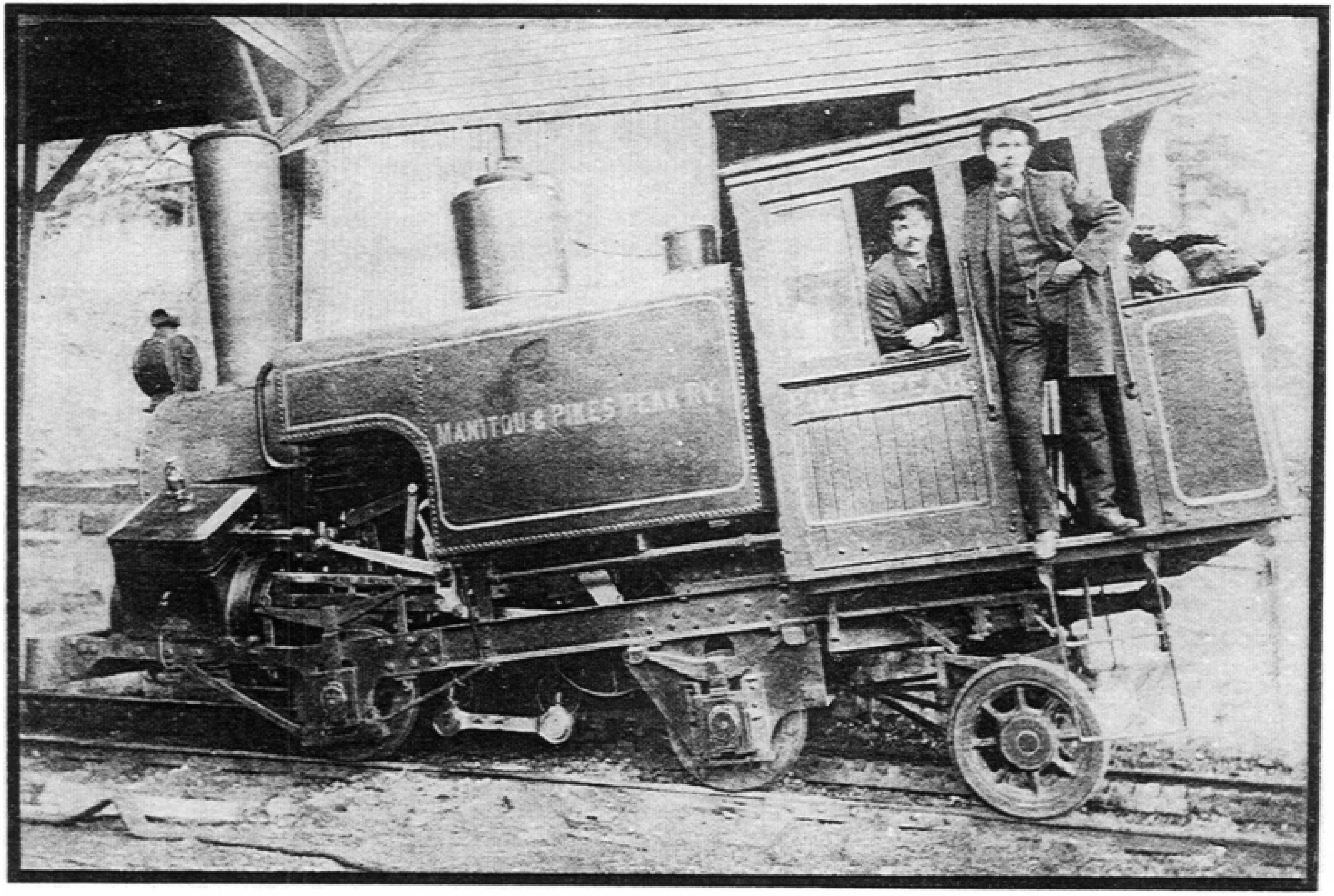
THE PIKE'S PEAK COG RAILWAY
COLORADO SPRINGS, COLORADO



A NATIONAL HISTORIC
MECHANICAL ENGINEERING LANDMARK

Manitou & Pike's Peak Railway Company

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

May 24, 1976

DEDICATION CEREMONY

Pike's Peak Cog Railway

9:00 A.M., May 24, 1976

Opening Remarks	Dr. Fred W. Smith, Chairman, Colorado-Wyoming Section, ASME
Introduction of Honored Guests	Arthur J. Clark, Jr., Vice President and Chairman, Region VIII, ASME
ASME Landmark Program	Donald E. Marlowe, Chairman, ASME National History and Heritage Committee
History of the Pike's Peak Cog Railroad	William Thayer Tutt, President, Manitou and Pike's Peak Railway Co.
Presentation of Plaque	Dr. Charles L. Tutt, Jr., President, The American Society of Mechanical Engineers
Acceptance	William Thayer Tutt, President, Manitou and Pike's Peak Railway Co.
Presentation of Bicentennial Plaque	The Hon. Governor Richard D. Lamm, Governor of the State of Colorado
Closing Remarks (Information on the New Railcars)	Klaus Von Meyenburg, President, Swiss Locomotive Works, Winterthur, Switzerland

ACKNOWLEDGMENTS

The Colorado-Wyoming Section of The American Society of Mechanical Engineers gratefully acknowledges the efforts of Martin R. Frick, Vice-President and General Manager of the Manitou & Pike's Peak Railway Company for supplying the historical information on the railroad. In addition the Section extends its gratitude to all the people who cooperated to make the ceremony a success.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS:

Dr. Charles L. Tutt, Jr.	President, 1975-76
Mr. Earle C. Miller	President-elect
Mr. Arthur Clark, Jr.	Vice President, Region VIII
Mr. Leroy H. Stradford	Chairman, History & Heritage, Region VIII
Dr. Rogers B. Finch	Executive Director

THE MANITOU AND PIKE'S PEAK RAILWAY COMPANY:

William Thayer Tutt	President
Martin R. Frick	Vice President and General Manager
Frederick R. Sindt	Director of Publicity

THE ASME NATIONAL HISTORY AND HERITAGE COMMITTEE:

Dr. Donald E. Marlowe	Chairman
Dr. R. Carson Dalzell	Secretary
Professor R. S. Hartenberg	Member
Professor J. J. Ermenc	Member
Dean John G. Burke	Member
Curator R. M. Vogel	Ex-officio (Smithsonian Institution)
Mr. Maurice Jones	ASME Staff Director of Operations

THE ASME COLORADO-WYOMING SECTION:

Fred W. Smith	Chairman
William D. Batton	Vice Chairman
Paul W. Weber	Secretary
Lee Gerbig	Treasurer
Fred Ellis	History and Heritage Chairman
Paul J. Wilbur	Director
Gerald D. Mordhorst	Director
Walter A. Clark	Director
James A. Hobson	Director

The Brochure	Edited and compiled by Fred Ellis and Martin R. Frick
The Cover	Photograph courtesy of L. P. Schrenk, Minneapolis, Minnesota
References	Abbot, Morris W., "The Pike's Peak Cog Railroad," Golden West Books, 1972

NATIONAL HISTORIC MECHANICAL ENGINEERING LANDMARK PROGRAM

In September 1971 the ASME Council reactivated the Society's History and Heritage program with the formation of a National History and Heritage Committee. The overall objective of the Committee is to promote a general awareness of our technological heritage among both engineers and the general public. A charge given the Committee is to gather data on all works and artifacts with a mechanical engineering connection which are historically significant to the profession. An ambitious goal, and one achieved largely through the volunteer efforts of the Section History and Heritage Committees and interested ASME members.

Accordingly, two major programs are carried out by the Sections under the direction of the National Committee: (1) a listing of industrial operations and related mechanical engineering artifacts in local Historic Engineering Records; and (2) a National Historic Mechanical Engineering Landmark program. The former is a record of detailed studies of sites in each local area; the latter is a demarcation of local sites which are of national significance -- people or events which have contributed to the general development of mankind.

In addition, the Society cooperates with the Smithsonian Institution on a joint project which provides contributions of historical material to the U.S. National Museum of History and Technology in Washington, D. C. The Institution's permanent exhibition of mechanical engineering memorabilia is under the direction of a curator, who also serves as an ex-officio member of the ASME National History and Heritage Committee.

The Pike's Peak Cog Railway is the fourteenth landmark to be designated since the program began in 1973. The others are:

Ferries and Cliff House Cable Railway Power House, San Francisco, CA - 1973
Leavitt Pumping Engine, Chestnut Hill Pumping Station, Brookline, MA - 1973
A. B. Wood Low-Head High-Volume Screw Pump, New Orleans, LA - 1974
Portsmouth-Kittery Naval Shipbuilding Activity, Portsmouth, NH - 1975
102-inch Boyden Hydraulic Turbines, Cohoes, NY - 1975
5000 KW Vertical Curtis Steam Turbine-Generator, Schenectady, NY - 1975
Saugus Iron Works, Saugus, MA - 1975
Pioneer Oil Refinery, Newhall, CA - 1975
Chesapeake & Delaware Canal, Scoop Wheel and Engines, Chesapeake City, MD - 1975
U.S.S. Texas, Reciprocating Steam Engines, Houston, TX - 1975
Childs-Irving Hydro Plant, Irving, AZ - 1976
Hanford B-Nuclear Reactor, Hanford, WA - 1976
First Air Conditioning, Magma Copper Mine, Superior, AZ - 1976

THE PIKE'S PEAK COG RAILROAD

The Manitou and Pike's Peak Railway, the Cog Road, is the highest railway in the United States and the highest cog railroad in the world. It has been in continuous (seasonal) operation since 1891. Over three million passengers have thrilled to the unsurpassed views en route to, and at the summit of, Pike's Peak. This has been accomplished without a single passenger casualty.

The Peak

Colorado's most famous mountain was first seen by the Spanish in the early 1700's. With the Louisiana Purchase in 1803, the United States doubled her territory, and with this expansion came traders, prospectors and the U.S. Army. Among the collection of pioneers was Lt. Zebulon Montgomery Pike, who first saw "The Peak" in 1806. In July of that year Lt. Pike and 26 men left St. Louis on "an official journey of discovery." Actually they were looking for the source of the Arkansas River -- the boundary between the newly acquired Louisiana and Spanish Territory, a boundary whose path had not yet been surveyed.

By mid-November they saw the Peak and attempted to reach the top. Though Pike never did make it to the summit, he was the first American to describe it. Believing it to be at least 18,000 feet high, he called it "The Great Peak" on his maps. His estimate was about 4,500 feet in error. And that was not his only mistake -- he also wandered into Spanish Territory, was arrested and sent off to Santa Fe.

The rest of his military career was more successful. By 1813 he had risen to Brigadier General and was deeply immersed in the War of 1812.

an elevation of 6,571 feet at the station in Manitou Springs -- a suburb of Colorado Springs -- to 14,110 feet at the summit of the Peak. The average grade is 16.23 per cent and the steepest is 25 per cent. The road is standard gauge and utilizes the Abt system of rack and pinion, invented by Dr. Roman Abt of Lucerne, Switzerland.

<u>Roman Abt</u>

Born in Switzerland on July 16, 1850, Abt studied mechanical engineering at the Swiss Federal Institute of Technology in Zurich. He was first employed in 1872 by the Swiss Central Railway, where he worked under Klaus Riggenbach, the inventor of the Riggenbach rack and cog system for mountain railways. In 1875 they both joined the International Company for Mountain Railways in Aarau, Switzerland, where they worked together until 1879.

After two years with the Swiss Railway and four years with an engineering firm in Paris, Abt started his own business in Lucerne. In 1882 he took out the patent on his new invention -- a rack and cog system which uses two or three rack rails arranged parallel, with the teeth staggered. The system was soon applied to numerous new mountain railways, not only in Switzerland but throughout the world. By 1923 a total of 300 miles of such lines were built. Abt also designed and built the first useful switches for cog railways, and it was his idea to construct railway lines with a combination of adhesion and rack (cog) sections.

He served on the Board of Directors of many Swiss companies, and was also Chairman of the Board of the Swiss Locomotive Works, Winterthur, Switzerland -- today the manufacturer of the new diesel-hydraulic units for the Manitou and Pike's Peak Railway. He died on May 1, 1933.

The Labor

Work was begun at the top on September 25, 1889 in order to get the upper end finished before winter. Quoting from The Pike's Peak Cog Road:

"The difficulties and problems of work and supply were many and troublesome...all supplies and equipment had to be brought up by pack train. The labor turnover was high, as the lack of oxygen at the higher levels made work difficult and unattractive...men who stayed two or three weeks were thereafter able to do a good job without much discomfort. [Thus] it seemed there were always three gangs -- one leaving, one working, one coming.

"Work was nearly all done with pick, shovel and wheel barrow. A time book of construction days found years later showed that top wages were 25 cents and common labor 18 cents an hour.

"There were at least five labor camps along the route. In December, 1889 two newspapermen...went to within a mile of the summit and described Camp No. 5 as having accomodations for 200 men: three bunk houses each 50 x 16 feet, a cook house 90 x 30 feet, all built of logs up four feet from the ground and canvas above that. Ordinary tents had proven too flimsy and cold.

"Most of the laborers were foreigners...breakfast was at 5:00 A.M., supper at 6:00 P.M. The pay was, according to these reporters, $2 per day for week days, $2.50 for Sundays, board and lodging $4.50 per week."

The Railway

The chief engineer during construction of the Railway was Roswell E. Briggs, formerly chief engineer of the Denver & Rio Grande. The engineer actually on the job was Thomas F. Richardson, C.E. Representing hewn red spruce ties nine feet long by seven by eight inches -- as opposed to steel ties used abroad. To maintain the correct relative height of the T-rails and rack rails, an ordinary jointer-planer was used to plane each tie where the chairs were to be located, at a cost of nine cents per tie."

The Locomotives

The three original steam engines were ordered from the Baldwin Locomotive Works (cover photo and Figure 1). Each of these weighed 26 tons, with coal and water. The bearing frames were so inclined that the boiler tubes were level when they stood on a 16 per cent grade (the average of the road). Water was carried in two tanks, one on either side of the boiler, and a bunker at the rear of the cab held a ton of coal. Each engine had three axles. The two forward ones were rigidly fastened to the frame, and the rear one was furnished with a radius bar. An inside frame fastened to the forward axles carried three double pinions, or cog wheels, made of hammered crucible steel with a tensile strength of 100,000 pounds per square inch with the teeth cut from the solid disc. The cylinders were 17 inches by 20 inches (bore and stroke) and their power was transmitted to a main drum whose teeth drove the two rear cog wheels; the forward cog wheel was connected to the next one by side rods.

These engines were designed to push two cars weighing 21 tons up a grade of 25 percent at three miles per hour, and to maintain a speed of eight miles per hour on the lightest grades. But they were unable to do so. They also developed other problems, including frequent breakage of the inside frame. Again quoting from The Pike's Peak Cog Road:

"The Baldwin Locomotive Works had sent an expert out with the original engines to get them running smoothly -- a man who had experience on the

Corcovado road at Rio de Janeiro, which had a 33 percent grade. He did not succeed...and even a second engineer had to wire Philadelphia for help. Vauclain himself was sent out, being then plant superintendent. He found the three engines all out of service and with parts missing or broken. His account of what ensued proves that he knew his locomotives and that he did not suffer from an excess of modesty.

"Omitting his description of what the Cog Road 'superintendent of motive power' (whoever that was) said and did, and in what words Vauclain told-him-a-thing-or-two, one is expected to believe that nobody there knew even the rudiments of running a steam locomotive.

"Vauclain wrote that they had removed the injector from the locomotive and thrown it down the bank. After it was re-installed, he found by trying the gauge cocks that the boiler was so full that the water nearly ran out of the whistle. After getting the water level down to normal, he was able to get one engine to work and took it out on the line. Then he got the other two to operate and hired new crews."

Requiring an additional locomotive, the company ordered a fourth from Baldwin in 1893. Number 4 was a Vauclain compound (the first three were simple), and measured 9" x 15" x 22". The inside frame and the main drum were eliminated, and power was delivered directly by means of rocking beams and cranks to two (instead of three) cogs which were fastened to the axles of the bearing wheels. This locomotive was a decided improvement and decreased the running time as well as the coal consumption.

The braking system utilized the cylinders of the engine to compress air while descending the mountain, with the valve gear reversed. In addition, the engine had a steam brake, controlled by the engineer, which worked on corrugated collars on the rear pinions. This locomotive was so superior to the previous three that the older engines were sent back to the factory for redesign (Figure 2). In 1901, locomotive No. 5 was added and was of the same design as No. 4 (Figure 3). Number 6, ordered from Baldwin in 1906, was an oil burner, Vauclain Compound 10" x 15" x 24". After one year it was converted to coal because the service was unsatisfactory.

Modernization

In 1925, through the initiative of Spencer Penrose of the Broadmoor Hotel, the ownership of the Cog Railway passed from the Simmons family to that of the Pike's Peak Auto Highway Company. With the new management came a new era and a complete modernization of the Company's fleet of motive power.

In 1936 a "Streamliner" was built by the railway's own workshop. This was a 24-passenger railcar, powered by a 175 hp General Motors gasoline engine. The motive power was later changed to a Cadillac V-8 engine.

Based on the experience with this first internal combustion engine-driven railcar, it was decided to gradually replace the steam locomotives with diesel-electric trains (Figures 4 and 5). Thus, in 1939 the first diesel-electric locomotive, built by the General Electric Company and powered by three General Motors Model 6-71 engines was put in operation. Four more diesel-electric locomotives followed over the years until 1956. These, however, were powered by two diesel-engines each. As with the steam trains, the diesel-electric locomotives were not coupled to the passenger coaches, but pushed them. Three types of brakes were provided: electro-dynamic; air; and hand. The first of these systems provides all the braking effect required on the down trip and is obtained by positioning the drum controller to connect with sections of a braking rheostat. The engines are shut down for the downhill trip.

A further step in the modernization of the equipment and an increase in passenger capacity was made, when in 1963 the cog railway obtained delivery of two diesel-electric railcars made by the Swiss Locomotive and Machine Works of Winterthur, Switzerland (Figures 6 and 7). These self-propelled units, each carrying 76 passengers, are powered by two 250 hp Cummins diesel engines. Two more railcars of the same design were ordered and delivered in 1968.

Increasing business in the early 1970's led the company to decide on the purchase from the Swiss Locomotive Works of two twin-unit diesel-hydraulic trains, with a seating capacity of 206 passengers each. The power of the four 300 hp Cummins diesel engines is transmitted through twin disc torque converters, gear boxes and universal shafts to the driving cog wheels. These units, delivered and put in operation for the 1976 season, represent the latest design of a diesel unit for a cog railway. As with the single unit railcars, the twin-unit trains are equipped with dynamic brakes, used on the downhill run to control the speed, and two mechanical brake systems (band brakes). One of these is further controlled by safety devices such as deadman's control, overspeed governor, alertness control and power failure, making the trains the safest equipment possible for a cog railway.

Today

Whereas in the past, two or three trips were made daily with as many as seven sections (units) per trip, in 1976 the season will have a new "continuous" schedule. Trains will leave every 80 minutes, from 8:00 A.M. until 5:20 P.M. Thus ascending and descending trains will pass each other at two points -- Minnehaha and Windy Point -- where new switches and passing tracks were installed during the 1975 season. In order to speed up the switching of trains at the Manitou Depot, two new switches, remote-controlled from the Dispatcher's office at the Depot, were installed. The railroad presently operates on a daily schedule from May 1 until late October.

In the 85 years of operation, the Pike's Peak Cog Railway changed from 50-passenger trains, operated by a crew of four men, to diesel trains of 206 passengers, run by a three-man crew. Today the total seating capacity of all the diesel units is 716, compared to 150 seats of the first three steam trains in 1891.

Figure 1: Steam Train at Timber Line

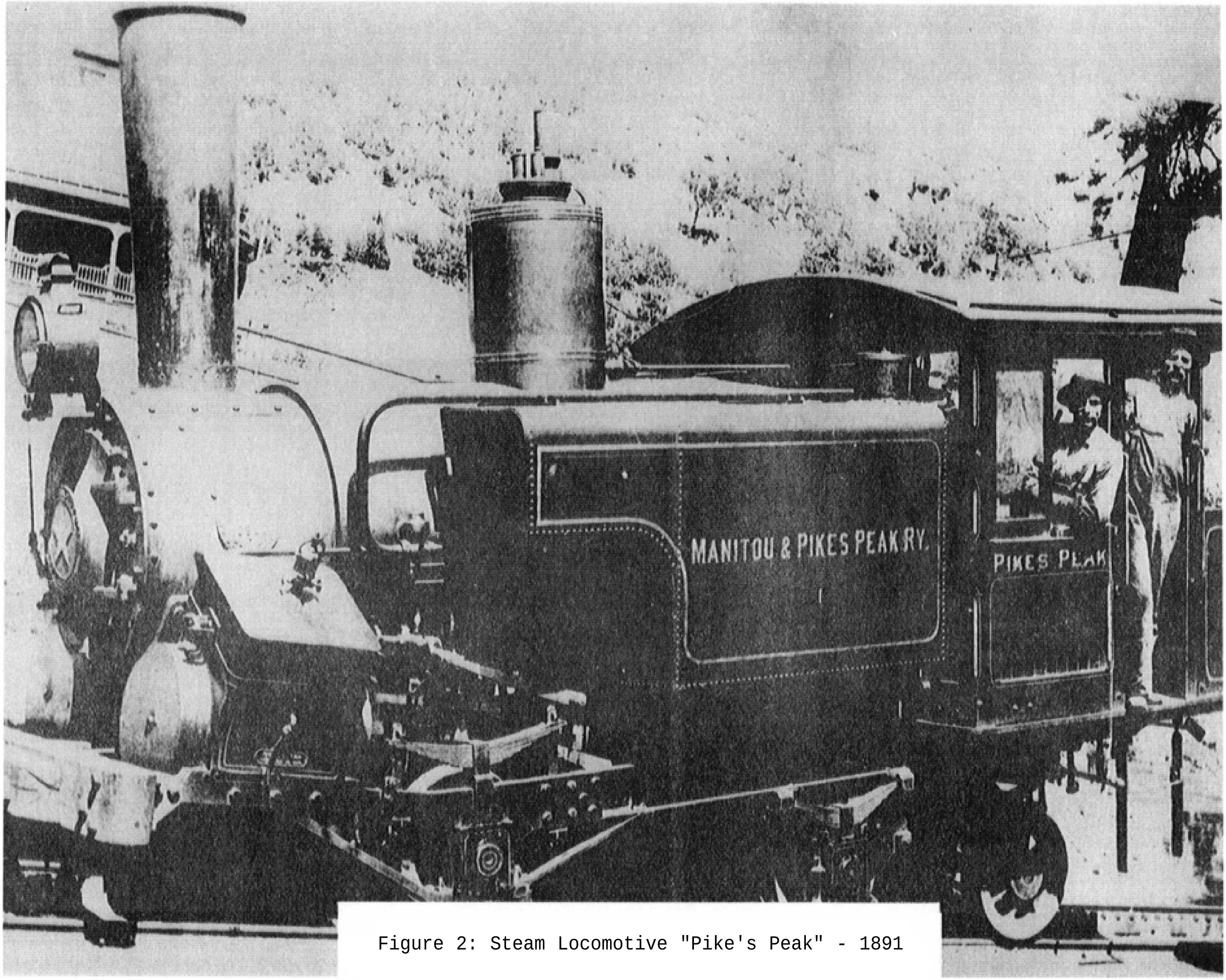


Figure 2: Steam Locomotive "Pike's Peak" - 1891

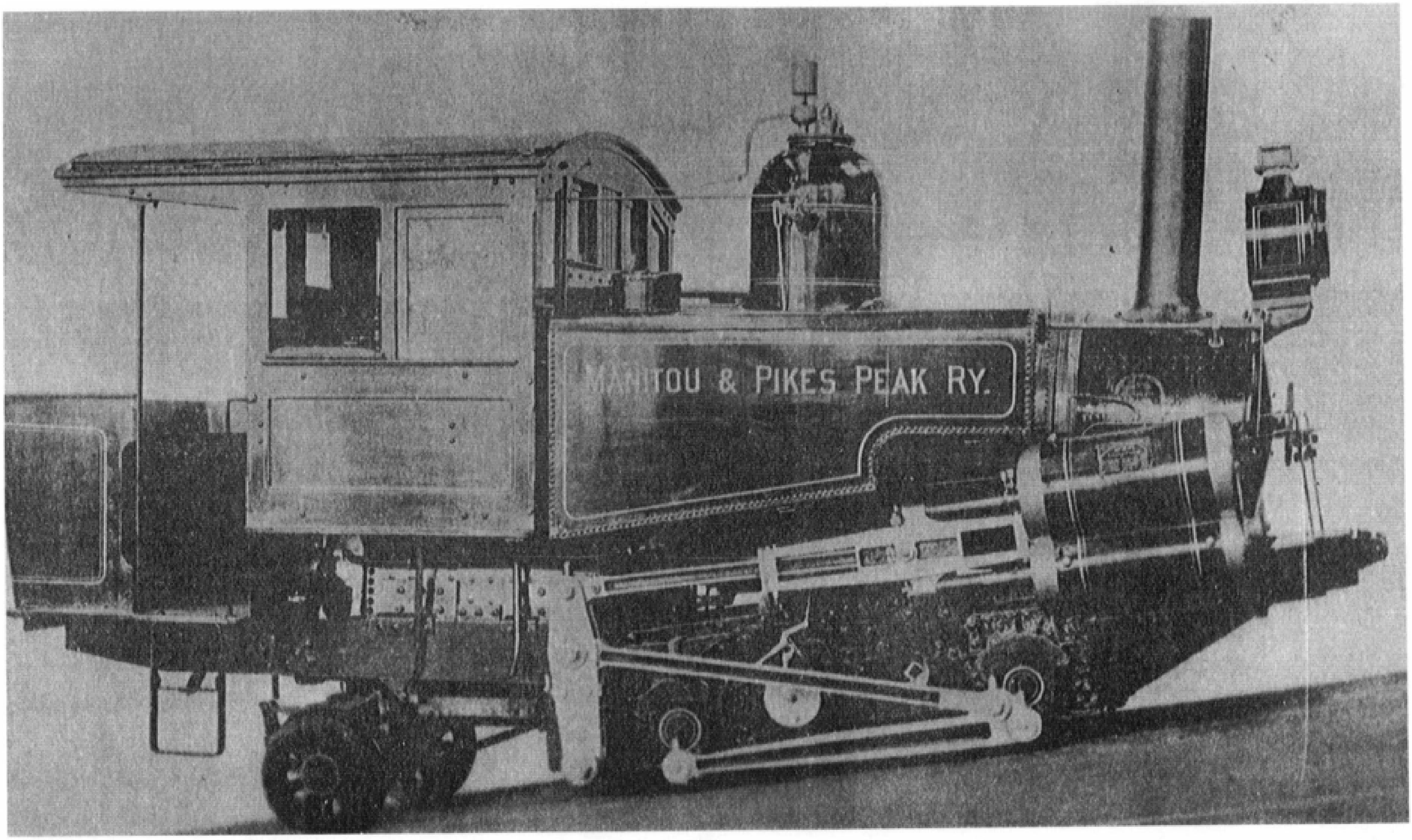


Figure 3: Rebuilt Steam Engine - 1896

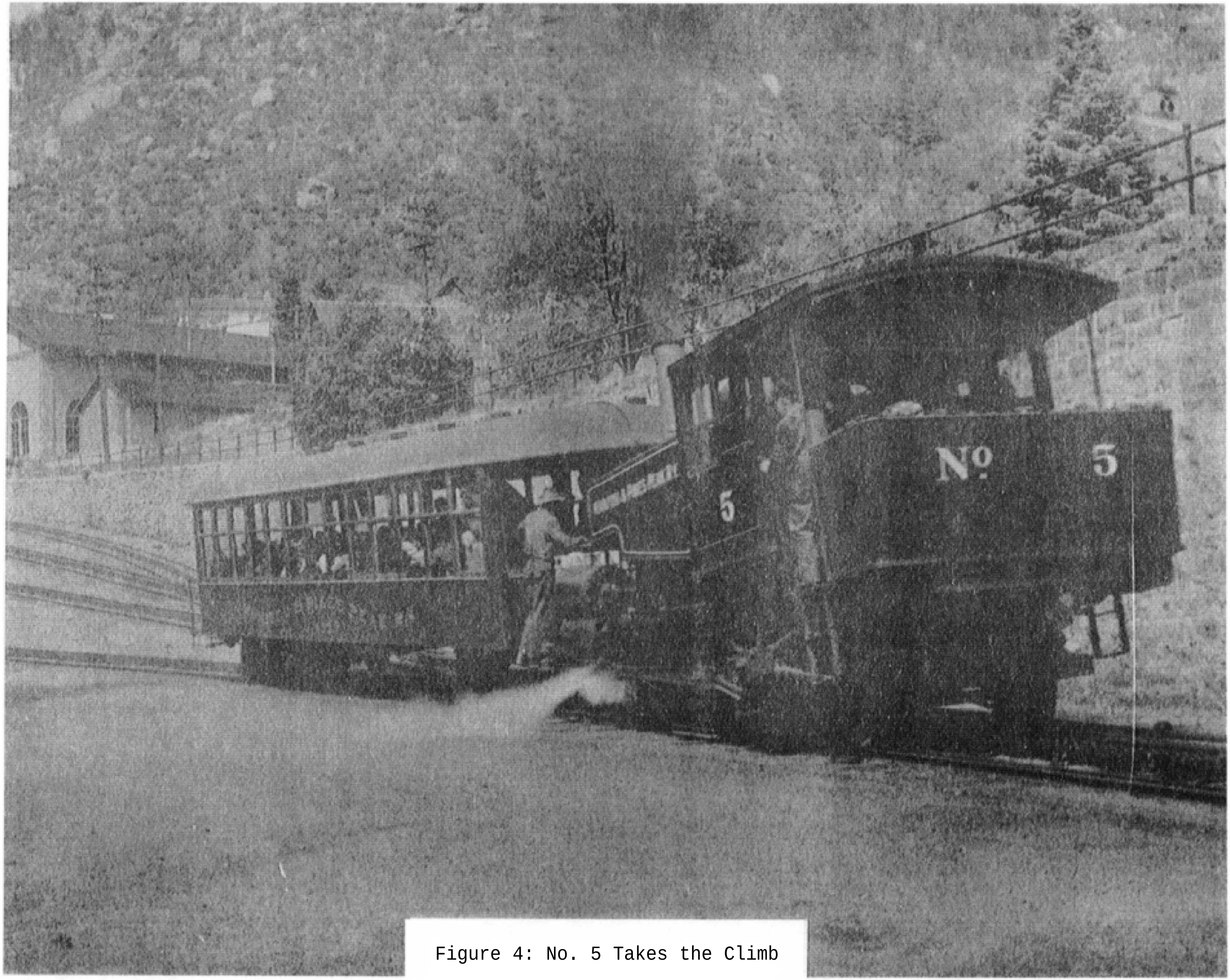


Figure 4: No. 5 Takes the Climb

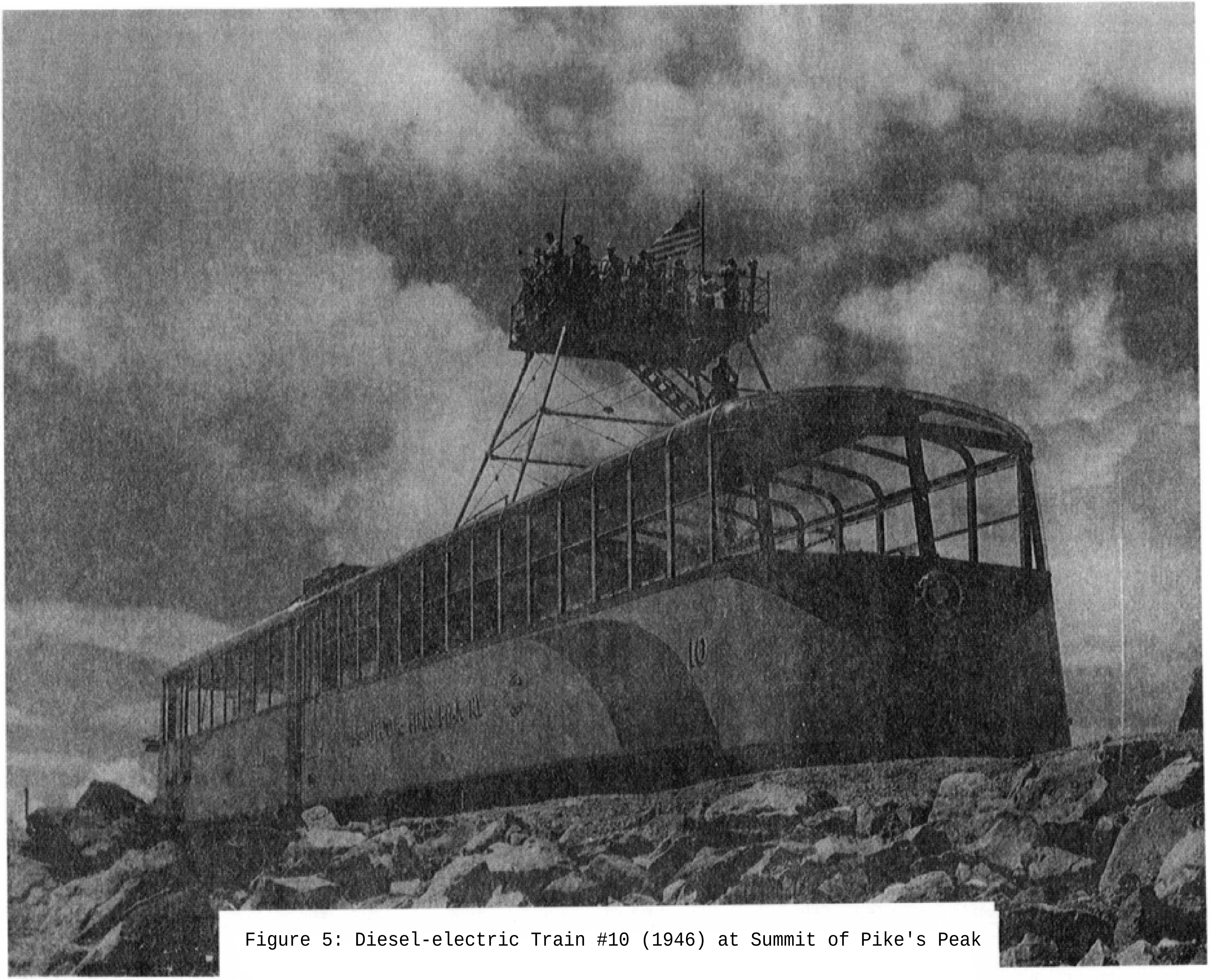
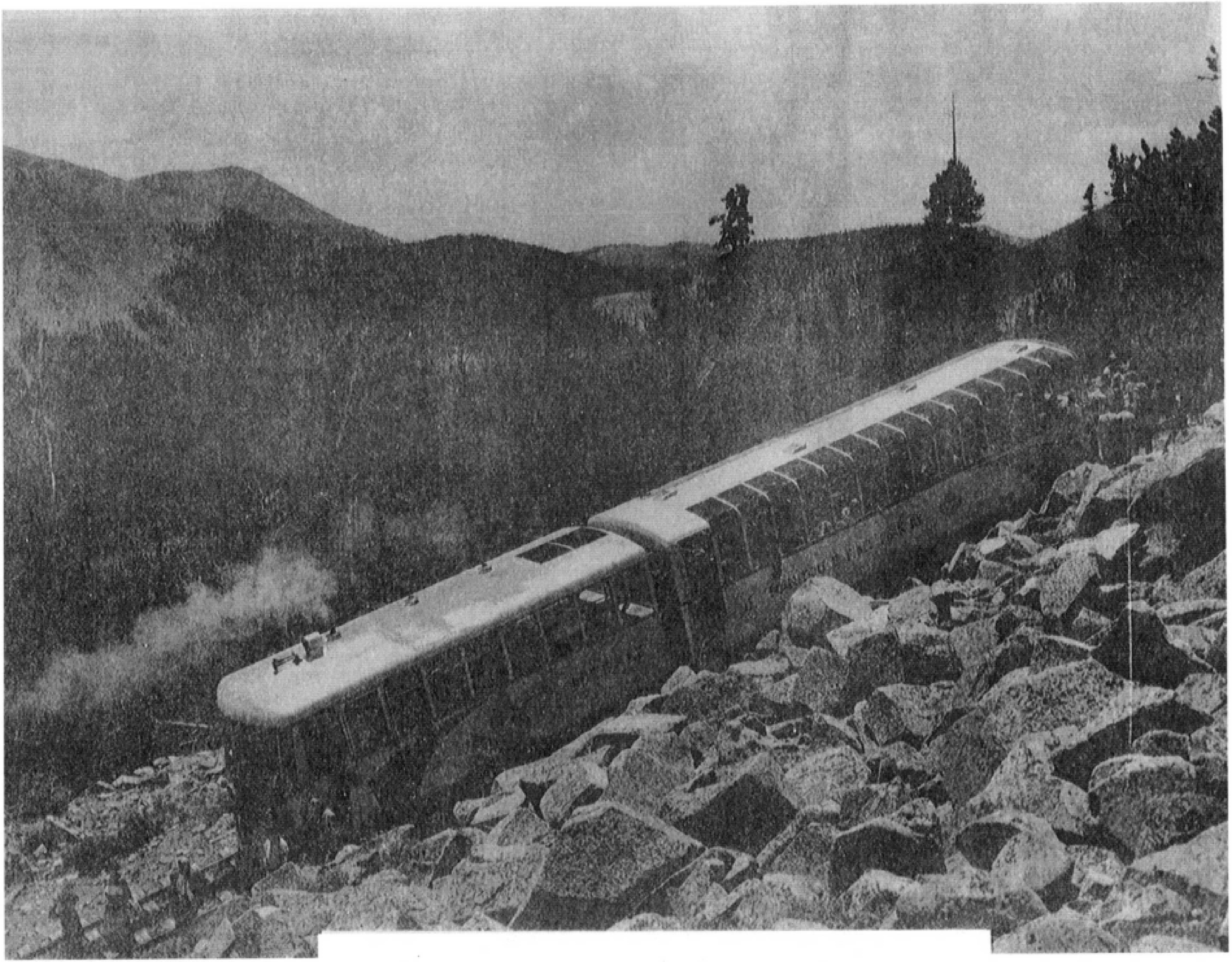


Figure 5: Diesel-electric Train #10 (1946) at Summit of Pike's Peak



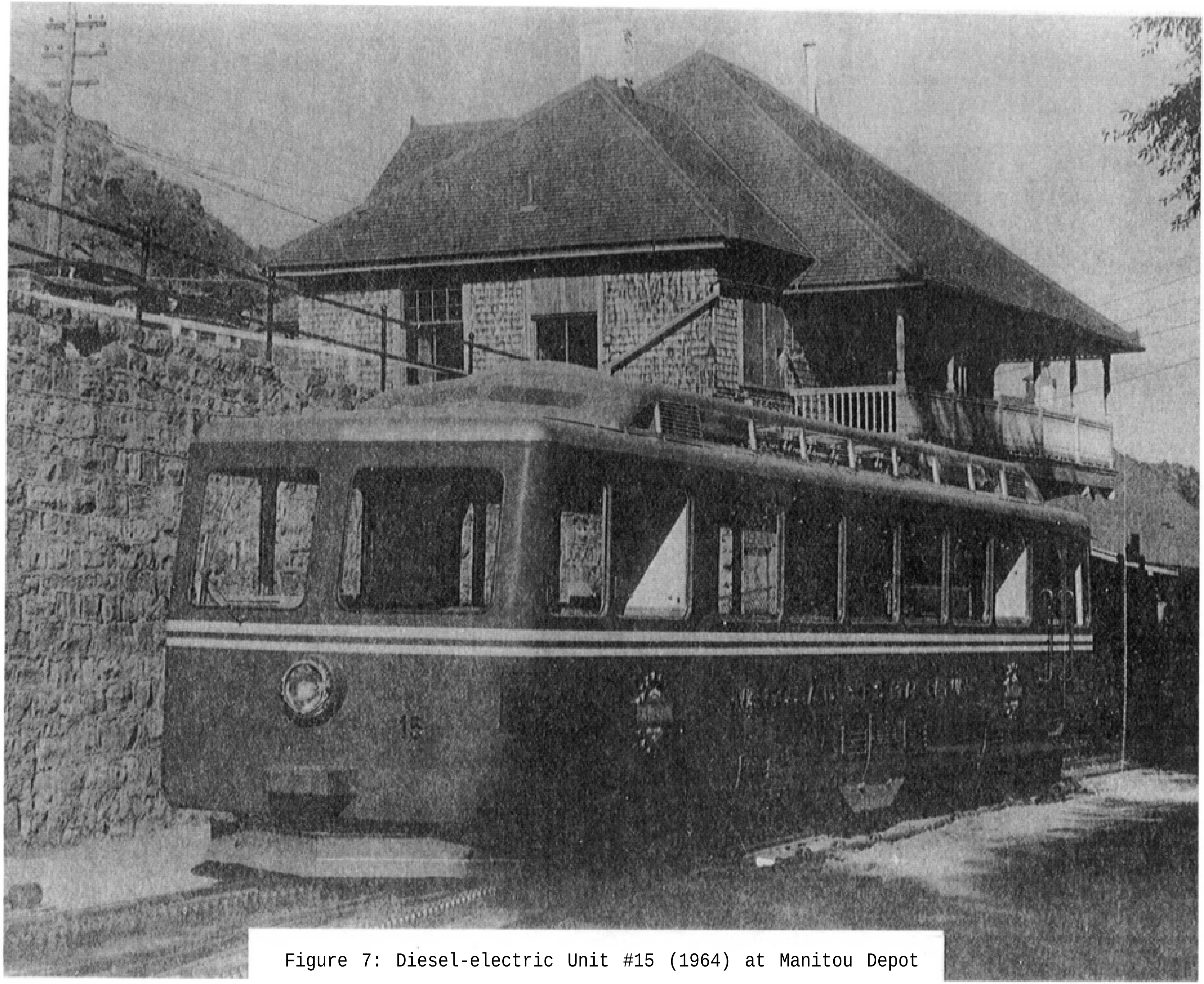


Figure 7: Diesel-electric Unit #15 (1964) at Manitou Depot

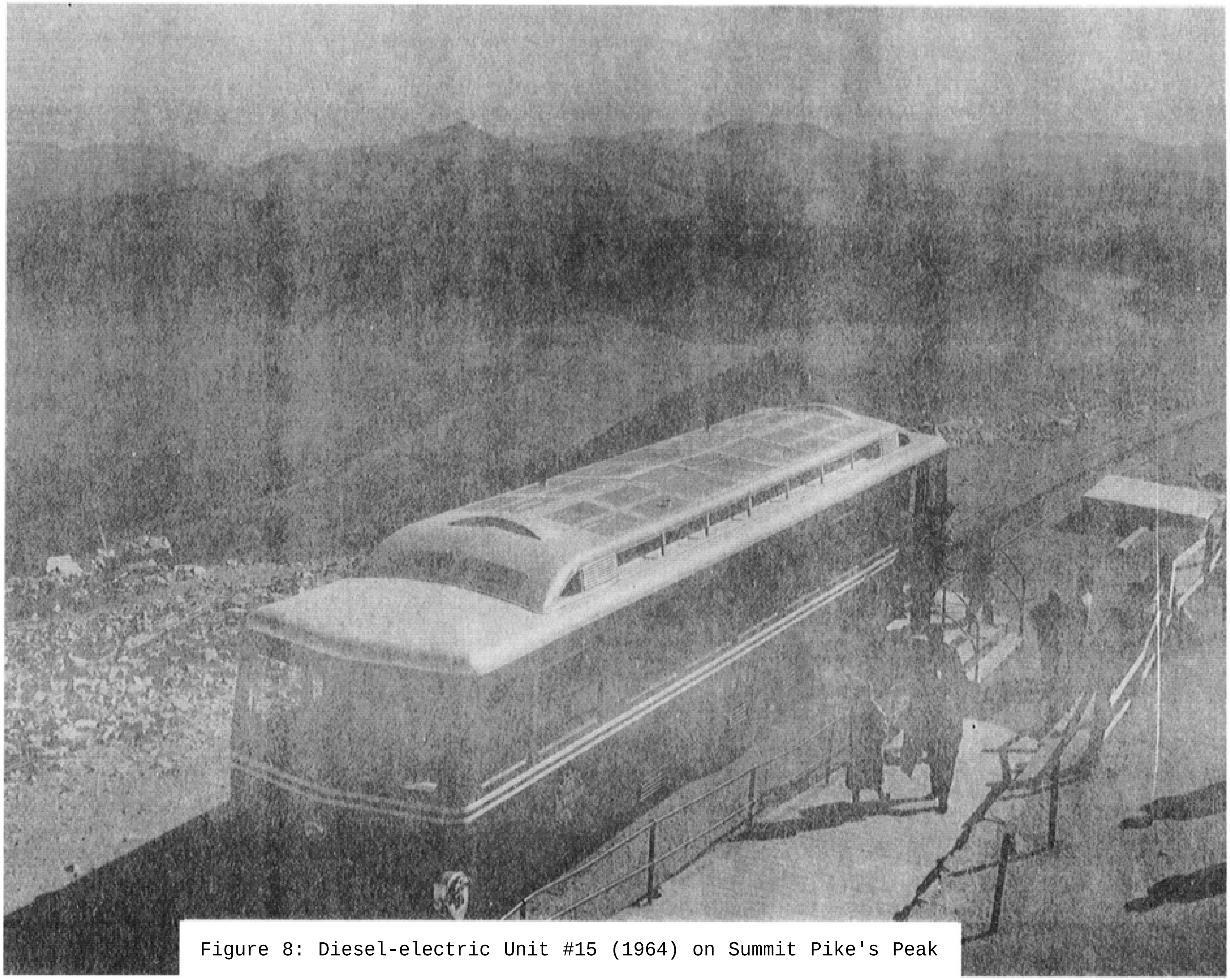


Figure 8: Diesel-electric Unit #15 (1964) on Summit Pike's Peak