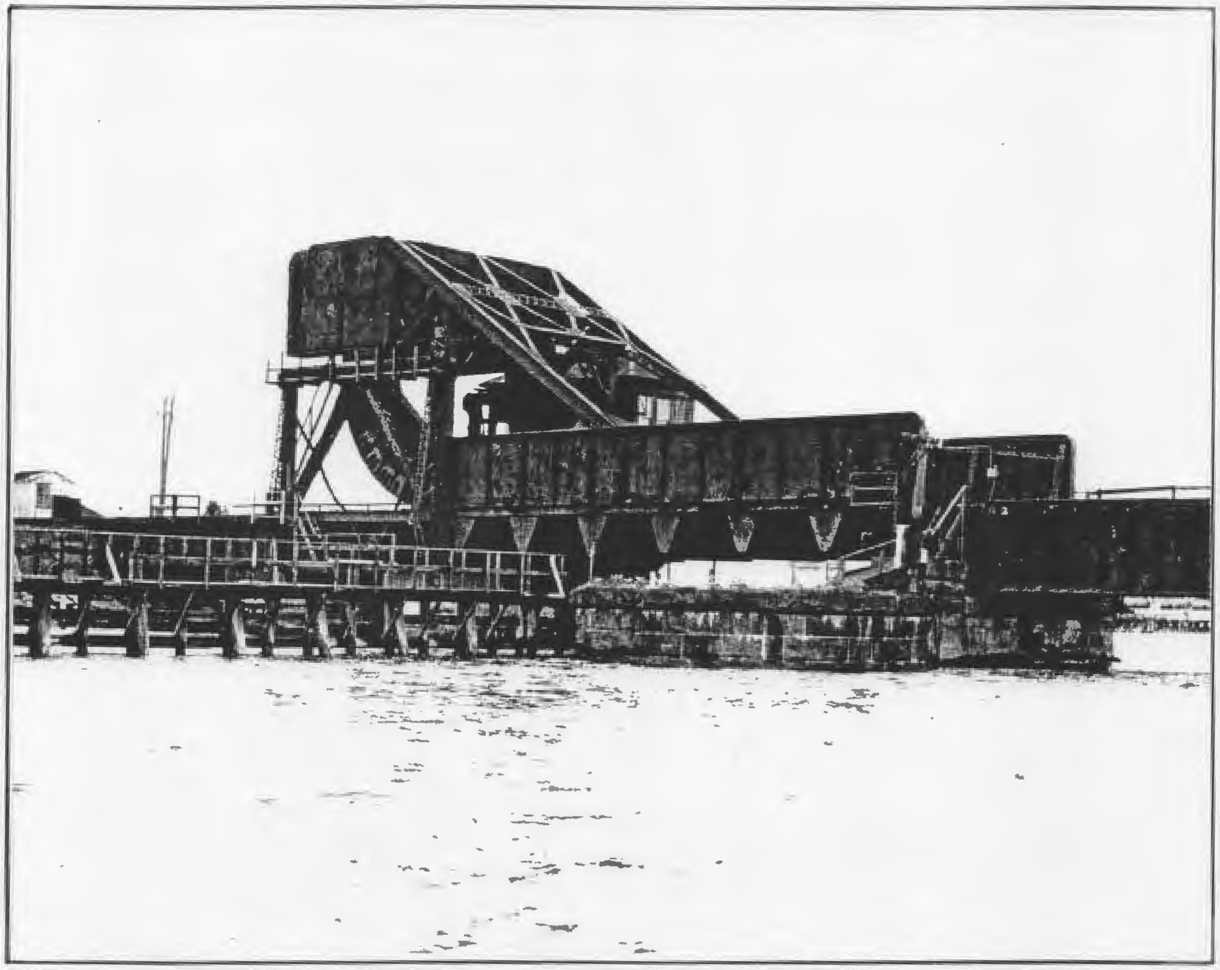
Historical Documentation

Niantic River Bridge

East Lyme, Connecticut

FRA Contract #DTFR53-98-D-00004
MHA Project #1213A



Federal Railroad Administration
Northeast Corridor Improvement Project

Parsons Transportation Group
Engineers and Planners

McGinley Hart & Associates LLP
Architects and Planners

August 2000

Description

The Niantic River Bridge is a chain-driven, through-girder Scherzer rolling-lift bascule bridge designed by the Scherzer Rolling Lift Bridge Company of Chicago for the New York, New Haven & Hartford Railroad Company. The bridge carries the former Shore Line, now part of Amtrak's Northeast Corridor, over the mouth of the Niantic River between East Lyme and Waterford, Connecticut. The bridge spans a narrow point in the river, at a barrier beach known as "The Bar," on Long Island Sound about 5 miles west of New London.

The bridge is 294' long and comprises five spans resting on stone masonry piers and abutments. From west to east, the spans are as follows: a 48'-3" deck plate girder span, a 26'-0" deck plate girder span, a 68'-0" through-girder movable span (the bascule leaf), a 67'-4" deck plate girder span, and a 74'-8" deck plate girder span. The movable span is an electrically-powered, chain-driven, through-girder Scherzer rolling-lift bascule bridge which consists of a pair of riveted plate girders with a curved "heel" on their west ends, above which is located an iron and concrete counterweight. The 26'-0" fixed deck plate girder span immediately west of the heel supports the lugged tread plates upon which the bascule rolls, as well as the framework for the chain drive. Fixed frames are located on either outboard side of the bascule leaf and run longitudinally. These fixed frames support the upper corners of the drive chains on idler sprockets.

The movable span closely follows the basic rolling-lift design patented by William Scherzer on December 26, 1893, but features a mechanical variation, in that it is the only chain-driven version out of seven Scherzer bascule bridges on the Northeast Corridor. This span consists of the bascule leaf with a fixed frame on either side and an overhead counterweight. The fixed frames are located just outboard of the bascule and run longitudinally. Each frame is comprised of two vertical members, one horizontal member connecting the upper ends of the verticals and two diagonal struts to provide rigidity. These fixed frames support the upper corners of the drive chains on idler sprockets. The drive chains allow the motor and gears to be located below the tracks, rather than in the more common overhead position with the counterweight. This configuration is unique among the seven Scherzer bridges built for the New York, New Haven & Hartford Railroad, and was presumably installed as a practical solution which allowed for easier maintenance and repairs, as well as for protection from weather and vibration. Another chain-driven Scherzer rolling-lift bridge may have been built for the Canadian National Railroad, but this information has not been confirmed.

The electric motor, which is located below track level, delivers its power to the drive chains via a series of reduction gears and associated shafting. Seen from either side of the structure, the drive chains are arranged in an inverted triangle, the lowest vertex being the drive sprocket and the upper two vertices being the idler sprockets. The ends of each chain are anchored to a common pivot pin, creating an endless loop. This pivot pin is located at the geometric center of the rolling segment girder of the bascule span. Rotation of the drive sprockets allows the chain to draw the pivot pin horizontally to open or close the bascule. As the bascule operates, the segment girder rolls along a lugged tread plate on the track girder of the fixed span. Engagement of these lugs with slots on the exterior curve of the segment girder maintains proper alignment and prevents sliding of the bascule as it traverses its track. The leaf can also be raised and lowered manually using a capstan.

Operations of the movable span and signals protecting the bridge approaches are controlled from the wooden operator's house, located on the south side of the rolling-lift span. The 26' x 12' wood-frame operator's house retains its original massing and form, but many of the original architectural details have been removed or replaced. Some of the original windows were removed prior to 1978, and the door, windows, exterior stairs, siding and roofing were replaced when the building was renovated in 1983. The building is supported on a platform with steel outriggers fastened to stone piers on the north side of the west end of the bascule. Inside the operator's house, some of the original finishes remain, including built-in storage cabinets, bead-board ceiling and walls, and various conduits, pipes and cables; however, much of the original operating equipment has been removed, including the Armstrong levers which mechanically controlled the rail locks and dwarf signals. A track model board is used for backup control of the switches and signals and a trolley-type drum control console is used to operate the bridge motor.

In 1999 an electric traction power-distribution system was installed as part of the Northeast Corridor Electrification Project between New Haven and Boston. Amtrak trains utilize a pantograph to draw electric power from an energized overhead contact wire system, called the catenary. As part of the construction of this system, retractable catenary sections were designed and installed on all movable bridges along the route. At the Niantic River Bridge, the main catenary terminates at a lattice steel portal, or "anchor bridge," at the west abutment and the third masonry pier. The west approach span and the adjacent bascule span are energized by a telescoping frame that rides on top of rails set outside and parallel to the girders of the fixed span. When the bridge opens, the telescoping frame withdraws the conductor beam structure from the movable span, thereby allowing the counterweight to descend and the bascule leaf to rise without interfering with the energized catenary.

Scherzer Rolling-Lift Bridges

Movable spans are required where bridges that cross navigable streams cannot economically be built high enough to provide proper clearance for marine shipping. The most popular types of movable bridges are: swing bridges which pivot on a central pier; lift bridges which remain horizontal as they are raised and lowered between a pair of towers; and bascule bridges which are raised or lowered at one end. In spite of its name, the Scherzer rolling-lift is actually a variation of the bascule type of movable bridge.

The term *bascule* comes from the French word for "*see-saw*," as the principle of counter-balance is fundamental to its design. Precedents of modern bascule bridges were developed in medieval Europe as manually operated drawbridges over castle moats, but neither the modern bascule nor the lift bridge could be developed until 1890 when a satisfactory method of counterbalancing the weight of the span had been found and the electric motor lifting technology refined. "*The real progenitor of the genre appeared in 1893 with the construction of Chicago's Van Buren Street Bridge, a rolling bascule, and in London's Tower Bridge, a roller-bearing trunnion bascule.*"[1]

The Van Buren Street Bridge was the first "rolling-lift" bridge, invented by William Scherzer (1858-1893), a native of Illinois who studied civil engineering in Zurich Switzerland. In 1893, after 3 years of designing bridges for the Pittsburgh, Fort Wayne & Chicago Railway Company, and 7 years with the Keystone Bridge Company, Scherzer opened his own consulting firm and designed the first Scherzer rolling-lift bridge for the Metropolitan West Side Elevated Railroad Company in Chicago. Shortly before his death that same year, Scherzer filed a patent application for his bridge design, which he described as, "*A lift-bridge having a movable span provided at one end with a curved part adapted to rest and roll upon a stationary supporting surface.*"[2] Although Scherzer never lived to see his patent granted (in December 1893), his brother Albert continued his work by obtaining a number of additional patents for the rolling-lift design, and organizing the Scherzer Rolling Lift Bridge Company in Chicago.[3] For nearly four decades, the Scherzer Company designed and supervised the construction of rolling-lift bridges throughout the country. Civil Engineer Otis Hovey's 1926 treatise on movable bridges states that the Scherzer rolling-lift design was "*vigorously advocated and widely used in the United States and, in several cases, in other countries. The type is attractive on account of its simplicity and the small power required for operation.*"[4] In 1936, Albert Scherzer's widow sold the firm to the company's manager, Craig Hazelet and chief engineer, Ingolf Erdal, who continued the business as Hazelet & Erdal. In 1995, Hazelet & Erdal was purchased by Dames & Moore, an engineering firm which merged with URS Corporation in 1999. The Chicago division of URS continues to produce rolling-lift bridges for highways and railroads.[5]

History of Bridge and Site

The earliest record of a crossing at the mouth of the Niantic River dates from 1660, when John Winthrop of New London was authorized to operate a ferry across the river. The first roadway bridge to span at, or near, this site was a toll bridge built by the Niantic Bridge Company in 1796.[6] Almost a century later, the first railway bridge was constructed when the Shore Line Railway was built between New Haven and New London in 1852. In 1891, shortly after consolidation of this rail line into the New York, New Haven & Hartford Railroad system, this railway bridge was replaced with a swing bridge. The present rolling-lift bridge was built in

[1] Carl W. Condit, American Building Art, the Nineteenth Century (1960) p.187.
[2] William Scherzer, U.S. Patent No. 511,713, December 6, 1893.
[3] Between 1903 and 1921, A.H. Scherzer obtained 12 patents for various improvements to the rolling-lift design.
[4] Otis Ellis Hovey, Movable Bridges, vol. I (New York: John Wiley & Sons, Inc., 1926), p.101.
[5] Telephone conversation with John Schultz, URS Corporation structural engineer, July 2000.
[6] Matthew W. Roth, "An Historical Survey of the Niantic River [Highway] Bridge," 1981.

1907, when the New York, New Haven & Hartford Railroad was making substantial improvements throughout the system, in order to permit the use of heavier and faster trains.[7] Many of these improvements pertained to bridges, as indicated by the following statement, which appeared in Railroad Gazette in 1905:

> *When these changes are all completed, yards enlarged to relieve freight congestion, and bridges strengthened to carry heavy engines at high speeds,a 4 1/2-hour service from New York to Boston will be easily possible and much more economical methods of handling freight can be practiced. The limitations of freight train service on the line at present are not grades or lack of track room in the open but insufficient yards and weak bridges, and when these limitations are removed the desired economies can be accomplished.*[8]

Until the late nineteenth century, railroads were technologically limited to using rim-bearing swing spans at locations requiring movable bridges. When the electric motor was refined and efficient counterweights developed in the 1890s, many railroads began replacing swing spans with the more economical and efficient bascule and lift spans. The Scherzer rolling-lift bridge proved to be a particular favorite because of its simplicity of design and speed of operation. An advertisement published in a 1905 issue of Railroad Gazette stated, "*More than 60 center-pier swing bridges have already been superceded, discarded, scrapped and replaced by modern Scherzer rolling lift bridges for railroads, electric railways and highways.*"[9] Two years later, Engineering News published an article describing the benefits of bascule bridges:

> *The bascule type of movable bridge is more recent in its development, in spite of the great age of the type, than those carried by the rim and center bearing tables. It has many advantages for certain conditions and has already been brought to a high degree of excellence. It occupies much less space for its motion and is peculiarly adapted to a multiplicity of tracks. The ease and comparative economy with which the requisite machinery can now be manufactured and installed makes the construction and maintenance of this type of structure expeditious and economical.*[10]

The Niantic River Bridge was designed for its unique setting and circumstances. It was the last of nine Scherzer Bridges built by the railroad between 1901 and 1907, all of which replaced earlier swing spans. Considering the increased number of tracks, the time required to open and close the span, and the narrowness of the river channel, a Scherzer rolling-lift bascule span was a practical choice for this site. The bridge was designed in January 1907. In March of that year a local contractor, John Y. Higginson of Niantic, constructed the masonry piers. The bascule span was designed by the Scherzer Rolling Lift Bridge Company of Chicago and fabricated by

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[7] "Improvements on the New York, New Haven & Hartford," Railroad Gazette, March 17, 1905, p.245.

[8] Ibid., p.246.

[9] Railroad Gazette, March 17, 1905, p.153.

[10] "Movable Bridges," Engineering Record, April 6, 1907, p.428.

the King Bridge Company of Cleveland, Ohio. The latter company, a nineteenth century bridge fabricator best known for its manufacture of iron truss bridges, also advertised, "*Highway, Swing & Railroad Bridges, Iron Turntables & Machinery of All Kinds.*"[11]

Alterations

Since its construction, the Niantic River Bridge has undergone the following documented repairs:

- 1934-35 Piers repaired.
- 1948 Original hand-operated brake replaced with magnetic brakes.
- 1956 New tread plates installed on track and segmental girders.
- 1965 New motor pinion and split gear installed.
- 1978 Fixed span plate girders and bracing members strengthened.
- 1982-85 Masonry repairs to piers and abutments (substructure).
  Structural repairs and strengthening of the movable span.
  Repairs and modifications to the mechanical operating systems.
  Removal of Armstrong mechanisms and replacement of the signal system.
  Exterior/interior renovations to control house.
- 1998-99 Electric traction power-distribution system (catenary and support structures) installed as part of Northeast Corridor electrification.

The Niantic River Bridge is still operational but plans are being considered to replace the aging structure and upgrade the line to accommodate high-speed trains as part of Amtrak's Northeast Corridor Improvement Project.

Significance

The Niantic River Bridge is historically significant as an important link on the former New York, New Haven & Hartford Railroad Shore Line, which is presently part of Amtrak's Northeast Corridor. It is technologically of interest as the only chain-driven example among the seven Scherzer rolling-lift spans on the Northeast Corridor. The bridge was designed by the Scherzer Rolling Lift Bridge Company, following William Scherzer's 1893 patent for a bascule-type drawbridge that was widely adopted, and is still in use today, for both railway and highway spans. The Niantic River Bridge was documented for the Historic American Engineering Record collection (HAER No. CT-27) in 1983. It was determined eligible for listing on the National Register of Historic Places on December 6, 1977.

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[11] Victor C. Darnell, Directory of American Bridge Building Companies, 1840-1900, Occasional Publication No. 4 (Washington, DC: Society for Industrial Archeology, 1984).

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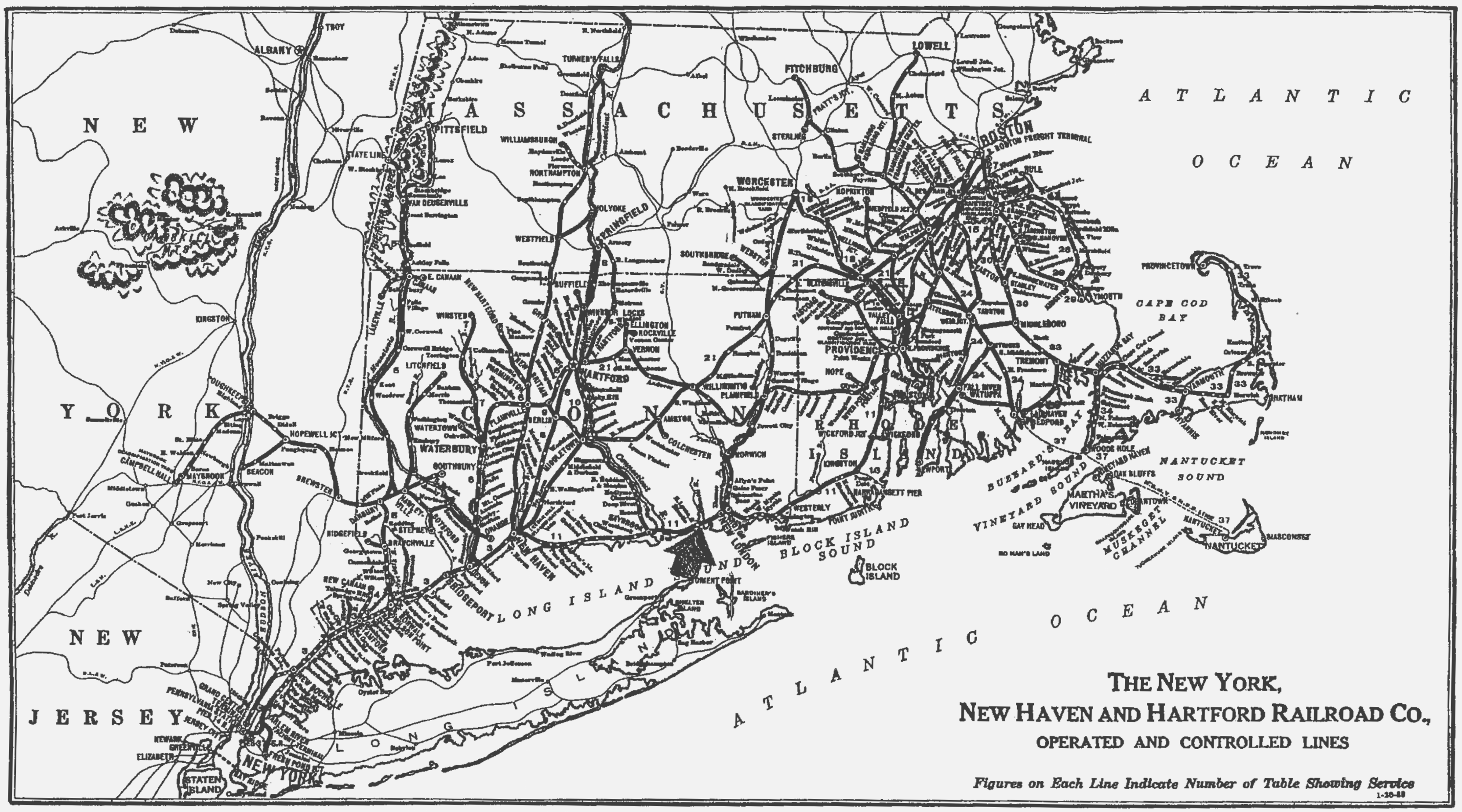
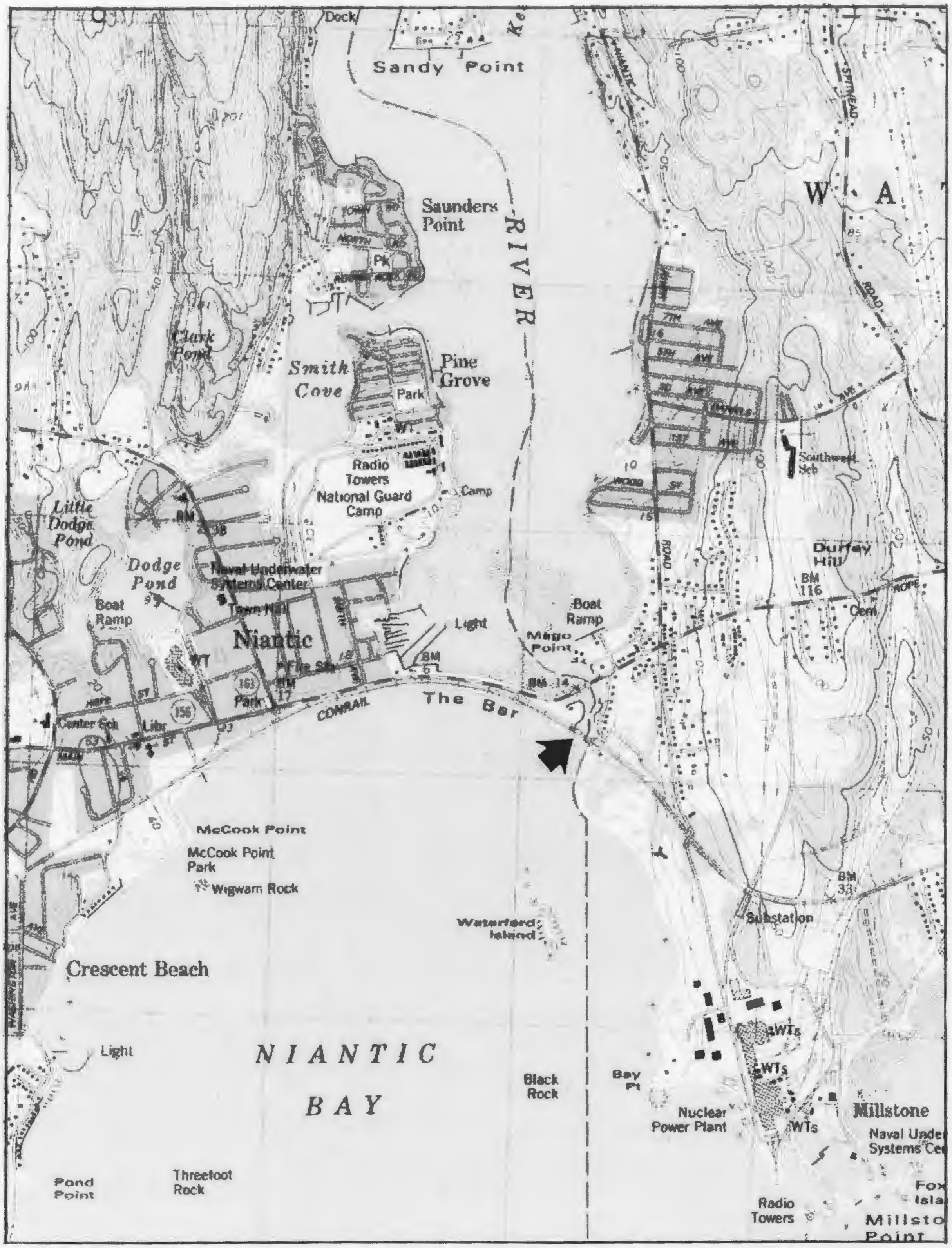


Schematic map showing location of Niantic River Bridge. [NYNH&HRR Timetable, 1939].



Topographical map showing location of Niantic River Bridge. [USGS, Niantic, CT Quad., 1983.]

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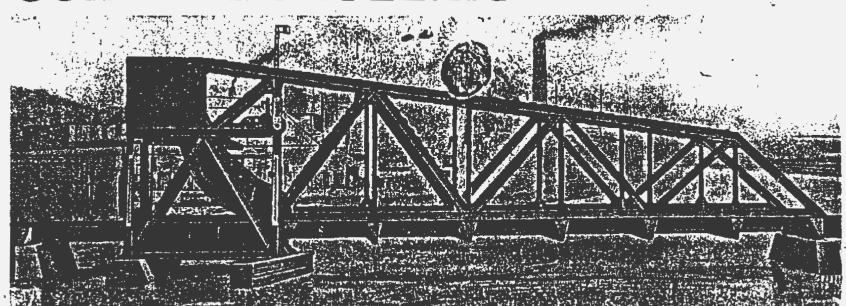

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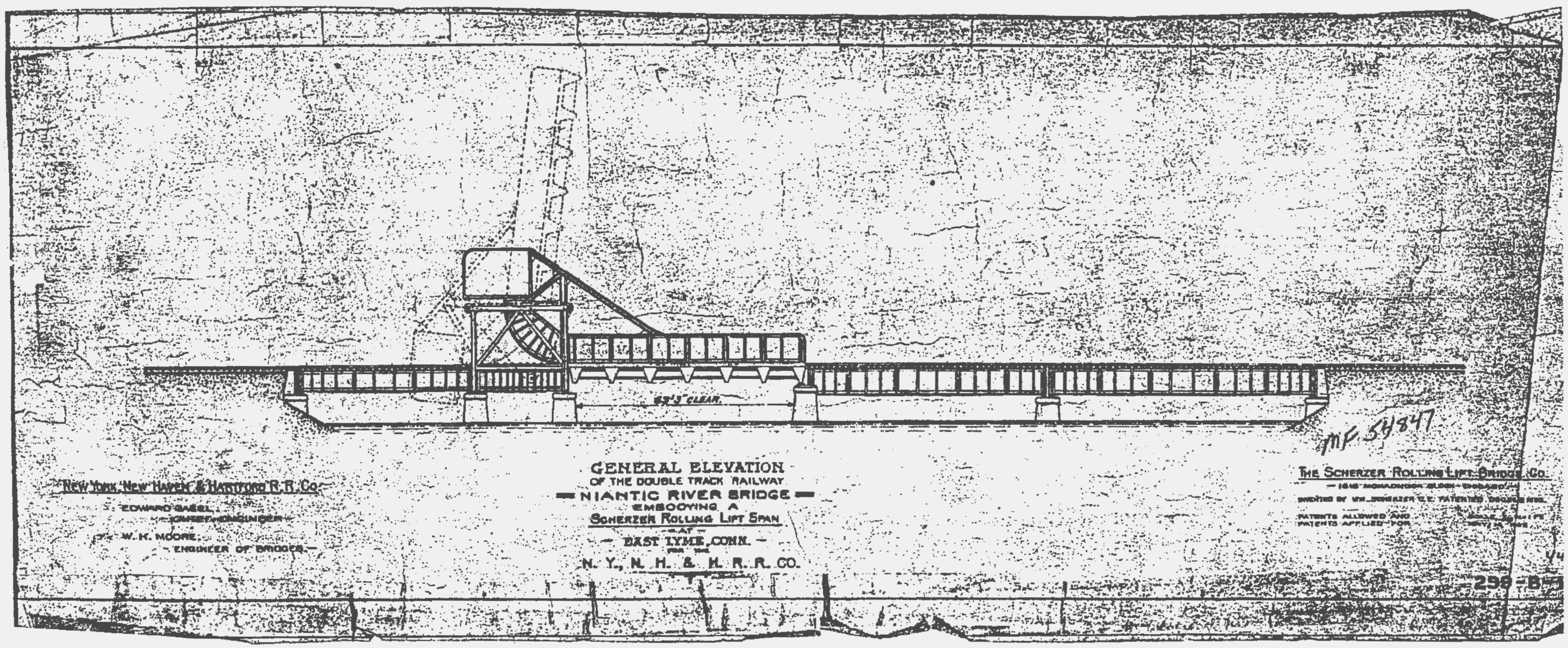
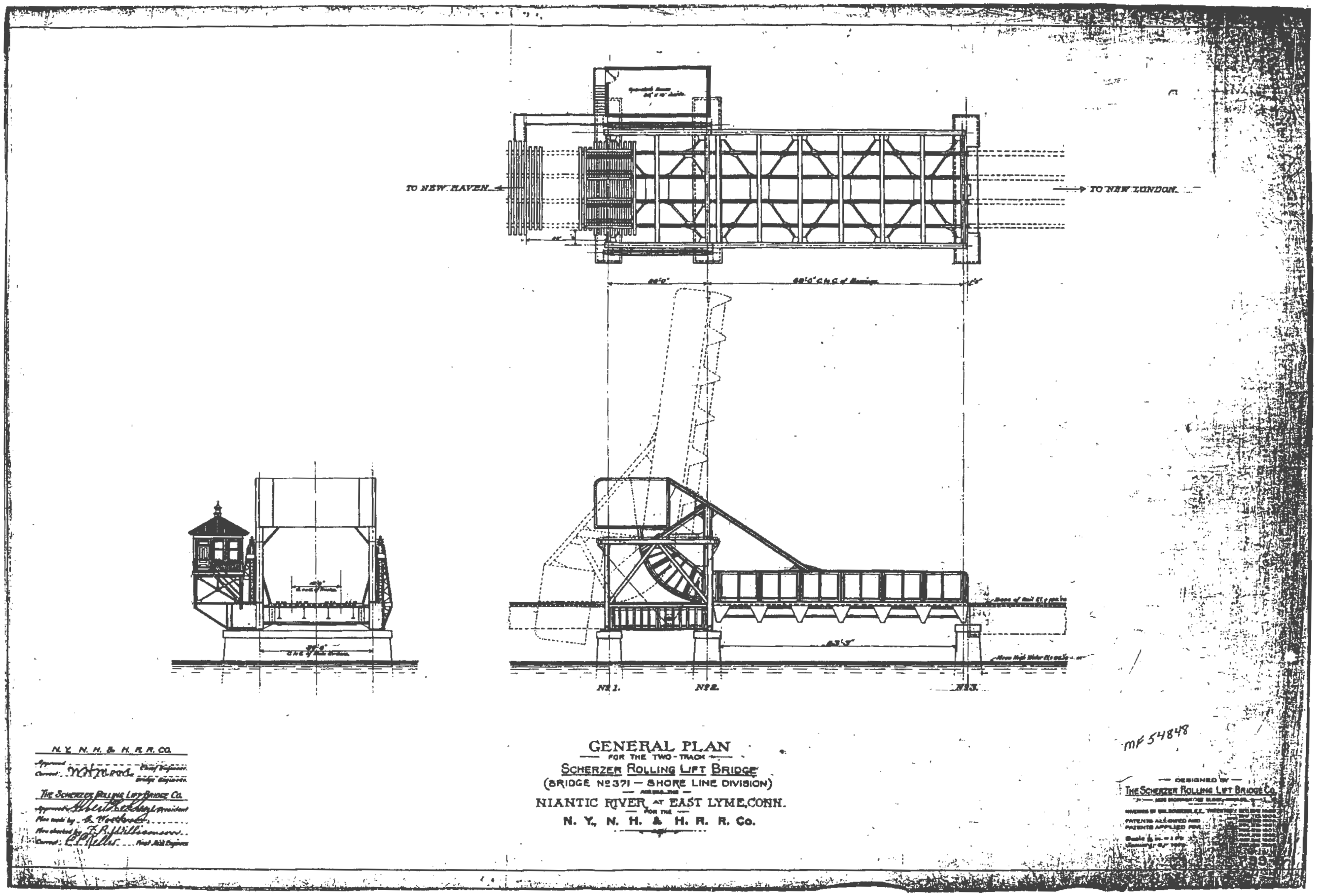
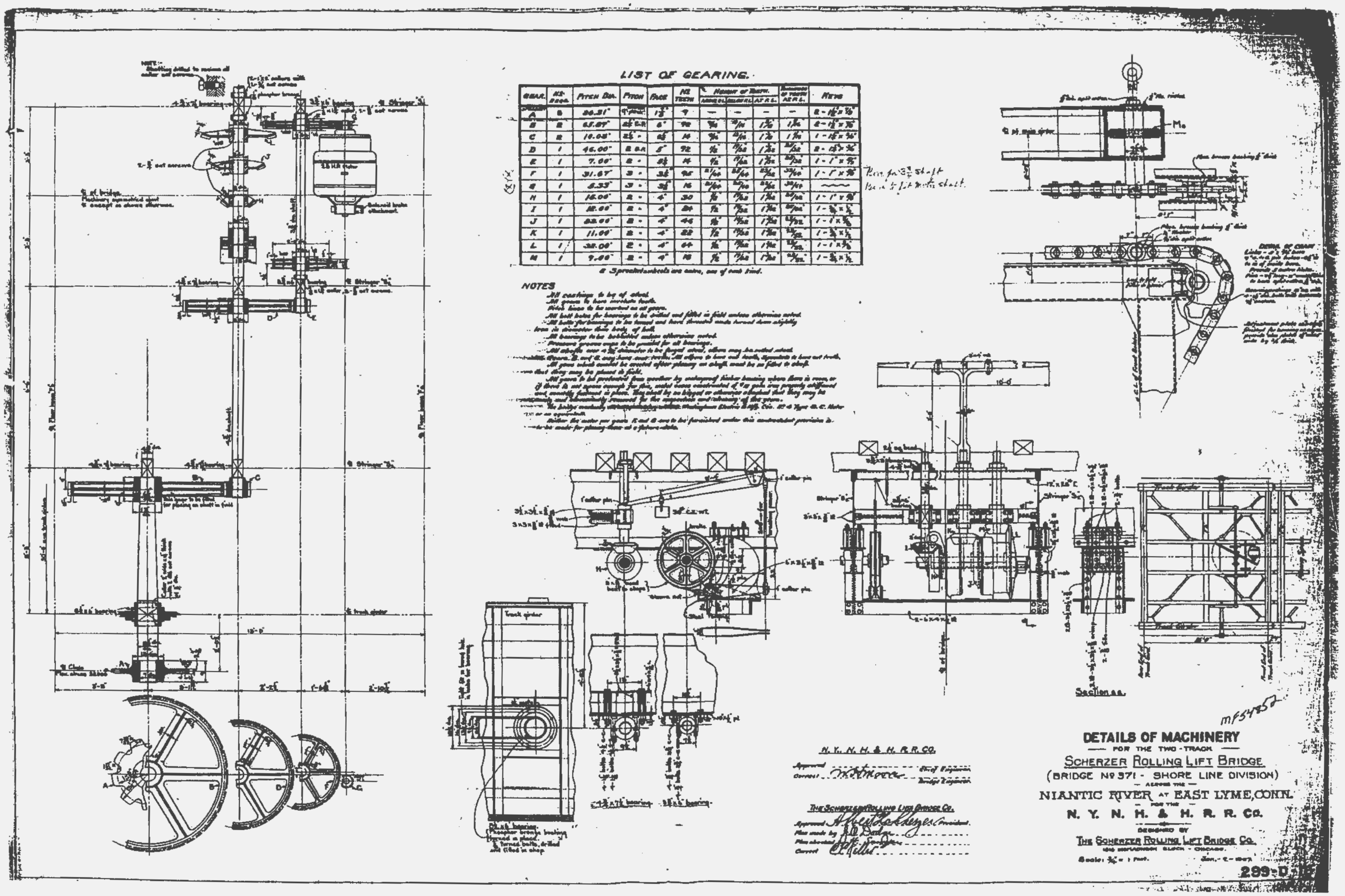
Scherzer Rolling Lift Bridge Company advertisement. [Railroad Gazette, March 17, 1905, p.153.]



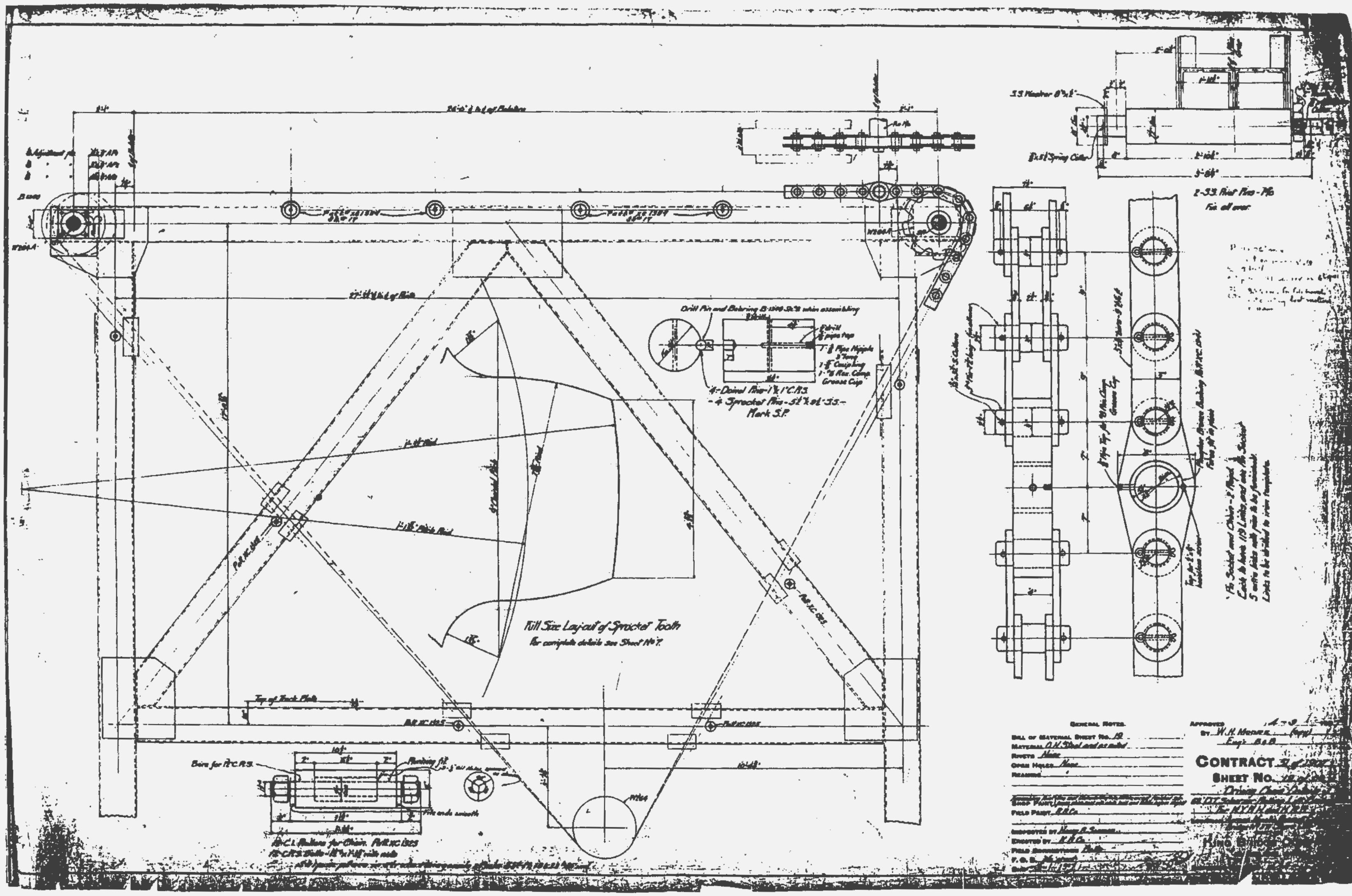
South elevation, Niantic River Bridge, 1907. [Original drawings on file at Amtrak Archives, Philadelphia.]



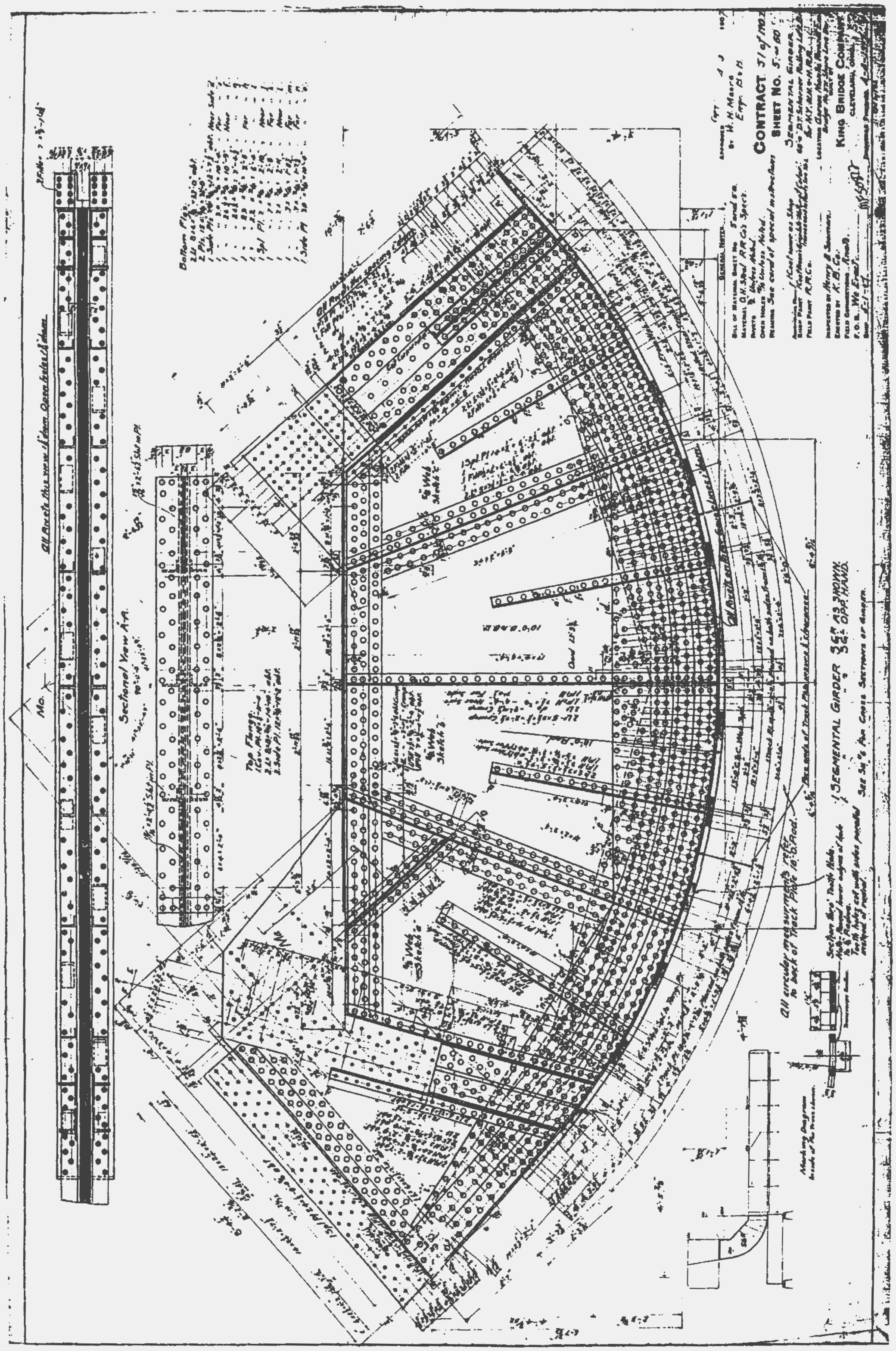
General plan of bascule, Niantic River Bridge, 1907. [Original drawings on file at Amtrak Archives, Philadelphia.]



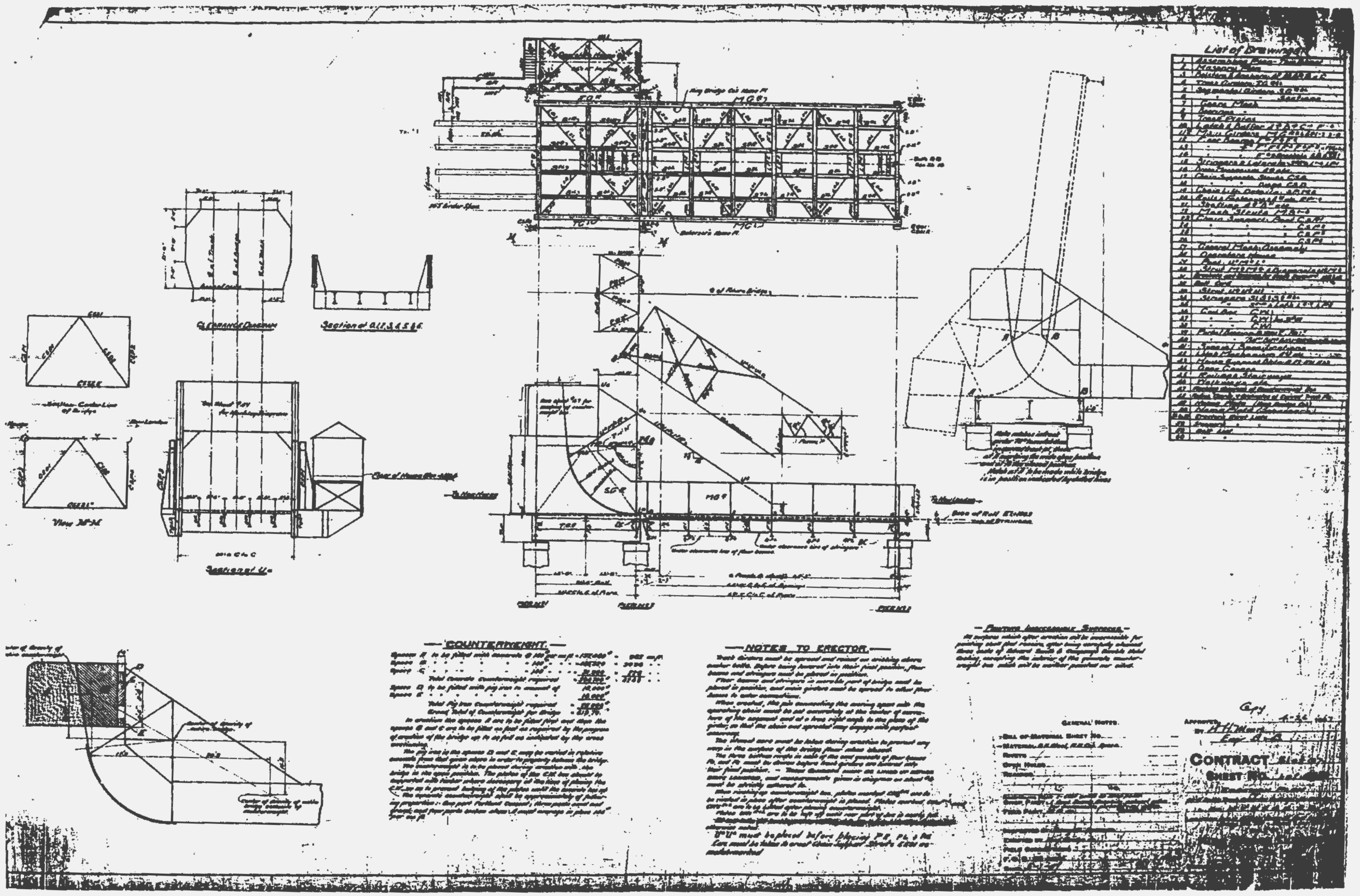
Details of Machinery, Niantic River Bridge, 1907. [Original drawings on file at Amtrak Archives, Philadelphia.]



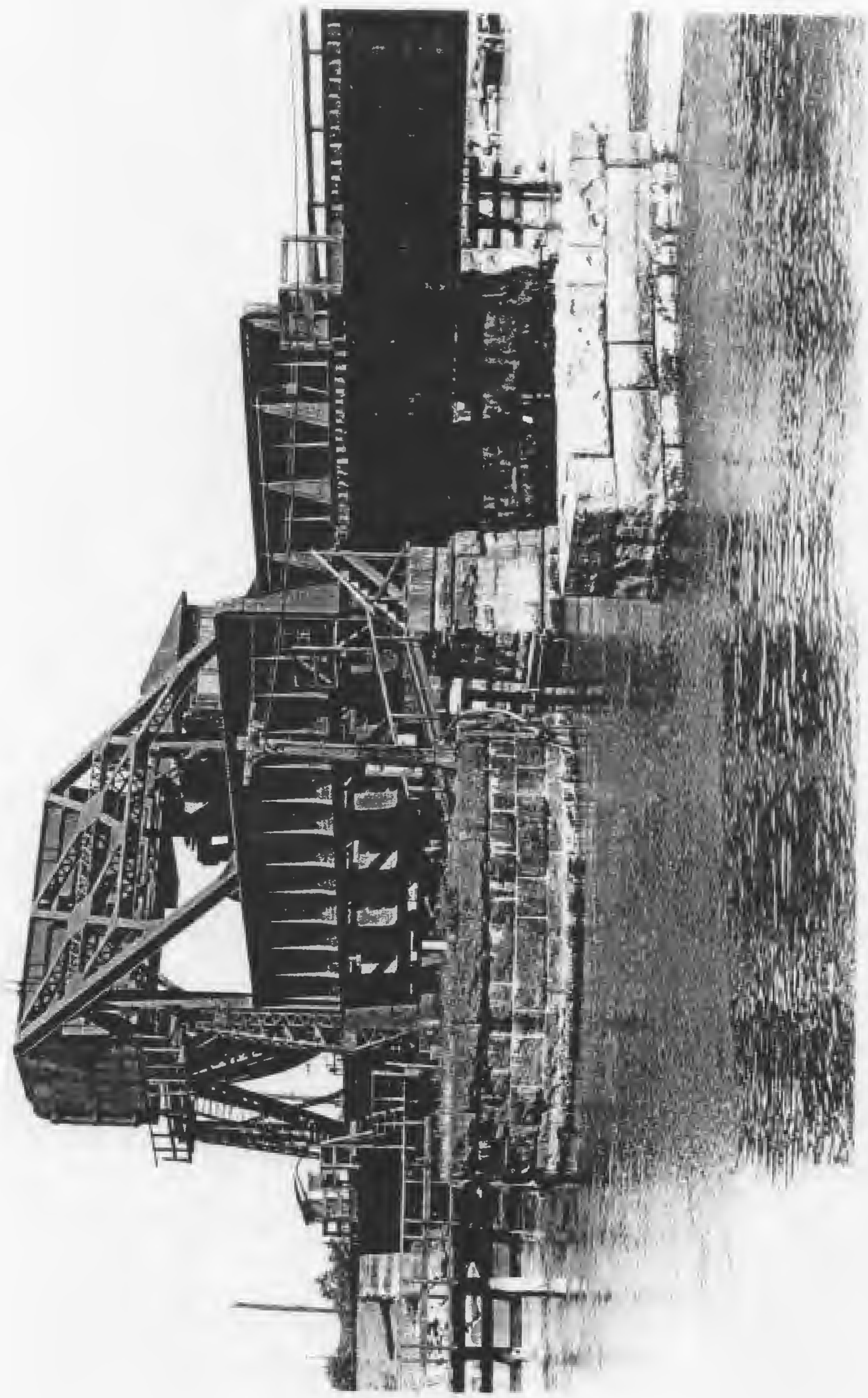
Details of drive chain, Niantic River Bridge, 1907. [Original drawings on file at Amtrak Archives, Philadelphia.]



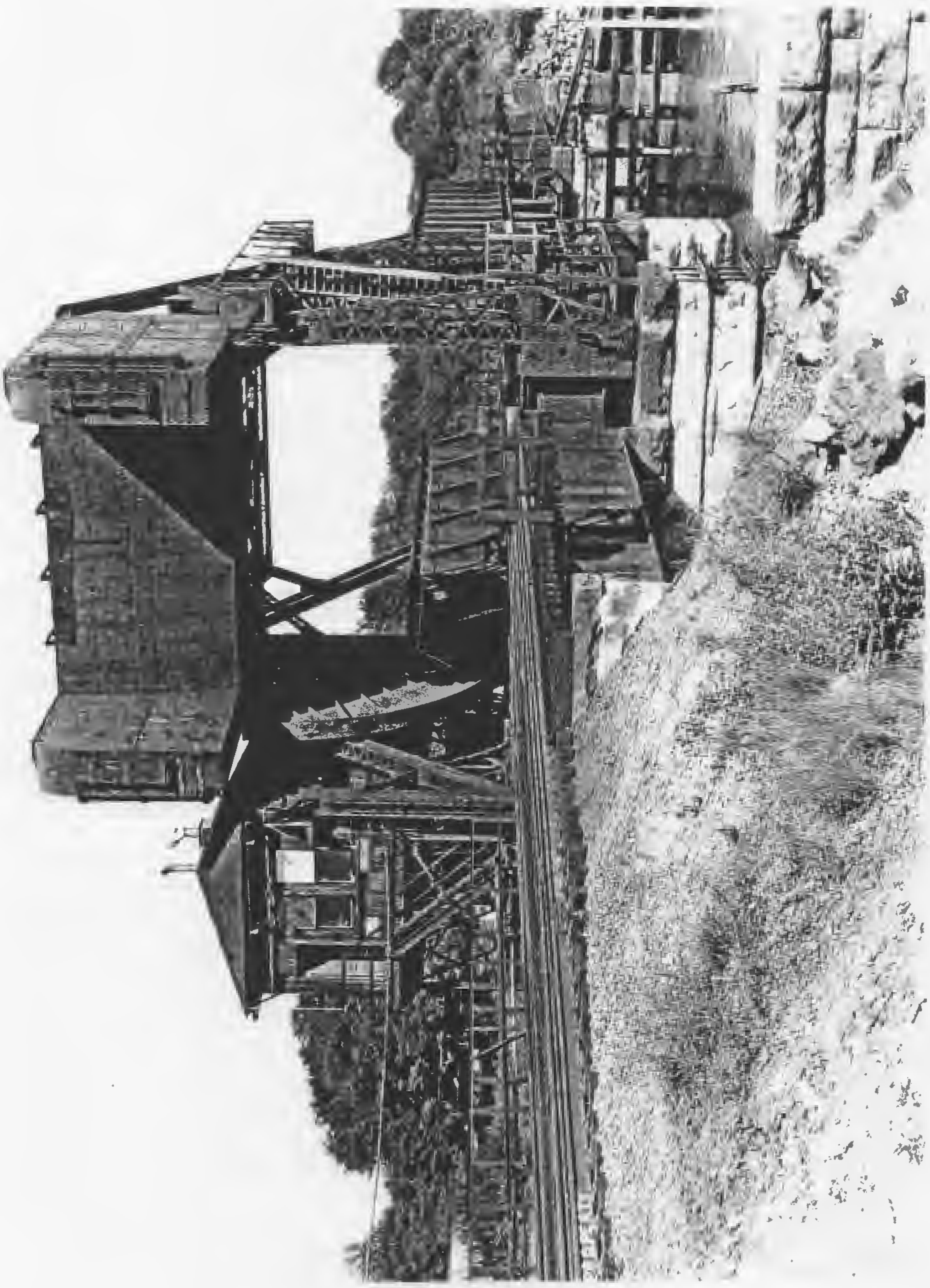
Segmental girder, Niantic River Bridge, 1907. [Original drawings on file at Amtrak Archives, Philadelphia.]



Details of counterweight, Niantic River Bridge, 1907. [Original drawings on file at Amtrak Archives, Philadelphia.]



View to northwest, showing bridge in closed position. [1978 HAER photo, William Barrett.]

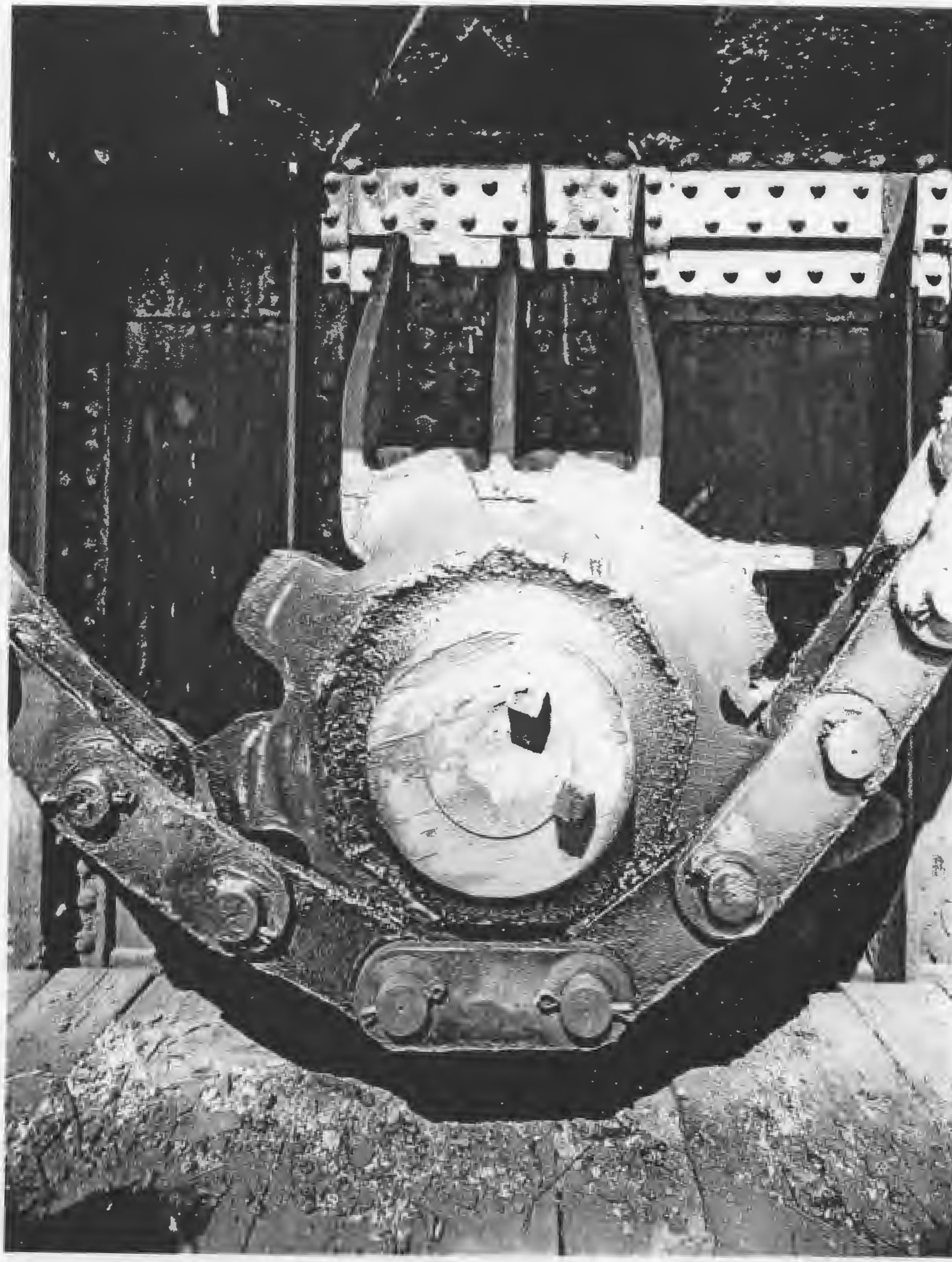


View to east, showing bascule span and operator's house. [1978 HAER photo, William Barrett.]

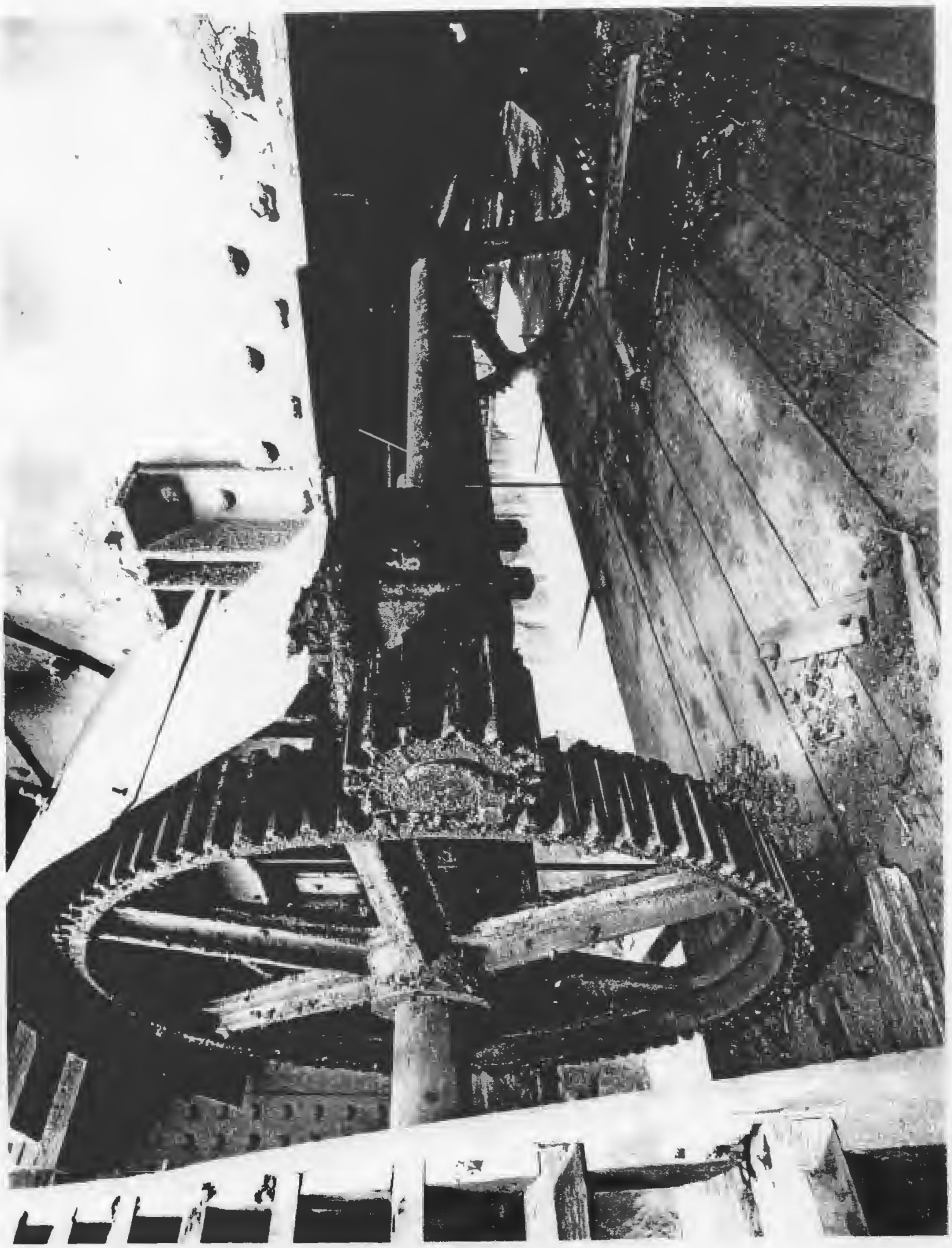
View to southwest, showing bridge in open position. [1978 HAER photo, William Barrett.]

View to east, showing bascule leaf in open position. [1978 HAER photo, William Barrett.]

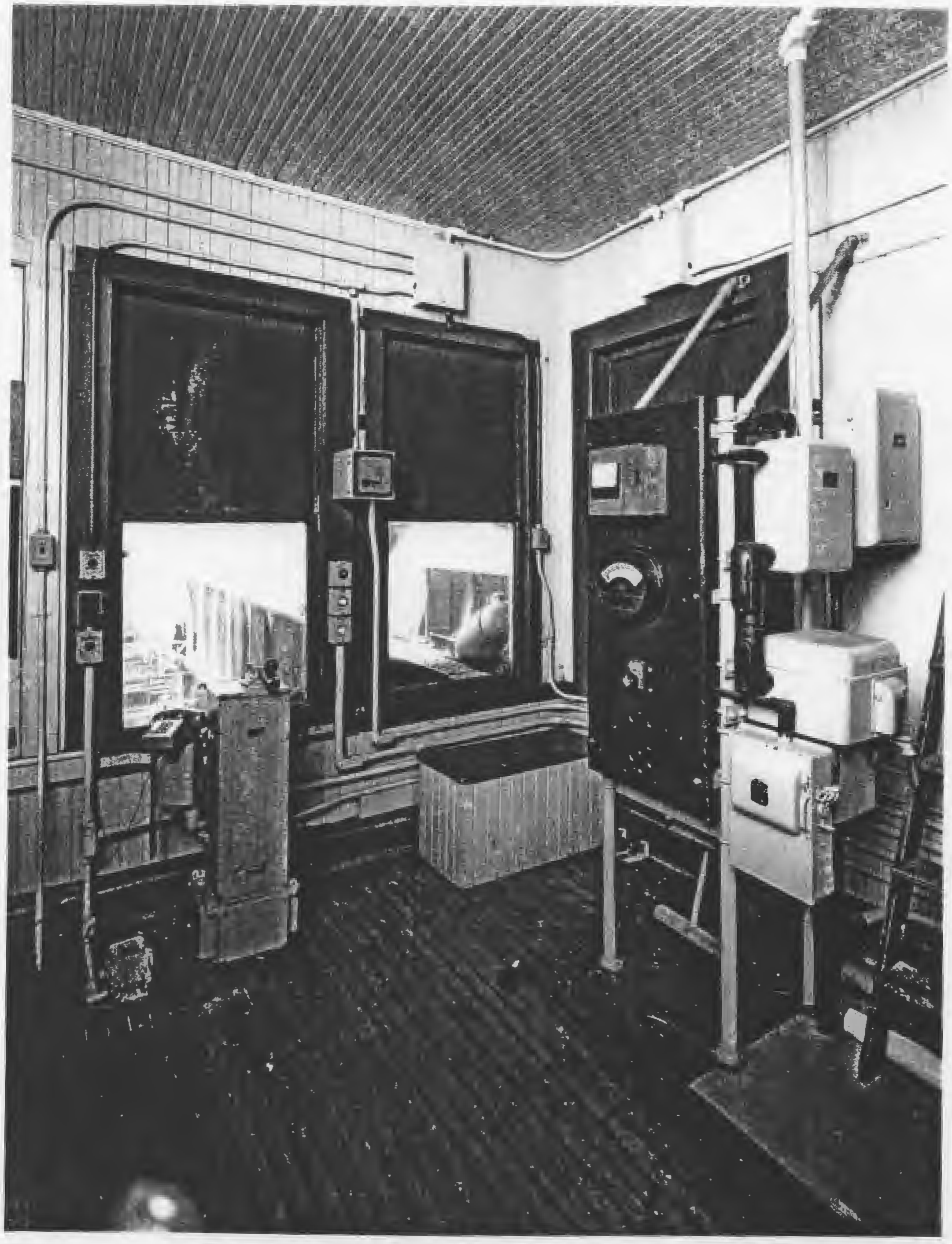
View to northeast, showing heel of bascule span and chain drive. [1978 HAER photo, William Barrett.]



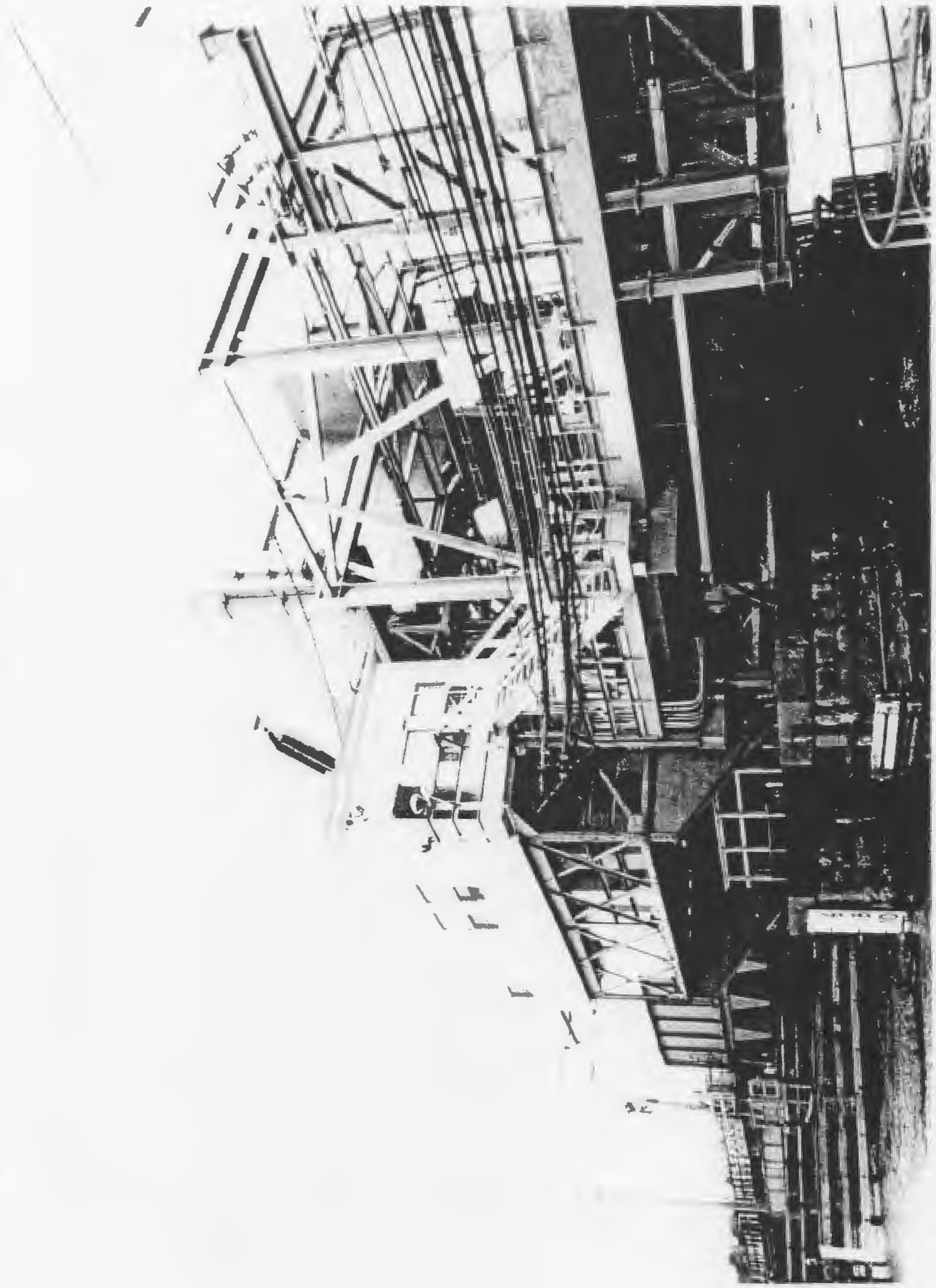
Close-up view of chain and drive sprocket. [1978 HAER photo, William Barrett.]



Close-up view of reduction gears and shafting. [1978 HAER photo, William Barrett.]



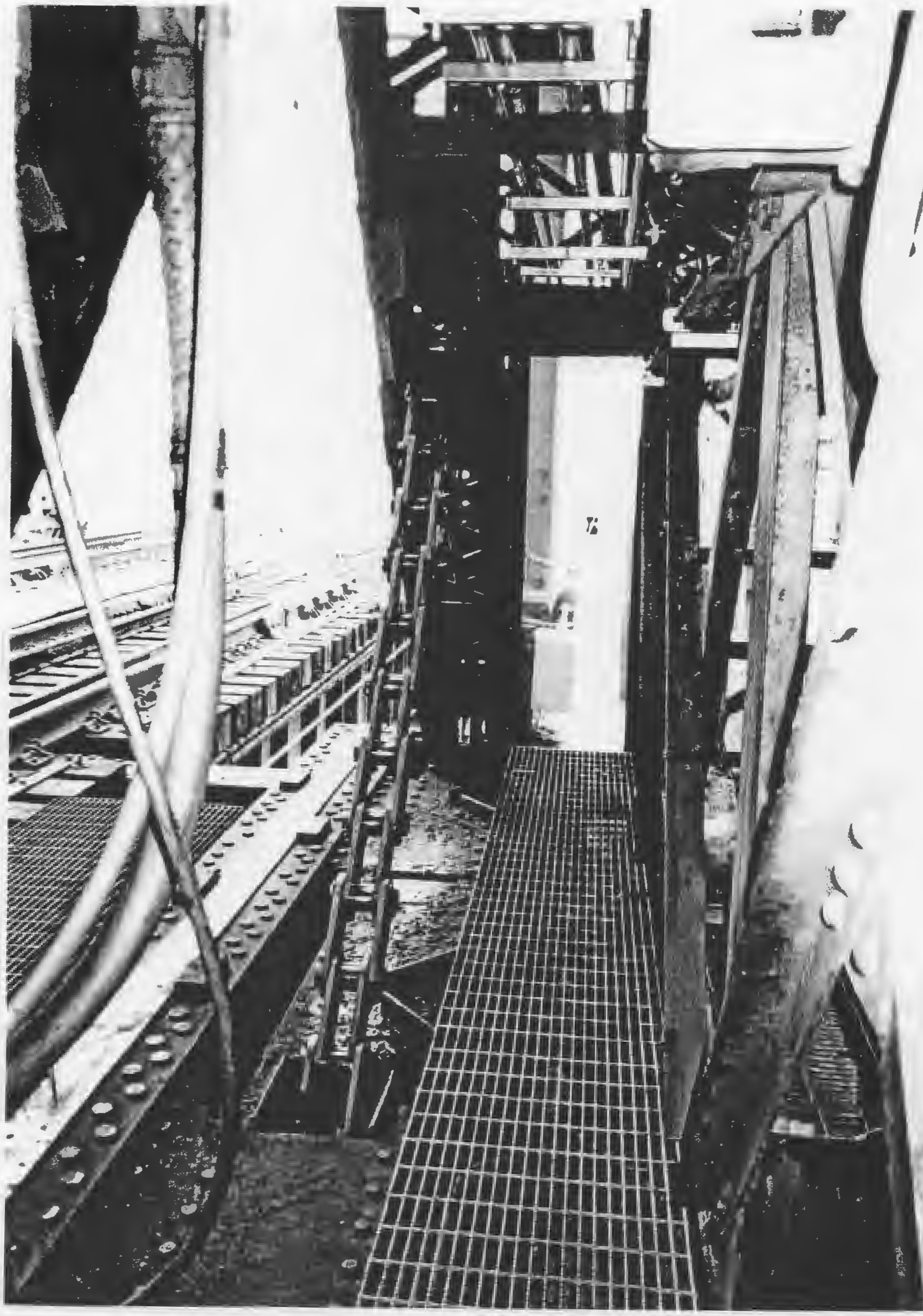
Interior view of operator's house, showing drum control console. [1978 HAER photo, William Barrett.]



Perspective view to southeast, showing operator's house and piers. [May 2000 field photo, Paul J. McGinley.]

View to east, showing electric traction system and retracting frame. [May 2000 field photo, Paul J. McGinley.]

Close-up view to south, showing heel of bascule. Note recently missing builder's plate (black rectangle).
[May 2000 field photo, Paul J. McGinley.]



Close-up view of chain drive on north side of bascule leaf. [May 2000 field photo, Paul J. McGinley.]

DESCRIPTION OF HISTORIC STRUCTURE

The Niantic River Bridge is a chain-driven, through-girder Scherzer rolling-lift bascule bridge designed by the Scherzer Rolling Lift Bridge Company of Chicago for the New York, New Haven & Hartford Railroad Company. The Niantic River Bridge closely follows the basic rolling-lift design patented by William Scherzer on December 26, 1893, but features a mechanical variation, in that it is the only chain-driven version out of seven Scherzer bascule bridges on the Northeast Corridor. The chain drive allowed the motor and gears to be located below the tracks, rather than in the usual overhead position with the counterweight. This configuration was, presumably, a practical solution that allowed for easier maintenance and repairs, as well as for protection from weather and vibration.

Plans for the bridge were completed in January 1907, and John Y. Higginson of Niantic began construction of the masonry piers in March. The bridge was fabricated by the King Bridge Company of Cleveland Ohio and erected by the American Contracting Company during the summer of 1907.

The steel superstructure, including approaches, is 294' long and comprises five spans resting on stone masonry piers and abutments. From west to east, the spans are as follows: a 48'-3" deck plate girder span, a 26'-0" deck plate girder span, a 68'-0" through girder movable span (the bascule leaf), a 67'-4" deck plate girder span, and a 74'-8" deck plate girder span. The movable span consists of a pair of riveted plate girders with a curved "heel" on their west ends, above which is located an iron and concrete counterweight. The fixed deck plate girder span immediately west of the heel supports the lugged tread plates upon which the bascule rolls, as well as the framework for the chain drive. Fixed frames are located on either outboard side of the bascule leaf and run longitudinally. These fixed frames support the upper corners of the drive chains on idler sprockets.

The electric motor, located below track level, delivers power to the drive chains via a series of reduction gears and associated shafting. Seen from either side of the structure, the drive chains are arranged in an inverted triangle, the lowest vertex being the drive sprocket and the upper two vertices being the idler sprockets. The ends of each chain are anchored to a common pivot pin, creating an endless loop. This pivot pin is located at the geometric center of the rolling segment girder of the bascule span. Rotation of the drive sprockets allows the chain to draw the pivot pin horizontally to open or close the bascule. As the bascule operates, the segment girder rolls along a lugged tread plate on the track girder of the fixed span. Engagement of these lugs with slots on the exterior curve of the segment girder maintains proper alignment and prevents sliding of the bascule as it traverses its track. The leaf can also be raised and lowered manually using a capstan.

Operations of the movable span and the gates and signals protecting the bridge approaches are controlled from the wooden operator's house, located on the south side of the rolling lift span. The 26' x 12' wood-frame operator's house retains its original massing and form, but many of the original architectural details have been removed or replaced. Some of the original windows were removed prior to 1978, and the door, windows, exterior stairs, siding and roofing were replaced when the building was renovated in 1982. The building is supported on a platform with steel outriggers fastened to stone piers on the north side of the west end of the bascule. Inside the operator's house, some of the original finishes remain, including built-in storage cabinets, bead-board ceiling and walls, and various conduits, pipes and cables; however, much of the original operating equipment has been removed, including the Armstrong levers which mechanically controlled the interlocking and switching equipment. A track model board is used for backup control of the switches and signals and a trolley-type drum control console is used to operate the bridge motor.

In 1999 an electric traction power-distribution system was installed as part of the Northeast Corridor Electrification Project between New Haven and Boston. Amtrak trains utilize a pantograph to draw electric power from an energized overhead contact wire system, called the catenary. As part of the construction of this system, retractable catenary sections were designed and installed on all movable bridges along the route. At the Niantic River Bridge, the main catenary terminates at a lattice steel portal, or "anchor bridge," at the west abutment and the third masonry pier. The west approach span and the adjacent bascule span are energized by a telescoping frame that rides on top of rails set outside and parallel to the girders of the fixed span. When the bridge opens, the telescoping frame withdraws the conductor beam structure from the movable span, thereby allowing the counterweight to descend and the bascule leaf to rise without interfering with the energized catenary.

Since its construction, the Niantic River Bridge has undergone the following documented repairs and alterations:

- 1934-35 Piers repaired.
- 1948 Original hand-operated brake replaced with magnetic brakes.
- 1956 New tread plates installed on track and segmental girders.
- 1965 New motor pinion and split gear installed.
- 1978 Fixed span plate girders and bracing members strengthened.
- 1983-84 Masonry repairs to piers and abutments (substructure).
  Structural repairs and strengthening of the movable span.
  Repairs and modifications to the mechanical operating systems.
  Removal of Armstrong interlocking and switching equipment and replacement with new signal system.
  Exterior/interior renovations to control house.
- 1998-99 Electric traction power-distribution system (catenary and support structures) installed as part of Northeast Corridor electrification.

The Niantic River Bridge is historically significant as an important link on the former New York, New Haven & Hartford Railroad Shore Line, which is presently part of Amtrak's Northeast Corridor. It is technologically of interest as the only chain-driven example among the seven Scherzer rolling lift spans on the Northeast Corridor. The bridge was designed by the Scherzer Rolling Lift Bridge Company, following William Scherzer's 1893 patent for a bascule-type drawbridge that was widely adopted, and is still in use today, for both railway and highway spans.