Addendum to HAER No. NY-8
COHOES COMPANY, GATEHOUSE NO. 1
(Cohoes Company Power Canal system, Head Gate House)
On Mohawk River, north end of canal abutting east bank
Cohoes
Albany County
New York

BLACK & WHITE PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
Northeast Regional Office
National Park Service
200 Chestnut Street
Philadelphia, Pennsylvania 19106

HISTORIC AMERICAN ENGINEERING RECORD

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(Cohoes Company Power Canal System, Head Gate House)

This report is an addendum to a 4-page report previously transmitted to the Library of Congress in 1970 and an addendum report previously transmitted to the Library of Congress in 1985.

Location: On Mohawk River, north end of canal abutting east bank
Cohoes
Albany County
New York
UTM: Zone 18. N: 605119 E: 4738838

Date of Construction: 1866, 1922

Engineer: William E. Worthen

Present Owner: Brookfield Power NY

Present Use: Gatehouse for hydroelectric facility

Significance: The existing head gate house was built in two sections. The section closest to the Mohawk River was built for the Cohoes Company's system of canals in 1866, while the section closest to North Mohawk Street was built in 1922 when the power canal was enlarged for the current hydroelectric facility. Each section of the head gate house contains its original set of gate operators. The building thus shows two early, but very different, approaches to controlling the water that enters a power canal.

Project Information: Under the terms of a new license from the Federal Energy Regulatory Commission, the present owner will replace the original gate operators with modern operators. The original 1866 portion of the head gate house contributes to the significance of the Harmony Mills National Historic Landmark, including the gate operators. No other alterations are proposed. To mitigate the adverse effect, the National Park Service stipulated documentation of the head gate house.

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Summary Description

The head gate house was constructed in two phases. The first part of the head gate house was constructed by the Cohoes Company in 1866 as part of a hydromechanical complex. This complex, an upgrade from the initial complex of the early 1830s, was designed to take advantage of the flow of the Mohawk River and the elevation drop of Cohoes Falls in order to power a range of factories in Cohoes. A more detailed history of the Cohoes Company and the manufacturing plant in the City of Cohoes can be found in the report of the pilot HAER project on the Mohawk-Hudson Area (Allen 1973; Huberman 1973; Rezneck 1973). Additional descriptive information can be found in the Addendum to the original HAER report, which was prepared in 1984 prior to the removal a the "T" section of the original head gate house that lay on the east side of the power canal. This section, which formed a "T" on the east bank of the power canal closest to the Mohawk River, was demolished in 1985. In the original design of the head gate house, this section housed two gates and a turbine that provided hydromechanical power to the head gate operators.

When constructed in 1866, the head gate house consisted of a one-story brick building that was constructed on a masonry foundation across the head of the Cohoes Company's power canal, immediately downstream of the dam that also was built in 1866. The original head gate house was approximately 120 feet long and 13 feet wide, and rested on a masonry foundation that contained nine gate openings through which water entered into the power canal. The "T" section was approximately 100 feet long and 10 feet wide, and rested on a masonry and parabolic brick arched foundation.

The interior of the original 1866 section featured unarticulated spaces in both the part that crossed the canal and the "T" section on the east bank of the power canal. The interior of the part that crosses the canal is dominated by the machinery that is used to operate the slide gates, lifting the gates to allow water to flow into the power canal and closing gates to stop water from entering the power canal. Each of the nine gates is controlled by its own operating machinery. With relatively limited modifications as described below, this historic configuration has remained intact. The interior of the "T" section, as originally designed and constructed, housed two sets of gates and machinery. One set of gates was used to dewater the forebay, while the other set was used to power a small Pelton-type water wheel. As described below, this water wheel provided hydromechanical power to the nine gate operators in the part of the head gate house that crosses the canal.

The second section of the current head gate house was constructed in 1922 by the Cohoes Power and Light Company. The Cohoes Power and Light Company had built a small hydroelectric facility near the base of Cohoes Falls in 1911, using the existing power canal as enlarged by the Cohoes Company in 1866. In 1922, the Cohoes Power and Light Company constructed the existing hydroelectric complex consisting of the powerhouse, lower gatehouse, upper gatehouse, and power canal. In order to provide enough water to power the larger generating units of the new powerhouse, the Cohoes Power and Light Company enlarged the power canal, making it both wider and deeper. In order to accommodate this widened power

canal, the Company added a new section to the existing head gate house. The new section, like the original section, is 13 feet wide, and is approximately 80 feet long. The floor of the new section also is approximately two feet higher than the original section, a difference in elevation that is visible both in the different roof lines and in the slope of the concrete floor inside the head gate house.

This 1922 section, which extends from the western end of the original head gate house to the west bank of the power canal, houses three tainter gates. Each of these gates is controlled by its own hydraulic lift mechanism.

Head Gate House Operators

The original head gate operating machinery has been in use, first for the Cohoes Company's power canal to power the hydromechanical machinery in the city's textile mills and later to power the School Street hydroelectric station, since they were installed in 1866. Although the power source for the gate operators has changed, the way that they work has not.

The gate operators in the Cohoes Company's head gate house were an ingenious solution to the problem of lifting and dropping the heavy timber gates that were necessary to control the large amount of water flowing into the power canal. The design of these gates appears to have been created by William E. Worthen, a civil engineer based in New York City. Worthen, born in Amesbury, MA in 1819, literally grew up in the world of hydraulic engineering. His father, Ezra Worthen, was instrumental in the development of the water power in the City of Lowell, MA in the early nineteenth century, and served as the first superintendent of the Merrimack Manufacturing Company. Worthen was educated at Harvard College, receiving a bachelor's degree in 1838, and immediately began work as a civil engineer with special attention on hydraulics and hydrology. Worthen's obituary in 1897 quotes "an authority" who wrote, in 1889, "As a hydraulic engineer he has designed and constructed masonry dams across rivers, for the establishment of water-powers, and the canals, mills, and shops connected therewith."

According to the builder's stone in the head gate house, William E. Worthen served as the engineer for the Cohoes Company's redevelopment of its dam and head gatehouse in 1866. Although no information survives regarding the designs for the gate operators, it is important to note that Worthen also served as the engineer for the Ousatonic Water Power Company when they constructed a dam across the Housatonic River between Shelton and Derby, Connecticut, in the late 1860s. This new dam provided water for power canals on each side of the river (Silvio and Artemel 1987). At the time the dam was built, each canal was controlled by a wooden gatehouse. Between 1890 and 1896, however, each of these wooden gatehouses was replaced with a new brick building. The existing gate operating machinery in the Shelton Canal gatehouse on the west side of the Housatonic River is similar to that used in the Cohoes Company's head gate house. Figure 1 shows a detail view of the gate operating machinery at the Shelton Canal gatehouse. It is important to note that the gate operators at the Shelton Canal gate house no longer have the vertical iron posts as at the School Street head gate house; it is unclear whether the operators at the Shelton Canal gate house were designed that way, or the vertical

iron posts have been removed. Although the report that documents the Ousatonic Water Power Company's facilities does not provide any details on the machinery, it is likely, given Worthen's connection to the Cohoes Company facility, that he designed both.

The gate operating machinery was powered initially by a Pelton-type water wheel located in the "T" section of the head gate house on the east side of the power canal, the section that was removed in 1985. The water wheel drove a series of shafts which extended along what was then the length of the head gate house, and provided power to each operator. A beveled friction gear at each gate allowed the lifting mechanism to draw power from the shaft. Figure 2 provides a view of the original gate operating machinery, while Figure 3 shows a detail view of the bevel gears. An 1885 study by the U.S. Census of the Water Power of the United States (Porter 1885) provide a more detailed description:

> The machinery for raising and lowering the gates is very easily operated and satisfactory in working. The turbine . . .is at the river end of the bulkhead, and operates three lines of shafting; one of these, 2 ¼ inches in diameter, runs in at right angles to the stream and connects with the head-gates; the other two run in either direction parallel to the stream and connect with the waste-gates. Each gate has attached to it two vertical iron posts with racks. Opposite one post of each gate is a pair of beveled friction-wheels revolving in parallel vertical planes; a third wheel, revolving in a plane at right angles to these, can by a small hand-wheel be brought in contact with either accordingly as it is desired to raise or to lower the gates. The turbine is started and sets in motion the long horizontal shaft and the odd friction-wheels; in the manner just described the motion is now communicated to one of the adjacent friction-wheels, which is thus made to revolve, and with it its iron shaft, having a worm-gear; this turns a large vertical toothed wheel, on the axle of which is a smaller toothed wheel directly engaging the rack, which is firmly connected to the gate. On the same axle is another toothed wheel, opposite to, and engaging, the other rack of the same gate.

It is unclear when this method of powering the gate operators was removed, though it appears to have been in the early- to mid-20th century. The preparers of the 1984 Addendum to the original HAER report interviewed Regional Operations personnel from the Niagara Mohawk Power Corporation, the owner of the School Street Hydroelectric Project at the time, but none was able to provide useful historical information on the power source for the head gate house. The first change was to replace the water wheels as a source of power with a gasoline engine. This gasoline engine remains in place, located between gates 5 and 6 in the head gate house. At some point in recent decades, though, the use of this gasoline engine has been discontinued; the gate operators are now powered by an electric motor. It is important to note, however, that though the power source has changed over the years, the way that the power is applied in the operation of the gates remains as it was in 1866.

The head gate house was altered in 1922 when the present hydroelectric powerhouse was constructed. As noted above, the need for vastly larger amounts of water for the new powerhouse required a wider and deeper canal; the new size of the canal in turn required a gate

house that would span it. Photographs recently acquired by the Mohawk-Hudson Industrial Gateway in Troy, NY provide partial documentation of the construction of the new section of the head gate house. The addition of the new section in 1922 included the removal of the original crenellated tower at the west end of the gate house above the western-most bay; the builder's plaque, which originally was inset in the west wall of the tower was salvaged and attached to the interior wall of the original section of the head gate house. Other than this tower and the removal of the western wall, however, the addition of the new section required no alterations in the existing head gate house, including the gate operating machinery.

By the 1920s, hydraulic and civil engineering had progressed such that timber slide gates were no longer the most efficient. Instead, the new section of the gate house used steel tainter gates to control flow into the canal. Tainter gates, which had been invented in 1886 by Jeremiah Burnham Tainter, featured a convex curve that faced the flow of water; the gate was rotated upward around a pivot point behind the gate's face to allow water to pass, while the weight and shape of the gates allowed the passing water both to assist them in opening and closing.

The 1922 section of the head gate house features three tainter gates. Instead of the hydromechanical and gasoline-engine power sources for the original timber slide gate operators, the new gate operators were powered by a unique hydraulic system. A riveted steel tank, which contains the hydraulic fluid, is located at the juncture of the 1866 and 1922 sections of the head gate house. The hydraulic fluid is pressurized using a large three-cylinder pump powered by electric motors located adjacent to the tank. Figure 4 shows the tank for the hydraulic fluid, while Figure 5 shows the pump. The pressurized fluid passes through metal pipes to a control mechanism located above each gate; when opened, the pressurized hydraulic fluid raises and lowers two tall stanchions at each gate. Chains attached to the top of each stanchion then rotate around a drum at each side of the gate; chains attached to these drums then rotate the tainter gates open and closed. Figure 6 shows the overall hydraulic gate operating assembly, while Figure 7 provides a detail view of a control mechanism.

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Unknown
1897 William E. Worthen Dead. Obituary in The New York Times, April 3. New York, NY.

APPENDIX:

FIGURES CITED IN TEXT

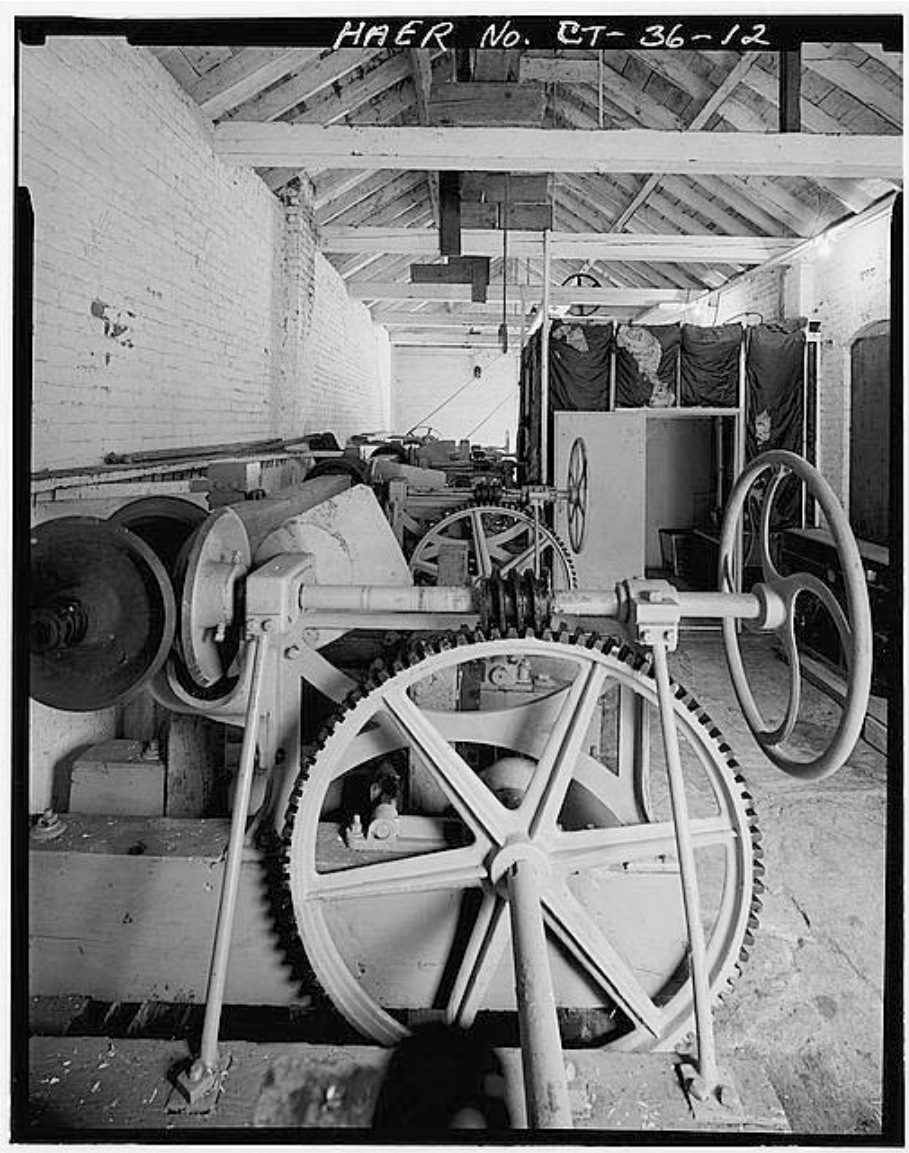

Figure 1: **Gate Operators, Shelton Gate House, Ousatonic Water Power Company. Source: HAER No. CT-36-12, available online at the Library of Congress' American Memory website, http://memory.loc.gov/cgibin/displayPhoto.pl?path=/pnp/habshaer/ct/ct0400/ct0426/photos&topImages=023787pr.jpg&topLinks=023787pv.jpg,023787pu.tif&title=12.%20%20INTERIOR%20VIEW%20OF%20SHELTON%20GATEHOUSE%20SHOWING%20MECHANISM%20FOR%20OPERATING%20GATES.%20%3Cbr%3EHAER%20CONN,5-DERB,1-12&displayProfile=0 (viewed September 18, 2009).**

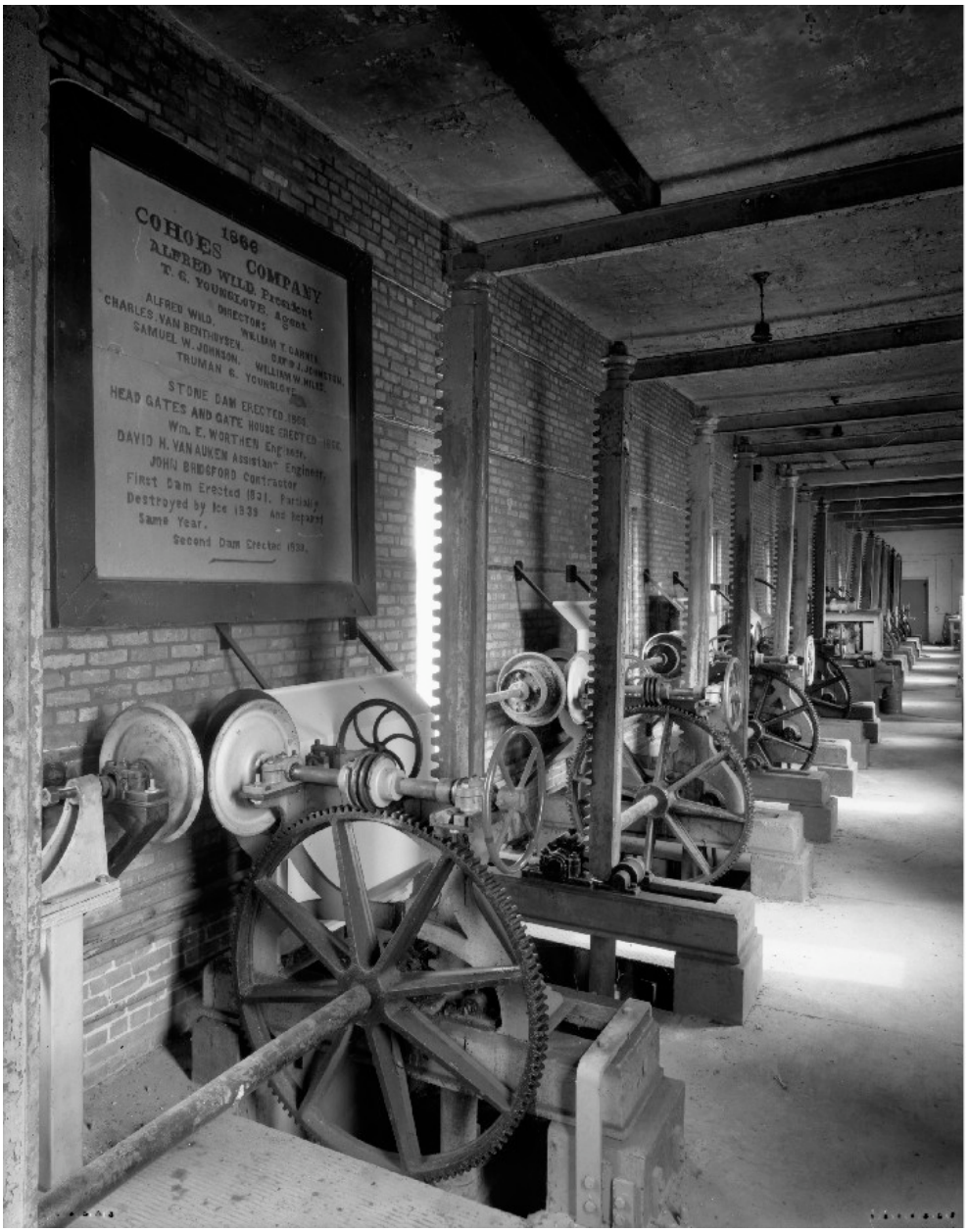

Figure 2: **View of the 1866 Section of the Head Gate House, Showing Beveled Gear Gate Operators. Source: HAER No. NY-8. Digital scan of original photograph taken for the present Addendum; original negative sent to National Park Service.**

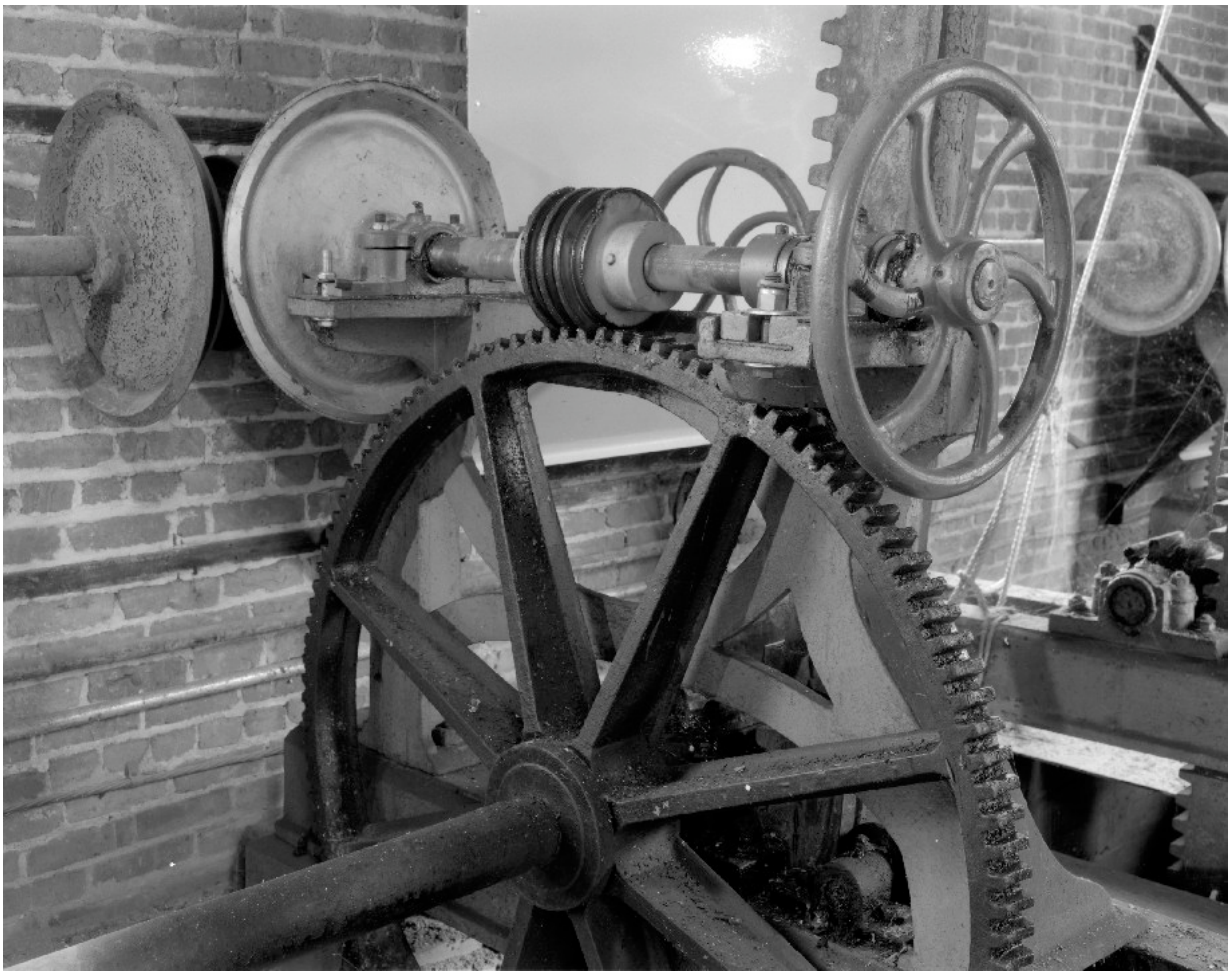

Figure 3: Detail View of Bevel Gears. Source: HAER No. NY-8. Digital scan of original photograph taken for the present Addendum; original negative sent to National Park Service.

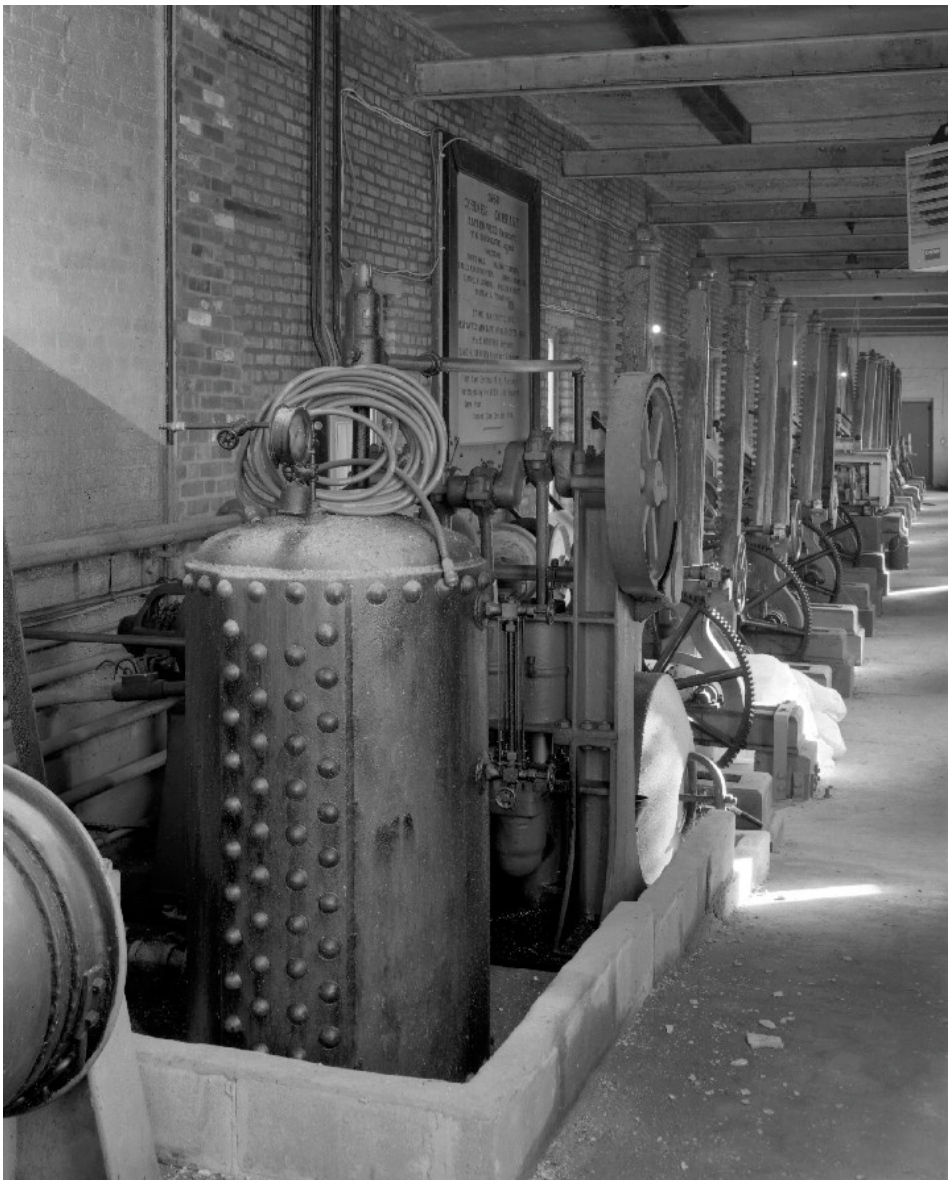

Figure 4: Riveted Steel Tank for Hydraulic Fluid. Source: HAER No. NY-8. Digital scan of original photograph taken for the present Addendum; original negative sent to National Park Service.

Figure 5: Detail View of Pump for Hydraulic Fluid. Source: HAER No. NY-8. Digital scan of original photograph taken for the present Addendum; original negative sent to National Park Service.

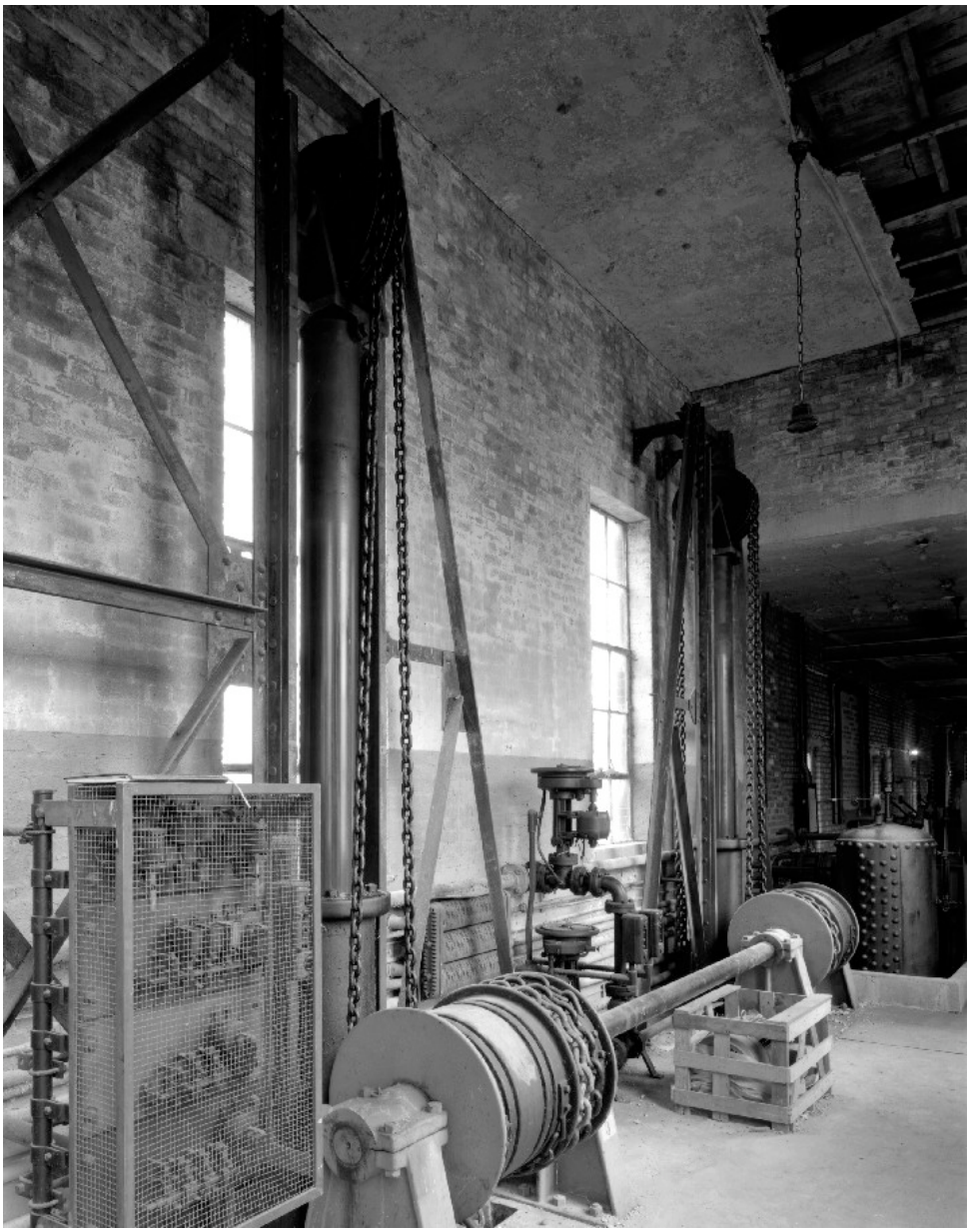

Figure 6: Hydraulic Gate Operator Assembly. Source: HAER No. NY-8. Digital scan of original photograph taken for the present Addendum; original negative sent to National Park Service.

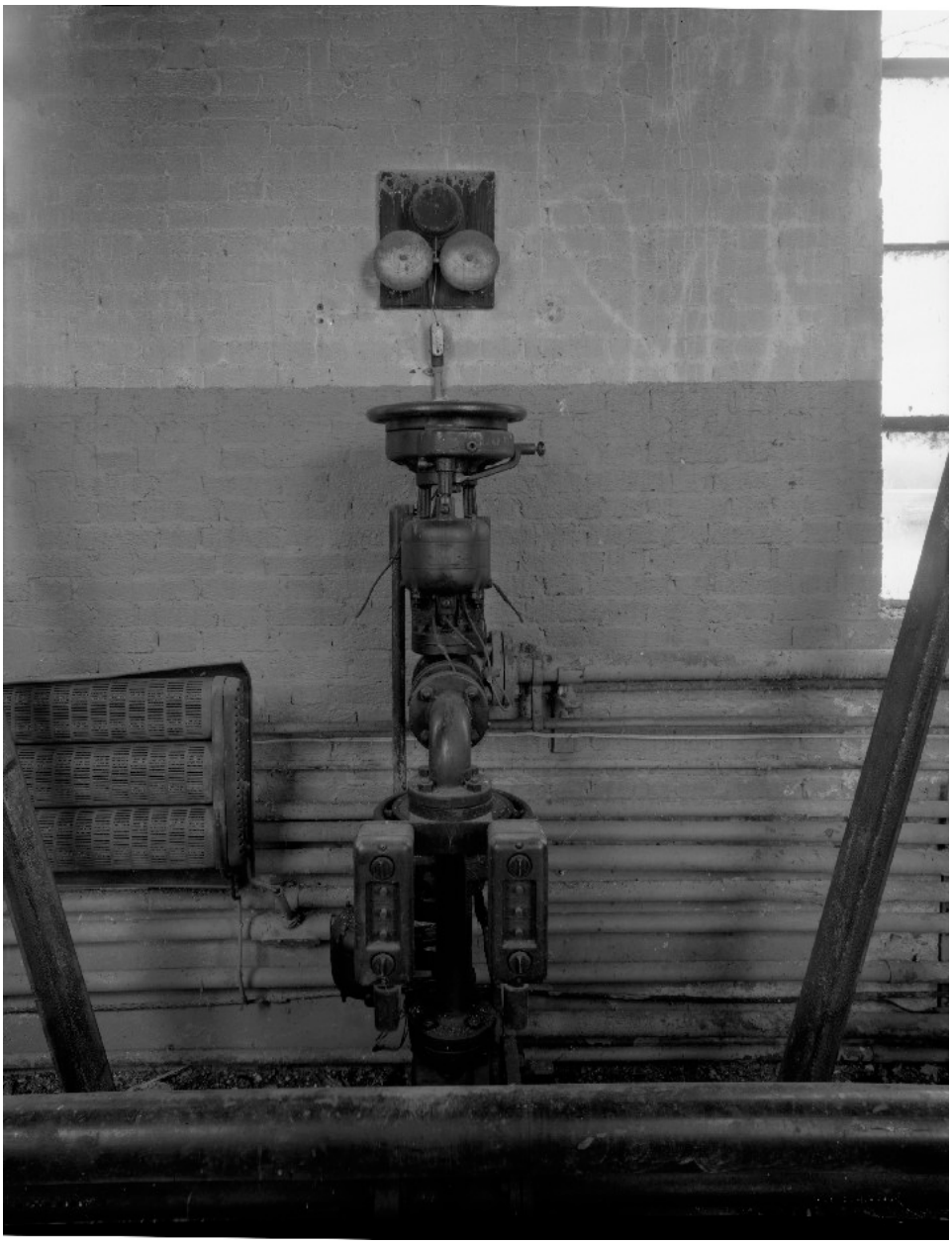

Figure 7: Detail View of Hydraulic Control Mechanism. Source: HAER No. NY-8. Digital scan of original photograph taken for the present Addendum; original negative sent to National Park Service.