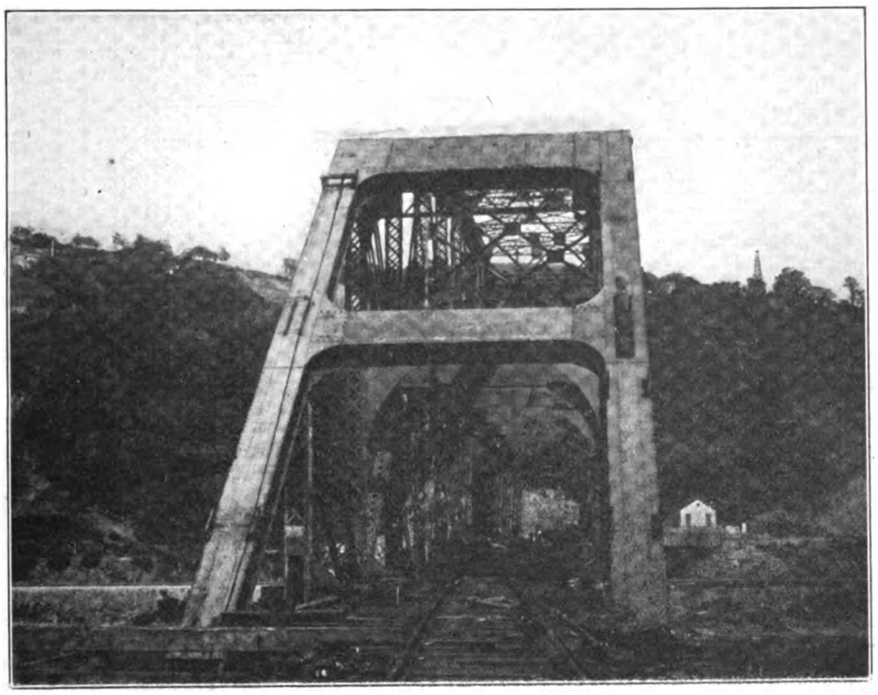
The Five-Hundred-Foot Channel Span of the Clairton Bridge.

The Saint Clair Terminal Railroad connects the Pittsburgh, Virginia & Charleston Railroad, which is the Monongahela branch of the Pennsylvania Railroad, with the Pittsburgh & Lake Erie Railroad, on opposite sides of the Monongahela River at Clairton, Pa., by means of a bridge having a channel span which is the subject of this sketch, and at the same time affords additional transportation facilities for the supply and output of the Clairton Steel Company's plant, at Clairton. This plant comprises three blast furnaces, twelve open-hearth steel furnaces, with blooming mill and billet mill, all of which have been completed, and were put into operation during 1903. The road is intended for double-track service, but at present is only operated as single-track. The masonry was built for a double-track superstructure with the exception of the shore pier and the abutment for the north leg of the Y, at the west end of the bridge, which have not yet been constructed. The two through spans are built for double track, the remaining deck spans are for single track. Additional single track spans are to be placed alongside of these whenever the necessity for double-track railroad arises.

The bridge was built by the Saint Clair Terminal Railroad Company, Mr. W. P. Snyder, president, Mr. J. B. McIntyre, chief engineer. The Drake & Stratton Company was the contractor for the substructure, and the American Bridge Company, of New York, for the superstructure, the shop work being done at its Toledo plant, with the exception of the eye-bars, which were manufactured at its plant at Athens, Pa. Mr. F. H. Bailey was the assistant engineer during the construction of the substructure, and Mr. C. D. Supplee during the erection of the superstructure. Mr. E. S. Warner was chief draftsman. The total length of the bridge is 1,154 feet, and includes one channel span, and at each end two deck and one through approach spans, varying in length from 86 to 117 feet. The piers supporting the channel span are 500 feet apart on centers and the trusses are 498 feet long, center to center of end pins.

The superstructure was designed according to the specifications of the Pittsburgh & Lake Erie Railroad for the heaviest locomotives and train loads that are used on any of the Pennsylvania railroads, and abundant mass was provided for impact, traction, secondary stresses and to secure the utmost rigidity. These conditions have resulted in some of the heaviest construction ever built for double-track service. The bridge was proportioned for a dead load of 10,400 pounds per linear foot and for a 152½-ton engine with tender followed by a train load of 5,000 pounds per linear foot for each track. Wind pressure was taken at 30 pounds per square foot on half the exposed area of both trusses, and the floor system and on a train surface 10 feet high, which gave a pressure of 900 pounds per linear foot for the bottom lateral system, 450 pounds for the top laterals, and 100 pounds on the upper floor. With these data the stresses were computed and materials proportioned as indicated in the stress diagram. The portal stresses were calculated by the method of least work, which gave a maximum of 9,300 pounds compression per square inch and 4,730 pounds bending stress per square inch in the end post. The maximum bending moment and shear in the lower deck stringers is 590,000 pounds and 78,000 pounds respectively. In the floor-beams the corresponding stresses are 2,063,000 pounds and 223,000 pounds. In the upper deck the floor-beams have a maximum moment of 641,900 pounds and a maximum shear of 64,000 pounds. All material is soft steel punched without reaming for all thicknesses up to ¾ inch, except for the pins, eye-bars and rollers which are medium steel.



Clairton Bridge: End View of Channel Span, Showing Massive Construction.

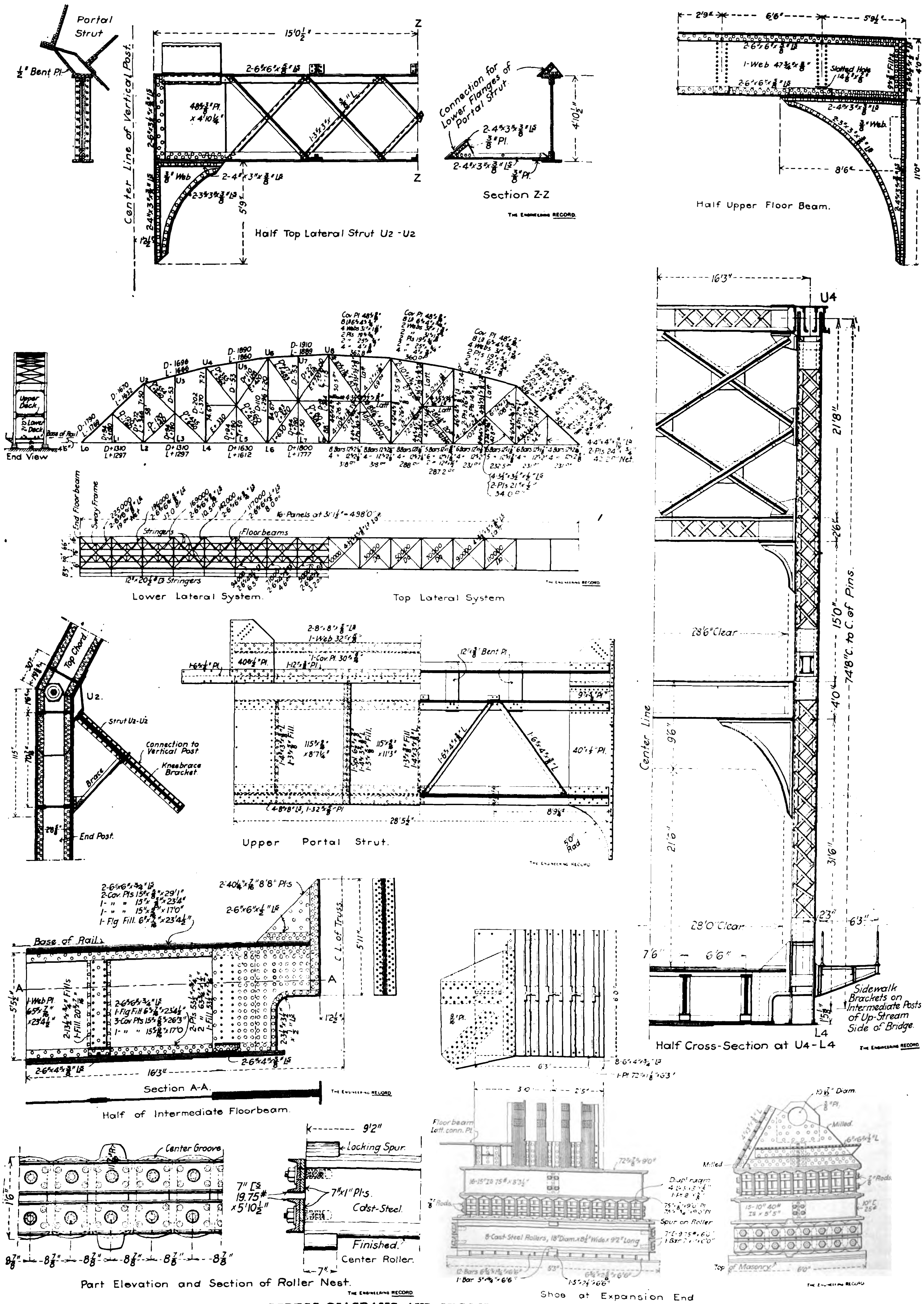
The main span is supported on two masonry piers at a clear height of about 53 feet above water level. The trusses have shoes and grillages on 10x14½-foot stone pedestals on a coping 48 feet long and 15 feet wide. The base of the pier is 17 feet wide and about 68 feet long, including a triangular cut-water at each end. There are several offset foundation courses which, in one pier, are seated on the solid rock and in the other on a timber grillage with pile and concrete footings. The superstructure is calculated for two railroad tracks on the lower deck and for future highway service on the upper deck, for which only the floor-beams have been erected, the remainder of the platform being designed to be built later when required. Most of the details of the superstructure conform to ordinary standards of high grade railroad work, and are of simple heavy construction with a few special features developed to provide for the large stresses.

All truss members are pin-connected. All floor, lateral, sway-brace and other secondary members have field-riveted connections. The pins at the main panel points are 10⅛ inches in diameter and have a maximum length of over 6½ feet. The pins in the middle of the diagonal members are 9 inches in diameter and the remainder are 5⅞ inches. The top chord and end posts are 4 feet wide and nearly 3 feet deep over all with four webs, each of them made with two or three plates riveted together, and a pair of 6x4-inch flange angles. The webs are connected by vertical transverse diaphragms each side of each panel point, by a single thickness of top cover-plate and by lattice bars on the lower flange. The webs are reinforced at pin points by as many as seven plates each at points of maximum stress. The top chords are made in lengths of 62 feet 3 inches, spliced on centers of the pins and locked together by the outside pin plates with full holes. The joints at the hips and at the center where there are angles, are protected by bent-plates over the top and bottom flanges.

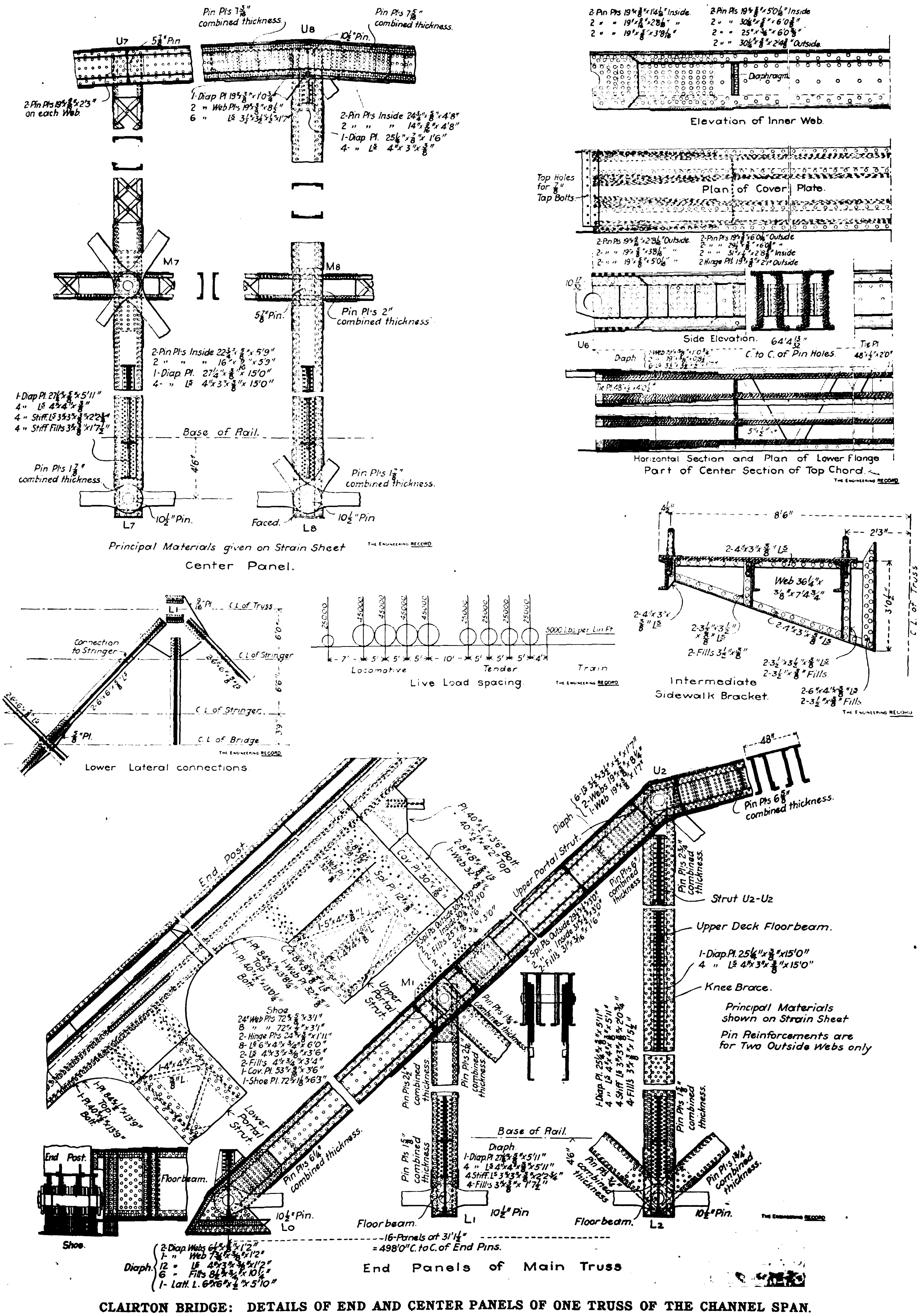
The foot of the end post is mitered on the center line of the pin Lo. The pedestal webs are mitered to correspond and each member has a half hole for pin bearing. The ½-inch clearance between the post and pedestal webs is covered by a bent plate on the upper side, which connects the end post with the inclined cover-plate across the pedestal webs. Each pedestal receives a total maximum load of 10,500,000 pounds, and its webs are heavily reinforced to give sufficient bearing area. The outer ones are 6 3/16 inches wide and the inner ones are 5 11/16 inches, thus making a total of about 250 square inches, which is distributed over a base about 5x6 feet, inclusive of a projection which carries the end floor-beams. The pedestal webs are connected by vertical transverse diaphragms on the center line. The outer web on the inner side has a horizontal connection angle to which is field-riveted a wide gusset plate receiving the end floor-beam and end lateral diagonal, and is reinforced under the bearing of the former by a vertical packing composed of transverse diaphragm plates and angles transmitting the load directly to the base plate.

At the sliding end of the bridge the pedestal rests on a grillage built of a double layer of crossed 15-inch I-beams set close together and bolted with separators made of vertical plates and angles. The beam flanges are riveted to thick plates which are planed top and bottom, and the lower plate has a transverse rib engaging a notch in the center line of a nest of segmental cast-steel rollers. Each roller is tap-bolted at each end to a top and bottom cross-bar and the center roller has a convex spur projecting from the curved surfaces on the upper and lower sides at each end, which engages a notch in the bearing plates and centers the nest in the required position. The rollers are seated on transverse bearing strips riveted to a bed-plate 6½ feet wide and 10½ feet long. At the other end of the bridge the grillages under the pedestals are seated on a special fixed bed-plate which corresponds to one tier of the grillage, but is made with ten 18-inch I-beams 9 feet long riveted to a planed 1-inch top plate and a double base-plate 2¼ inches thick, 6 feet 3 inches wide and 9 feet 9 inches long, anchored to the masonry. The webs of the grillage beams are connected by a riveted transverse diaphragm and the ends are enclosed by vertical transverse plates riveted to the top and bottom plates. The spaces between the beam webs are filled solid with rich Portland cement concrete.

The intermediate floor-beams in the lower deck are plate-girders about 30 feet long and nearly 6 feet deep over all. The web plate is made with three sections and the short end sections project above the top flange to make the connections with the vertical posts, serving also



CLAIRTON BRIDGE: STRESS DIAGRAMS AND MISCELLANEOUS DETAILS OF THE CHANNEL SPAN.



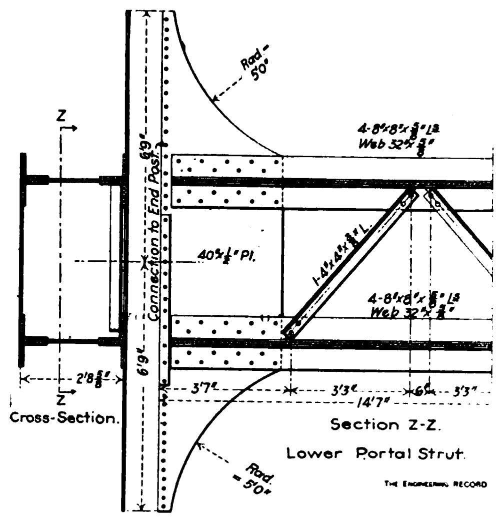
CLAIRTON BRIDGE: DETAILS OF END AND CENTER PANELS OF ONE TRUSS OF THE CHANNEL SPAN.

as kneebraces. They are spliced to the middle sections by four cover plates which extend far enough to receive the stringer connections. The lower corners are notched to clear the bottom chord bars and the edges are finished with curved flange angles. The connection to the vertical post is made with seventy-eight ⅞-inch field-driven rivets in single shear. The stringer connections are made with twenty-six ⅞-inch rivets each. In the upper deck the floor-beams have 48-inch webs and 6x6-inch flange angles without cover-plates. They are seated on wide solid-web kneebraces with curved flanges resembling portal struts. Both floor-beams and brackets are field-riveted to the vertical posts through their end flange angles. The floor-beams are punched with holes for stringer connections, but the stringers are not erected.

The trusses are connected by lattice-girder transverse struts at every top chord panel point. These are made with solid web plates at the ends and are field-riveted to the vertical posts through the kneebraces and their end vertical angles. The top lateral diagonal braces are I-shaped members made with pairs of angles back to back, latticed. Their depth is equal to the depth of the top chords, to which they are connected by field-riveted horizontal plates engaging the inner flanges of the chords. At intersections one of them is continuous and the other is cut to clear it and spliced across it by top and bottom flange cover plates. The bottom lateral diagonals are pairs of 6x6-inch and 6x4-inch angles riveted together back to back and having their vertical flanges upwards. Their connection plates are field-riveted to the bottom flanges of the floor-beams and 54-inch stringers and to the feet of the vertical posts. At intersections one diagonal is continuous and the other is cut to clear and spliced across it by a bottom flange cover-plate, which is also field-riveted to the continuous diagonal.

The portal is a rather complicated member consisting of three parts, as indicated in the diagram of the cross-section. There is a deep box plate-girder connecting the upper parts of the end posts and extended at the hips to join a six-sided strut with two of the sides in the planes of the top chord flanges. These two members are riveted together to form one and are connected by continuous bent plates to an I-shaped girder on the center line of the end vertical member of the truss. The girder is seated on deep kneebrace brackets and its lower flange is braced with zigzag angles to the lower flange of the end post strut, a massive construction without diagonal or lattice members to interfere with the highway on the upper deck.

At the center and at four intermediate panel points there are upper and intermediate transverse struts from 20 to 30 feet apart with heavy latticing between them, as indicated in the main



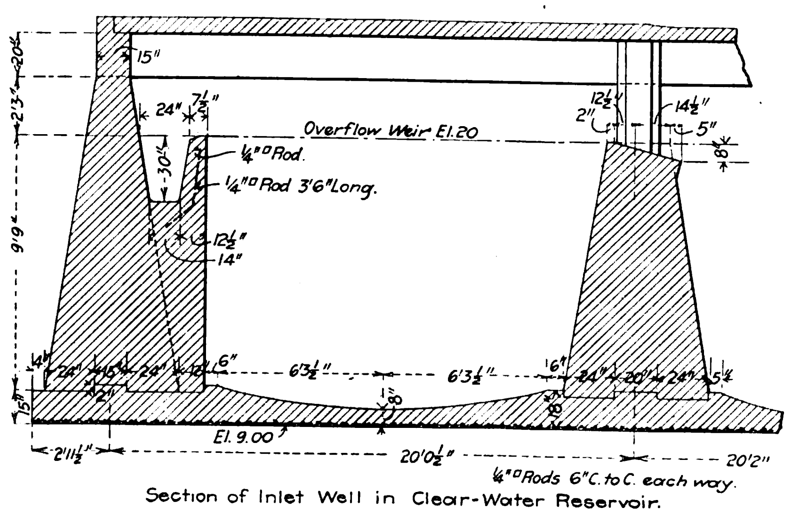
Lower Portal Strut, Clairton Bridge.

cross-section. The intermediate latticing is made with I-shaped members formed with two pairs of angles back to back, latticed. These members in one direction are continuous and in the other are cut to clear them and spliced across with large square connection plates on both flanges. The bottom portal struts connecting the end posts have rectangular cross-sections composed of two plate-girders with horizontal webs, which are connected on the outer flange by a 69½-inch cover-plate and on the inner flange by lattice-angles. They are field-riveted to the end posts through the flanges of the latter and through kneebrace plates projecting from both sides of the struts. On one side of the bridge a 6-foot sidewalk is carried by solid web cantilever brackets field-riveted to the vertical posts.

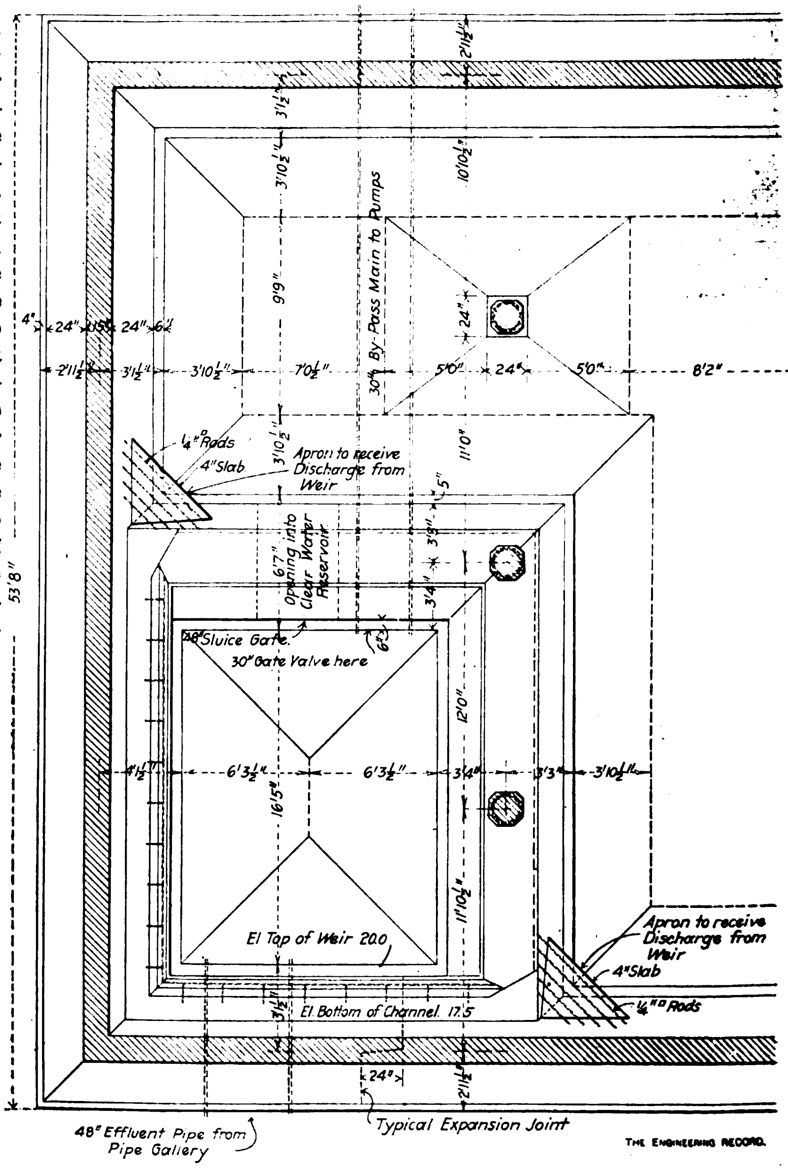
The shop work on this bridge was of the usual character for high grade railroad construction except for the top chords and the 90-foot, 60-ton end posts, which were machined rather differently from the usual custom in the shops where they were made. They were so long and heavy that it was thought too inconvenient and expensive to turn them end for end to mill and bore and the machines were accordingly brought to the work instead of bringing the work to the machines, as is customary. All these machines are driven by independent motors, seated on them or on their beds, and one of the milling machines was lifted by the girder crane and set in position to mill one end of the piece after it had been moved longitudinally from the position in which the other end had been milled by the other machine. The horizontal boring machine was removed from its foundations and set temporarily in an open space where it could bore first one end hole, and then move slowly along until it reached the center and opposite end, and bored all the holes with the piece stationary. The total weight of the structural material, in the channel span, including the sidewalk, is approximately 5,500,000 pounds.

A Concrete-Steel-Construction Filtration Plant for the New Haven Water Company.—II.

Raw water will flow by gravity from Lake Whitney to the filters and through them to the clear-water reservoir, from which the filtered water will be raised about 100 feet to Prospect Hill reservoir, through a 30-inch force main about 2,100 feet long. Not far from the clear-water reservoir are two pumping stations which have been in use for some years. The nearer station is driven by steam power and contains a 10,000,000-gallon Worthington high-duty pump, and, as a reserve, a curious horizontal pumping engine built in 1871 by Mr. Thomas Sault, of New Haven. The other station is situated just below the Whitney dam and is equipped with a single 27-inch horizontal turbine built by the Rodney Hunt Machine Company, of Orange,



Section of Inlet Well in Clear-Water Reservoir.



Plan of Inlet Well in Clear Water Reservoir.

NEW HAVEN FILTERS: DETAILS OF INLET WELL IN CLEAR WATER RESERVOIR.