936	Aerial Tramway	Breuil - Plan Maison	Cervinia (AO)	Ceretti & Tanfani
1938	Aerial Tramway	Pian dei Valli - Terminilluccio	Leonessa (RI)	Ceretti & Tanfani
1939	Aerial Tramway	Cortina - Mandres	Cortina (BL)	Ceretti & Tanfani
1939	Aerial Tramway	Mandres - Faloria	Cortina (BL)	Ceretti & Tanfani
1940	Aerial Tramway	Campi Flegrei - Posillipo Alta	Napoli	Ceretti & Tanfani
1941	Aerial Tramway	Cortina - Mandres	Cortina (BL)	Ceretti & Tanfani
1950	Aerial Tramway	Castellammare - Monte Faito	Castellammare (NA)	Ceretti & Tanfani

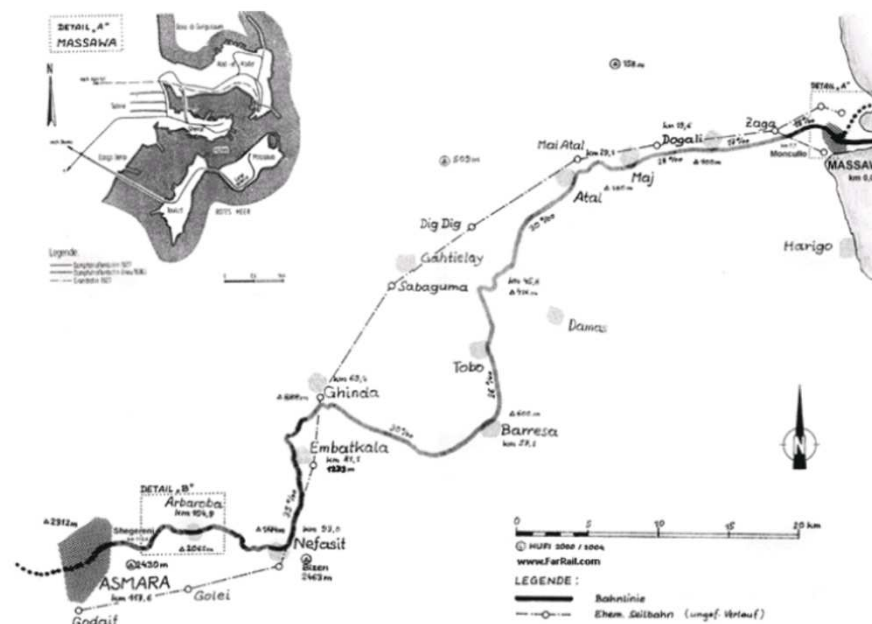


Ceretti & Tanfani



At the same time, the same company produced overseas dozens of other cableway installations dedicated to people or materials transport the most important is the material ropeway Asmara Massaua on 1937 Following some impressive data from that ropeway:

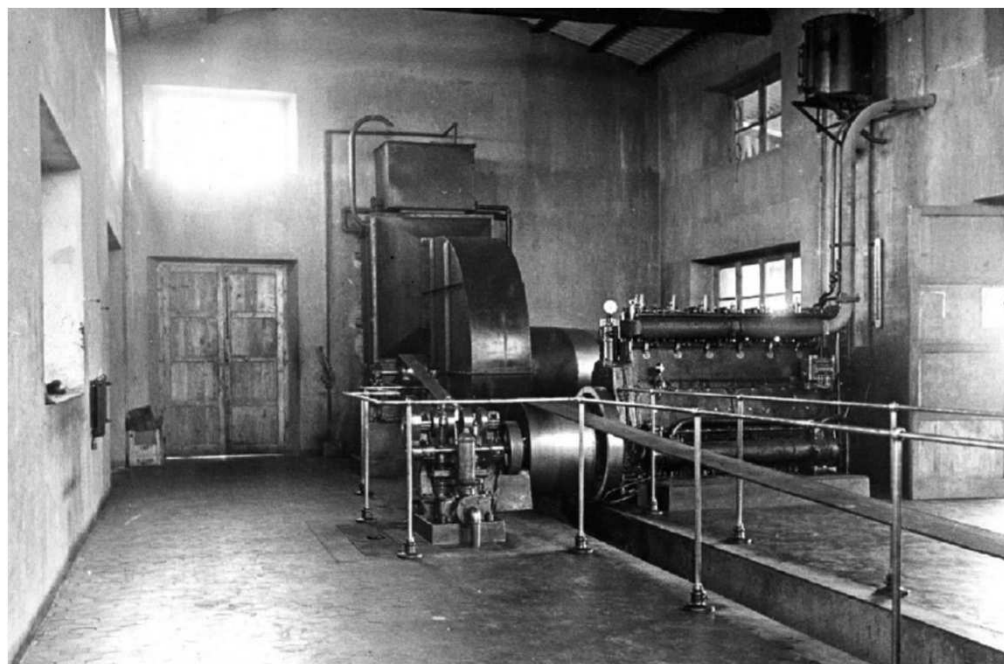
Lenght	m	75.070
Difference in level	m	2.326
Number of bucket	n.	1620
Bucket on line	n.	1540
Number of trestles	n.	464
Drive station	n.	8
Return station	n.	5
		Diesel motor
Power		150 HP





Ceretti & Tanfani

- 1937 Material ropeway Asmara – Massaua
- Drive station with diesel engine Franco Tosi
- Line view





Ceretti & Tanfani

1894 Aerial Tramway at Milan expo



1898 Aerial Tramway at Turin expo





Ceretti & Tanfani



1910 Mont Blanc Aerial Tramway



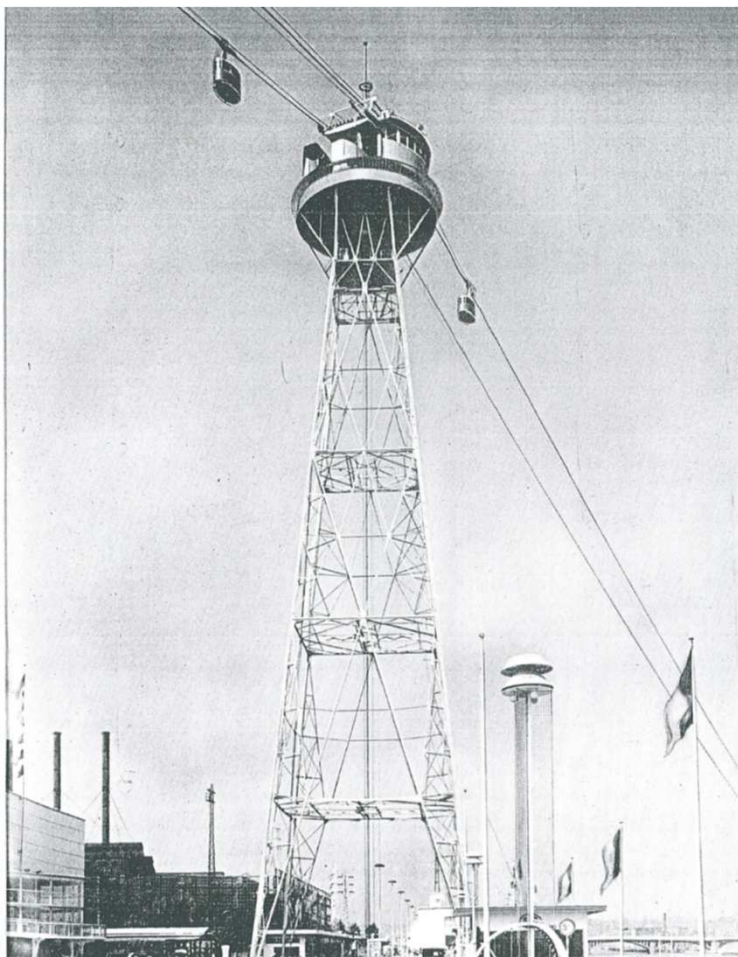
1930 Claviere Aerial Tramway



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Ceretti & Tanfani



1939 Expo de l'eau Liege
4 cars on line each car transporting 30
persons, one towers 100 m high



1939 Funicular San Pellegrino



Other important and interesting ropeways



1880 Funicular Vesuvio (Dall'Ongaro and Olivieri)



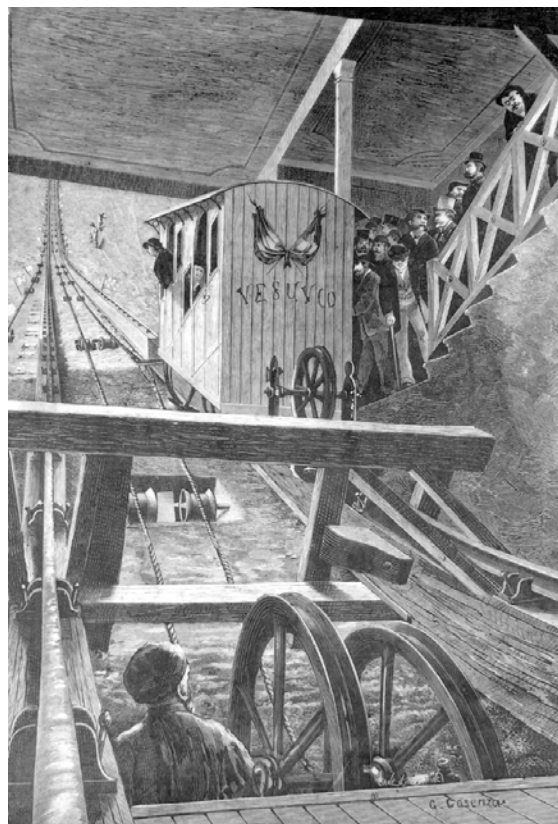
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Other important and interesting ropeways



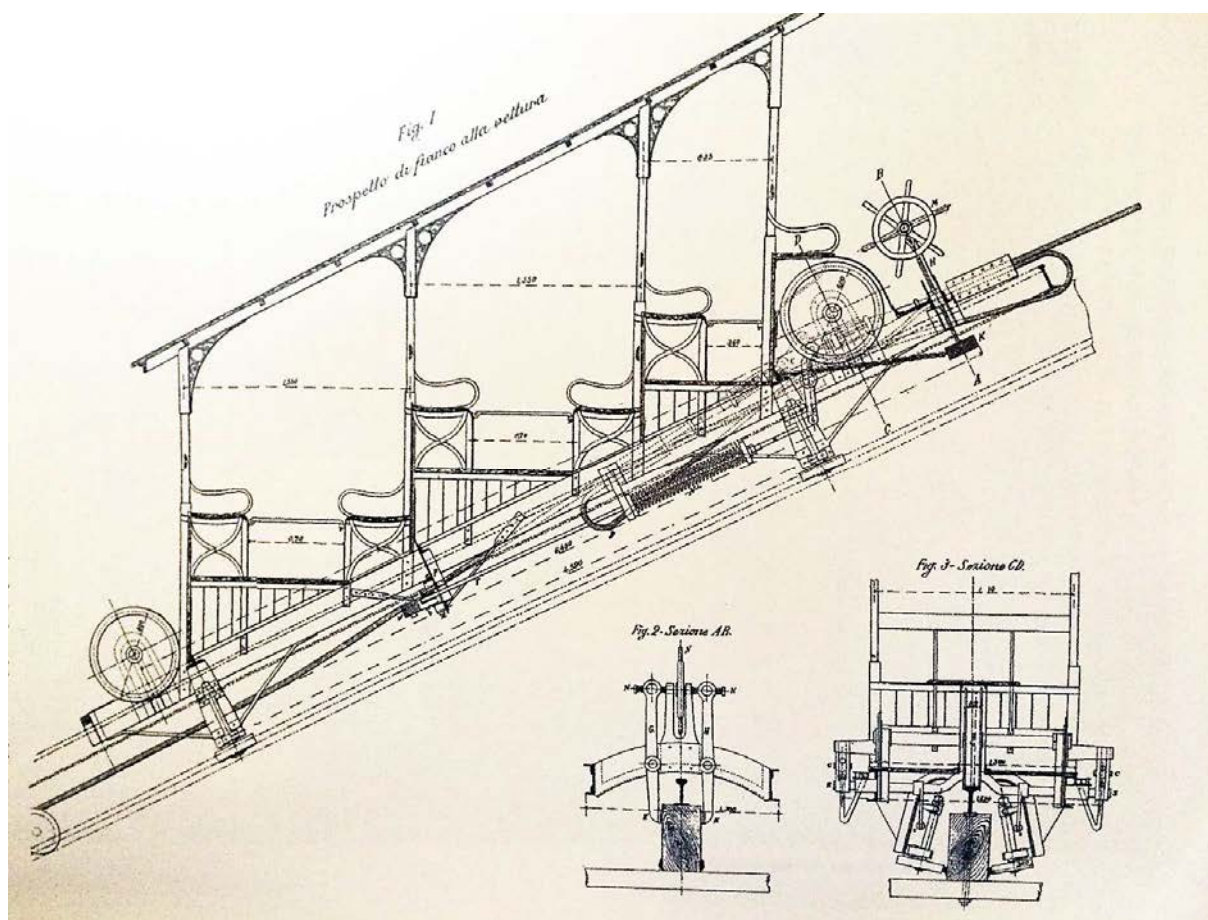
1880 Vesuvio
Funicular «Etna» car



1880 Vesuvio Funicular
«Vesuvio» car



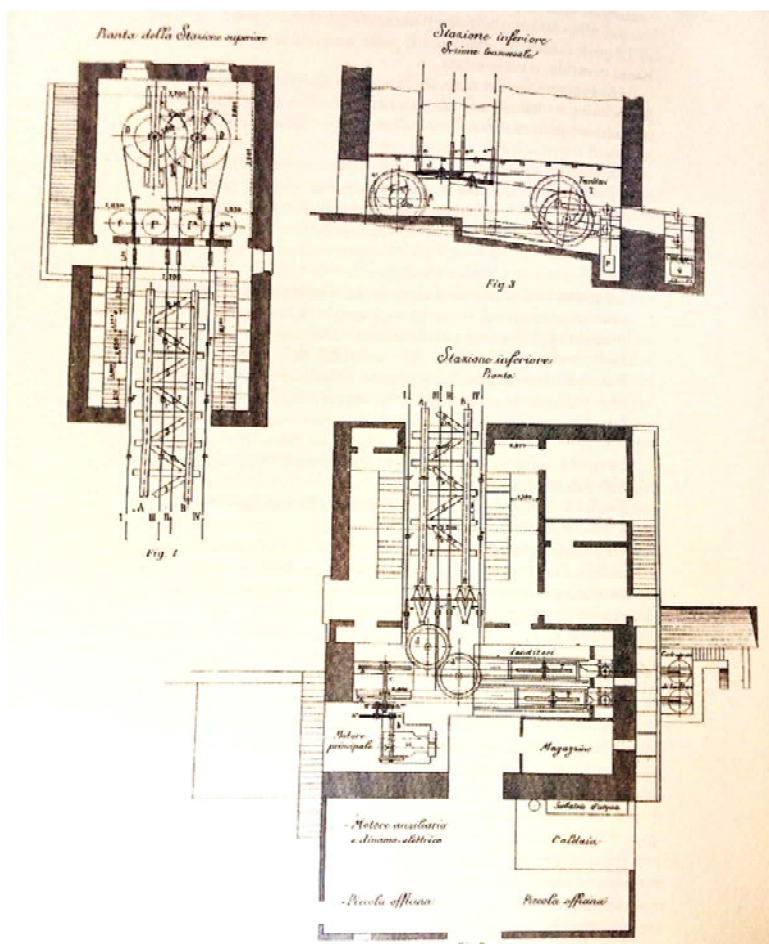
Other important and interesting ropeways



1880 Vesuvio Funicular
Vehicle and line design



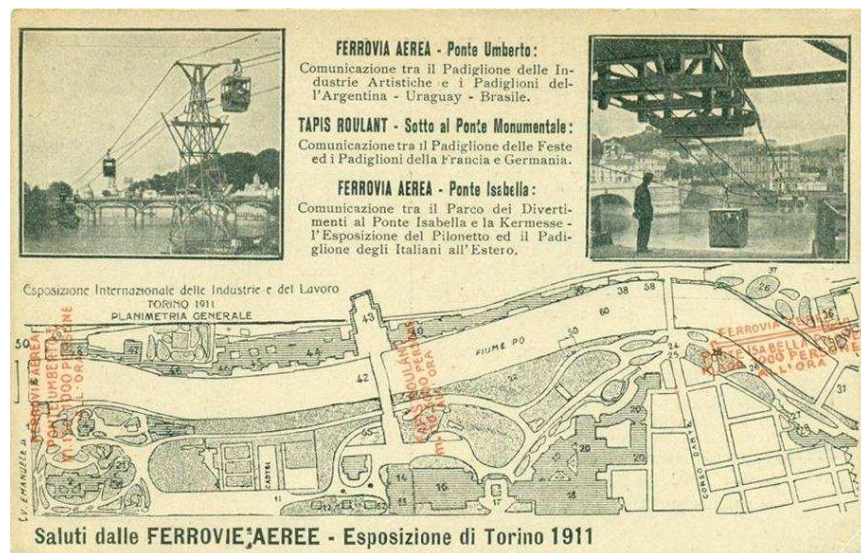
Other important and interesting ropeways



1880 Vesuvio Funicular
Stations design



Other important and interesting ropeways



1911 Expo Torino
(Mancini / Bellani &
Benazzoli)





Material ropeways

Technological developments in the materials transport from 1889

Inclined Haulage



Hundreds of plants built for the construction of hydroelectric plants, marble quarries or mineral extraction



Material ropeways

Technological developments in the materials transport from 1889



Aerial cableways



Hundreds ropeways built for the dams construction, mineral extraction or cement industry



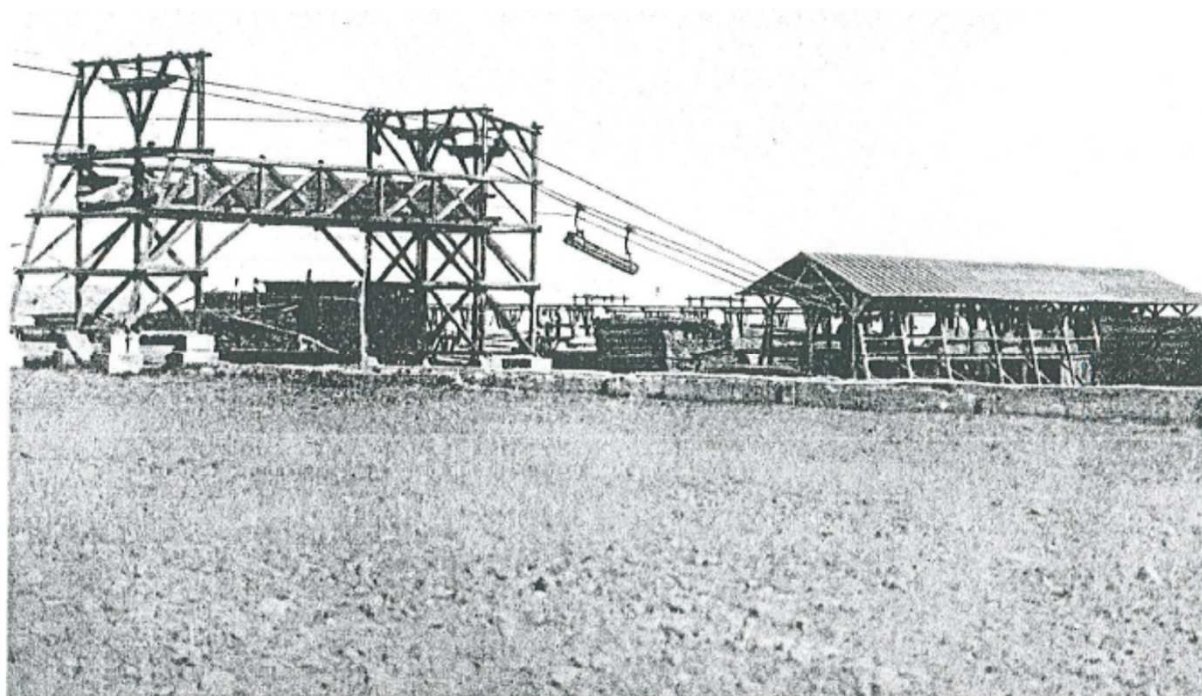
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Material ropeways



Aerial cableways



Coal transport in Savona - Length 18.665 m
two parallel sections

Transport of logs in Cariatì Cosenza - Length 22.665 m

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La teleferica agevola il trasporto
dello zolfo alle raffinerie.



Main ropeways built in Italy before W.W.I*



YEAR	SYSTEM	NAME	PLACE	FIRST CONSTRUCTOR
1861	Telodynamic "Agudio"	Dusino	Asti	T. Agudio
1880	Funicular	Vesuvio	Vesuvio (NA)	Dall'Ongaro/Olivieri
1883	Funicular	Villa Arrigone Monte Berico	Vicenza	A. Ferretti
1884	Telodynamic "Agudio"	Superga	Torino	T. Agudio
1885	Funicular	Monte dei Cappuccini	Torino	A. Ferretti
1885	Funicular	Biella - Piazza	Biella	E. Vaccarino / Off. Vergnasco
1886	Funicular	Breo-Piazza	Mondovì (CN)	A. Ferretti
1887	Funicular	Città alta	Bergamo	A. Ferretti
1888	Funicular	San Luca	Bologna	A. Ferretti
1888	Funicular	Orvieto	Orvieto (TR)	A. Ferretti
1889	Funicular	San Michele	Bologna	A. Ferretti
1889	Material Ropeway	Valestra - Oca	Valestra (RE)	A. Ferretti
1889	Funicular	Chiaia	Napoli	Off. Savigliano
1890	Funicular	Regoledo	Perledo (LC)	A. Colli / Von Roll
1891	Funicular	Montesanto	Napoli	Off. Savigliano
1891	Funicular	Ortona mare	Ortona (CH)	A. Ferretti
1891	Funicular	Sant'Anna	Genova	Torres
1892	Funicular	Expo Genova	Genova	A. Ferretti
1893	Funicular	Como - Brunate	Como	Von Roll
1893	Funicular	Sorrento	Sorrento (NA)	A. Ferretti
1894	Aerial Tramway	Expo - Milano	Milano	Ceretti & Tanfani
1895	Funicular	Largo Zecca - Righi	Genova	Theodor Bell
1898	Funicular	Montecatini Terme	Montecatini (PT)	A. Ferretti
1898	Funicular	Salsomaggiore Terme	Salsomaggiore e Terme (PR)	A. Ferretti
1898	Aerial Tramway	Expo Torino - Oltre Po	Torino	Ceretti & Tanfani

n. 34 funiculars, Agudio's systems or funicular – tramway

n. 4 big material transport

n. 4 aerial tramways

* Not included South Tyrol and Italian ropeways in other countries



Main ropeways built in Italy before W.W.I*



YEAR	SYSTEM	NAME	PLACE	FIRST CONSTRUCTOR
1900	Funicular /Tramway	Monreale	Monreale (PA)	A. Ferretti
1901	Funicular	Saint Vincent	Saint Vincent (AO)	E. Strada / Diatto
1904	Material ropeway	Trabia - Campobello	Campobello (AG)	Ceretti & Tanfani
1906	Funicular	Valle Oscura - Rocca di Papa	Marino (RM)	Von Roll
1907	Funicular	S. Margherita - Lanzo d'Intelvi	Lanzo d'Intelvi (CO)	Von Roll
1907	Funicular	Marina Grande - Capri	Capri	Von Roll
1908	Funicular	Antignano - Montenero	Livorno	Ceretti & Tanfani
1909	Funicular	San Pellegrino - Vetta	San Pellegrino (BG)	Ceretti & Tanfani
1909	Funicular	Del Sacro Monte	Varese	A. Ferretti / Ceretti & Tanfani
1909	Material ropeway	Boccheggiano - Niccioletta - Scarlino	Scarlino (GR)	Ceretti & Tanfani
1910	Funicular /tramway	Sala - Città	Catanzaro	Ceretti & Tanfani
1911	Funicular	San Vito - Kursaal	Varese	Von Roll
1911	Funicular	Campo dei fiori	Varese	Von Roll
1911	Material ropeway	Savona - San Giuseppe line 1	Savona	Pholig
1911	Aerial Tramway	Expo Torino - Oltre Po	Torino	Mancini / Bellani & Benazzoli
1912	Funicular	Bergamo alta - San Vigilio	Bergamo	A. Ferretti / Fervet - Von Roll
1914	Aerial Tramway	Expo Genova	Genova	A. Ferretti

n. 34 funiculars, Agudio's systems or funicular – tramway

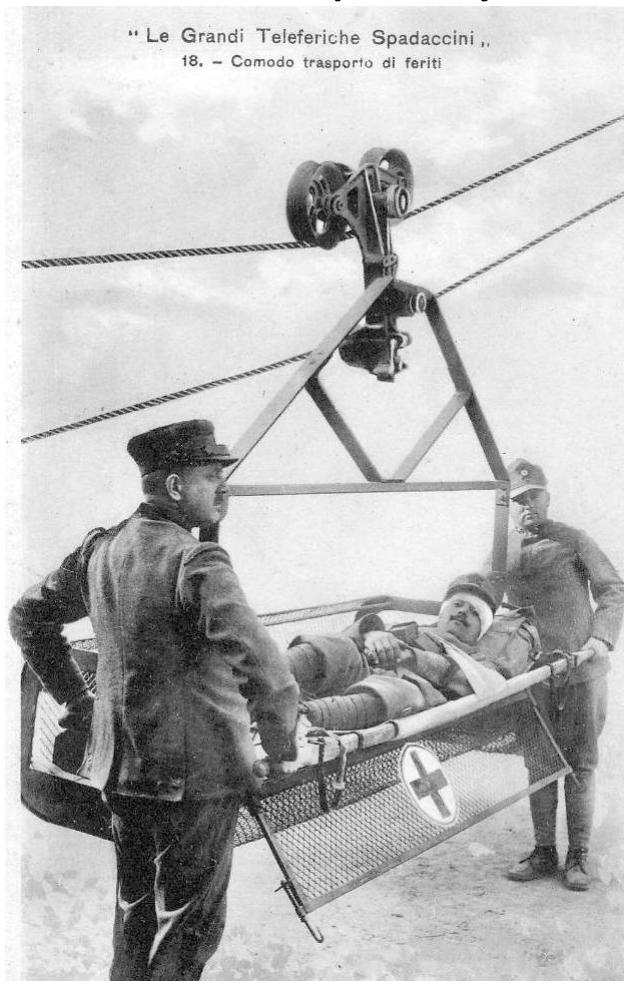
n. 4 big material transport

n. 4 aerial tramways

* Not included South Tyrol and Italian ropeways in other countries



Ropeways serving the mountain war



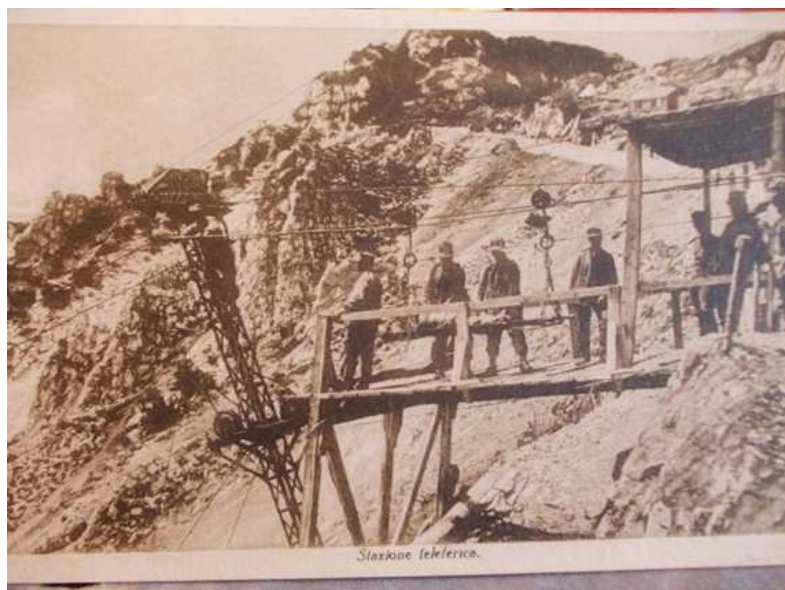
The war in the high mountains entails enormous supply and transport difficulties (200 t/day for brigade - 200.000 soldiers). For the Italian commanders it was clear that the ropeways can provide a great help and, in 1916, they founded the “genius ropeways department”.

Many industries in the ropeway sector such as Ceretti & Tanfani, Agudio, Badoni and Spadaccini, etc.; develop demountable and modular ropeway systems with flow rates up to 50 t / h!

At the end of the war they will be in operation about 2,000 for a length of 2,500 km with an overall flow of 3.800 t / h!



Ropeways serving the mountain war



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In the postwar period there was the great development of aerial tramways and material transport



YEAR	SYSTEM	NAME	PLACE	FIRST CONSTRUCTOR
1922	Funicular	Celle Ligure	Celle Ligure (SV)	
1923	Aerial Tramway	Merano - Avelengo	Merano (BZ)	L. Zuegg
1924	Aerial Tramway	Champlong - Colonna (Mining)	Cogne (AO)	Ceretti & Tanfani
1924	Material ropeway	Monte Rombolo - Piombino	Piombino (LI)	Ceretti & Tanfani
1925	Aerial Tramway	Trento - Sardagna	Trento	
1925	Aerial Tramway	Zambana - Fai	Zambana (TN)	Wisniska /Off. Bressanone
1926	Aerial Tramway	Cortina - Pocol	Cortina (BL)	Ceretti & Tanfani
1926	Material ropeway	Trieste	Trieste	Pholig
1926	Aerial Tramway	Oropa - Muchrone	Oropa (BI)	L. Zuegg
1928	Funicular /tramway	Trieste - Opicina	Trieste	Theodor Bell /
1928	Aerial Tramway	Torre de Busi - Valcava	Valcava (BG)	L. Zuegg
1928	Funicular	Centrale	Napoli	Ceretti & Tanfani
1929	Aerial Tramway	Depot - Ospedale Agnelli	Fenestrelle (TO)	Ceretti & Tanfani
1929	Aerial Tramway	Montecassino	Cassino	P. Ferretti
1930	Material ropeway	Palazzago		Pholig
1930	Aerial Tramway	Clavière - Pian del Sole	Clavière (TO)	Ceretti & Tanfani
1931	Aerial Tramway	Bologna - San Luca	Bologna	Off. Bressanone
1931	Funicular	Mergellina - Posillipo	Napoli	Ceretti & Tanfani
1932	Funicular	Valle Vergine - Rocca di Papa	Marino (RM)	Von Roll
1932	Aerial Tramway	Sestriere - Alpette - Monte Sises	Sestriere (TO)	L. Zuegg / Bleichert
1933	Aerial Tramway	Sestriere - Monte Banchetta	Sestriere (TO)	L. Zuegg / Bleichert
1934	Aerial Tramway	Fonte Cerreto - Campo Imperatore	Assergi (AQ)	Ceretti & Tanfani
1934	Aerial Tramway	Rapallo - Montallegro	Rapallo (GE)	Agudio
1936	Aerial Tramway	Breuil - Plan Maison	Cervinia (AO)	Ceretti & Tanfani
1936	Material ropeway	Savona - San Giuseppe line 2	Savona	Pholig
1937	Aerial Tramway	San Remo - Monte Bignone 1° section	San Remo (IM)	Guarda e Groff
1937	Aerial Tramway	San Remo - Monte Bignone 2° section	San Remo (IM)	Guarda e Groff
1937	Aerial Tramway	San Remo - Monte Bignone 3° section	San Remo (IM)	Guarda e Groff
1937	Material ropeway	Asmara - Massaua	Massaua	Ceretti & Tanfani
1938	Aerial Tramway	Pian dei Valli - Terminilluccio	Leonessa (RI)	Ceretti & Tanfani
1938	Aerial Tramway	Sestriere - Fraiteve	Sestriere (TO)	L. Zuegg / Bleichert
1938	Material ropeway	Seruci - Porto Vesme	Porto Vesme (CA)	Ceretti & Tanfani
1939	Aerial Tramway	Cortina - Mandres	Cortina (BL)	Ceretti & Tanfani
1939	Aerial Tramway	Mandres - Faloria	Cortina (BL)	Ceretti & Tanfani
1939	Aerial Tramway	Plan Maison - Cime Bianche - Plateau Rosà	Cervinia (AO)	Zignoli / Carlevaro
1940	Aerial Tramway	Campi Flegrei - Posillipo Alta	Napoli	Ceretti & Tanfani
1941	Aerial Tramway	Cortina - Mandres	Cortina (BL)	Ceretti & Tanfani
1941	Funicular	Castel San Pietro	Verona	Agudio

In 1934 Professor Carlevaro builds first
“slittovia” (sled cable) in Oropa





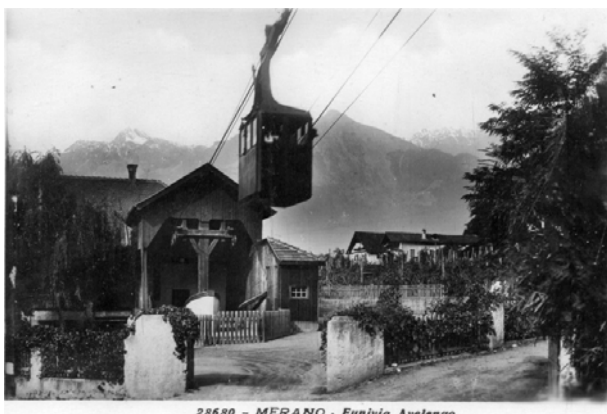
Dino Lora Totino

Engineer, born in Pray (BI) in 1900, eclectic entrepreneur promoted the construction of the Caselle (Turin) airport, of the aerial tramway of the Matterhorn, the Mont Blanc, Chamonix, Cervinia, Etna, Erice, Mercogliano, funicular and of the Mont Blanc Tunnel.



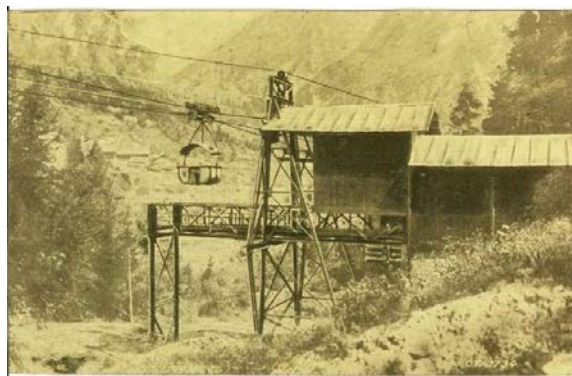


The most important projects of this period



1923 Merano - Avelengo

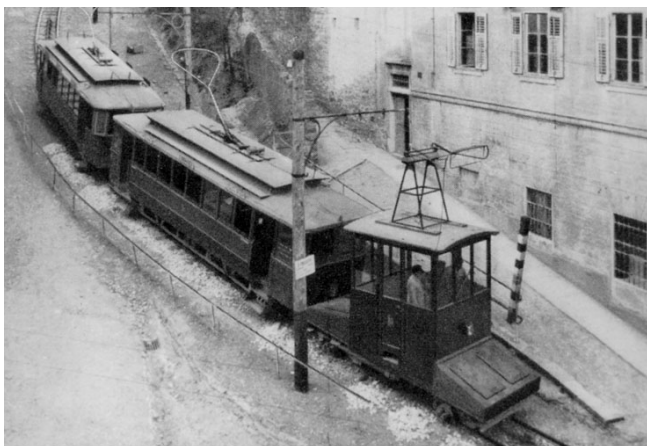
1922? Champlong - Colonna



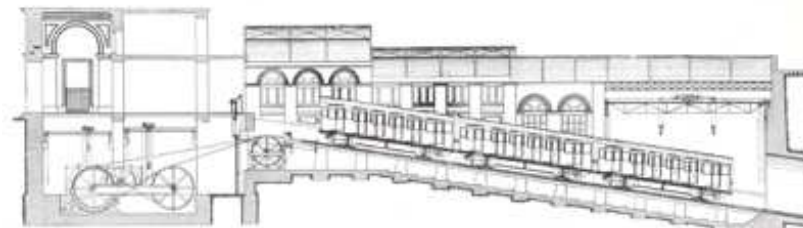
1925 Trento - Sarnonza



The most important projects of this period



1928 Piazza Scorcola – Vetta Scorcola



1928 Funicular Centrale



1928 Funicular Centrale



The most important projects on this period

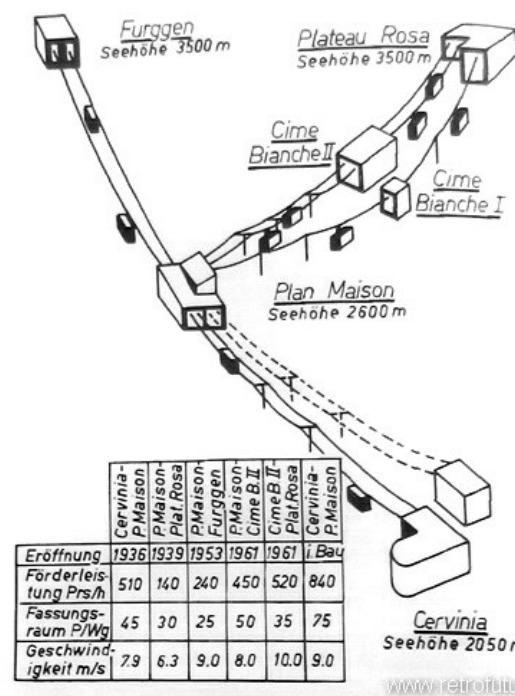


1934 Rapallo - Montallegro



1934 Gran Sasso

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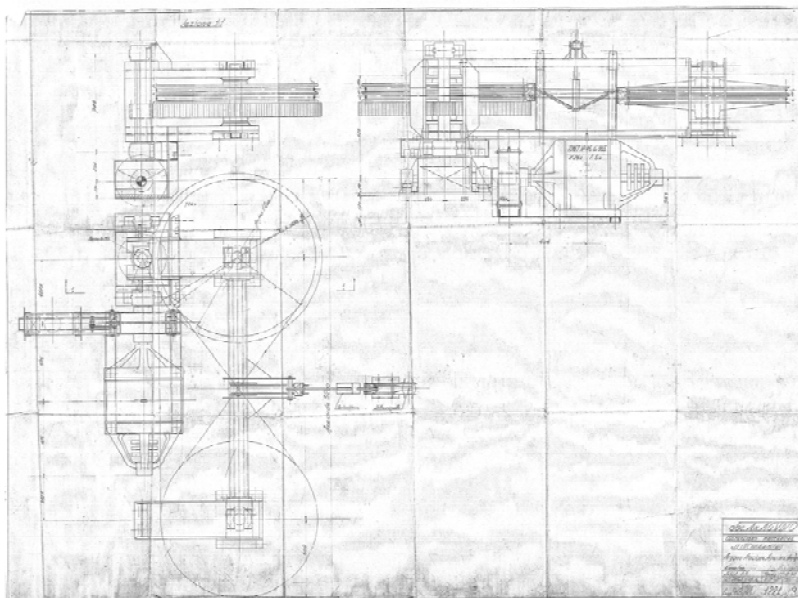


1936 Cervinia – Plan Maison –
Cime Bianche I – Plateau Rosà

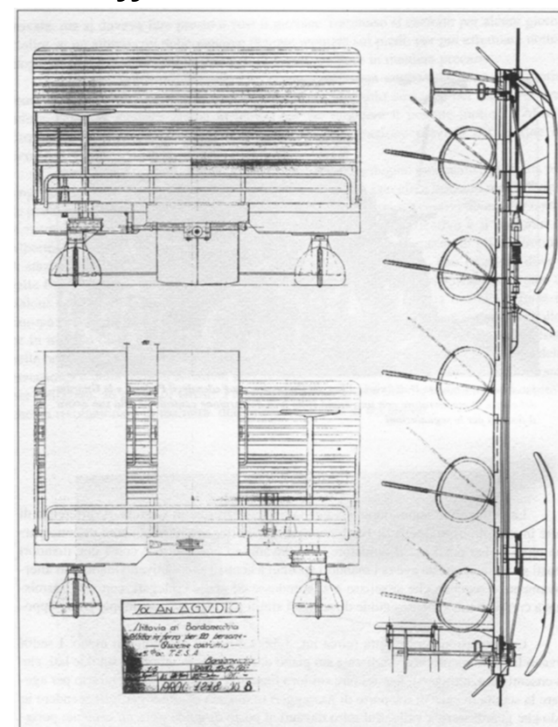


A new type of plant: the "slittovia"

Ski sport become popular and so many dozen of ropeway was built by different manufacturers: Carlevaro & Savio, Agudio, Graffer and other



1940 Slittovia Alpe di Siusi





The New World War stops developing between 1940 and 1945, ropeway companies recapture production on military supplies by becoming military targets.



Agudio workshops before and after the bombing of 1943



After the war, increase the Italian companies that specialize on ropeways:



Agudio

Carlevaro & Savio

Ceretti & Tanfani

Graffer

Hölzl

Leitner

Marchisio

Nascivera

Piemonte Funivie

Troyer

Zemella

....



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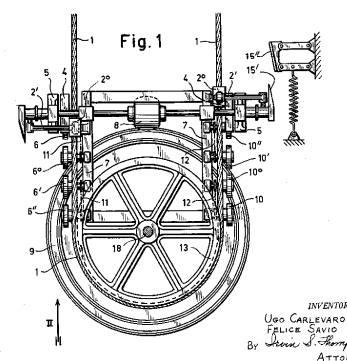
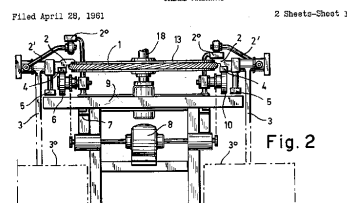


Ugo Carlevaro

Engineer, Mechanical professor, born in Varzi (PV) in 1897, inventor and entrepreneur, He founded the Carlevaro & Savio company and built in Italy the first «Slittovia» (1935), the first Chairlift (1946) and the first patented Automatic Gondola (1949)

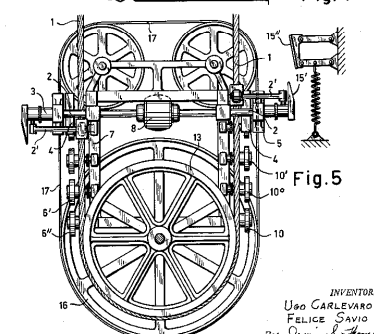
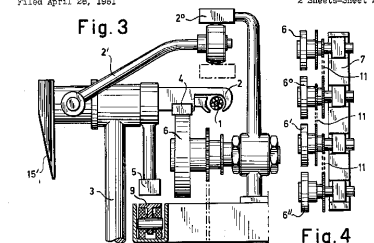


May 14, 1963 U. CARLEVARO ET AL. 3,089,433
CABLE RAILWAY
Filed April 28, 1961 2 Sheets-Sheet 1



INVENTORS
UGO CARLEVARO AND
FELICE SAVIO
BY *Steven S. Thompson*
ATTORNEY

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ATTORNEY

Carlevaro & Savio
Fin dal 1934 Carlevaro & Savio
costruisce impianti di risalita

- 1934: prima slittovia italiana
- 1946: prima seggiovia italiana
- 1949: prima telecabina automatica del mondo
- 1957: prima seggiovia biposto italiana, costruita in U.S.A.
- 1963: prima telecabina quadriposto italiana, costruita in U.S.A.
- 1964: prima seggiovia triposto italiana, costruita in U.S.A.
- 1964: prima telecabina « con gli sci », costruita in U.S.A.
- 1967: prima seggiovia biposto costruita in Italia
- 1968: prima telecabina « con gli sci » costruita in Europa: CHAMONIX - Francia.

CARLEVARO & SAVIO - FUNIVIE
10128 - Torino, Via S. Secondo, 43
Telef. 58.71.42 - Telegr. TELECAR



Oct. 17, 1967

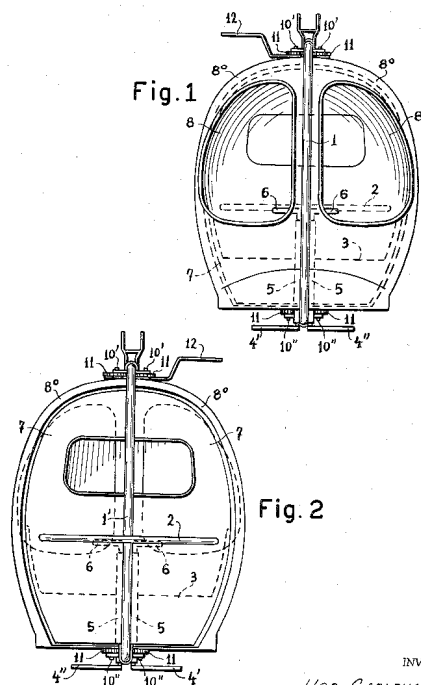
U. CARLEVARO

3,347,173

FLOORLESS, TWO SEAT CABIN FOR CABLEWAYS

Filed July 19, 1966

2 Sheets-Sheet 1



INVENTOR
UGO CARLEVARO
BY *Young & Thompson*
ATTORNEYS

1969 patent openable vehicle



1946 Chairlift in Bormio



1949 Gondola in Alagna

The Carlevaro grip was used, conceptually identical, in the underlying plants until 1974:

Italy: 11

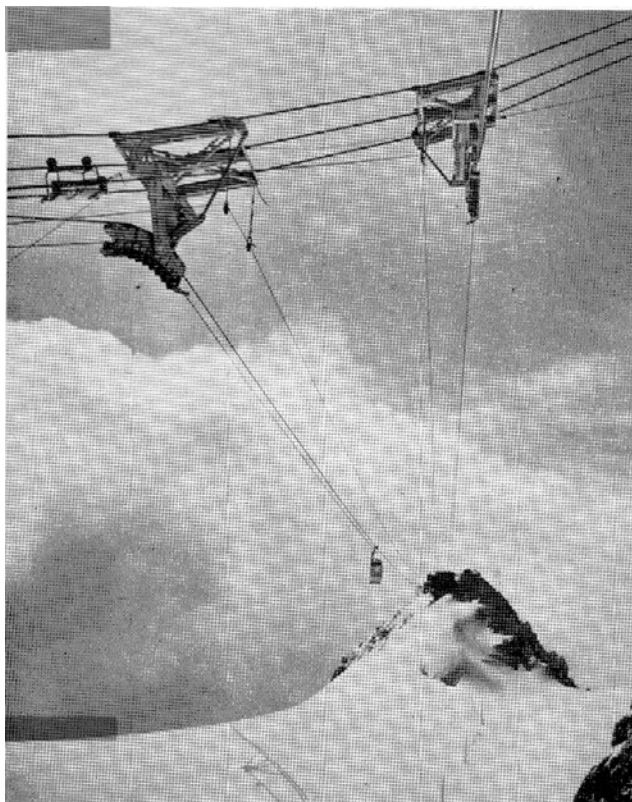
USA: 11

France: 5

Switzerland: 6

Malaysia: 1

Spain: 1



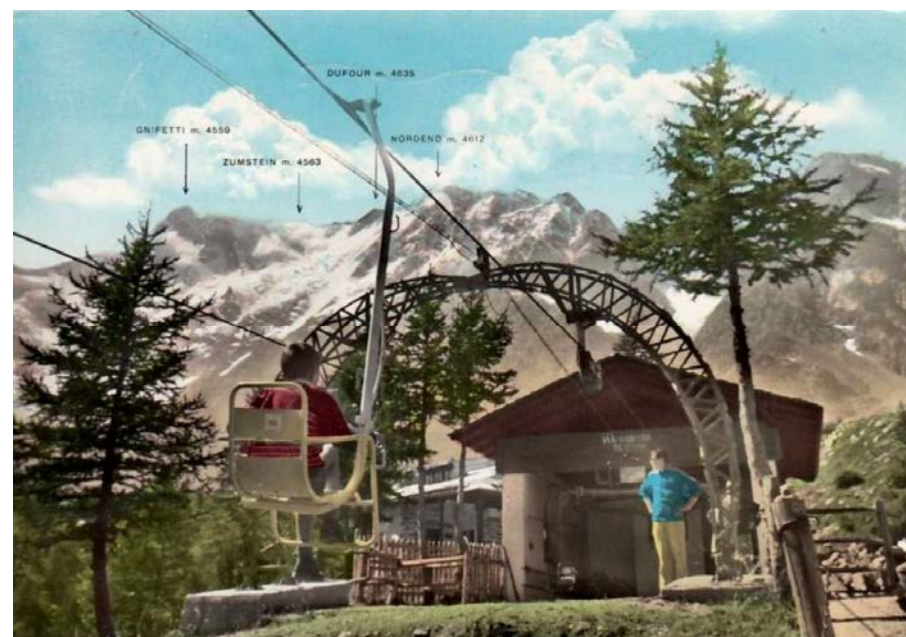
1954 Aerial threstle from Punta Helbronner to Aguille du midi



1948 Blondin 12t Dam San Giacomo Fraelle



1952 Detachable chairlift Von Roll Vesuvio



1951 fixed grip chairlift Agudio Macugnaga



Another new type of ropeway: the skilift (surface lift)



1920 First skilift 1 HP!



1950? First skilift in Italy - probably Graffer?

Ropeway system invented in 1934 by the Swiss engineer Ernst Gustav Constam, In Italy officially present since 1950, in a few years they will have so much success to supplant completely the sled cable or "slittovie".

Over the years '70 will become over 2.000!



Thanks for your attention!

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Ing. A. Recupito
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Wikipedia and other web site

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- FUNIVIE.ORG nella persona di Paolo Sutto
- Simone Bassi