THE LARGEST ARCH BRIDGE IN THE WORLD.

An important feature in the costly improvements being carried out by the Pennsylvania Railroad in and around New York is the building of a connecting railway for uniting the systems of the Pennsylvania Railroad and the New York, New Haven and Hartford Road. This connection will be made by means of a crossing of the East River, the most important feature of which will be an arch bridge (the largest in the world) of about 1,000 feet span. The plans for this bridge have been recently submitted to the Municipal Art Commission for its approval, in accordance with the franchise granted by this city to the company. The great steel arch will form part of a steel viaduct, itself the largest of its type in the world, the whole length of the structure, from abutment on Long Island to abutment in the Bronx, being 17,000 feet, considerably over three miles. With a wide, sweeping curve, the viaduct will pass over Hell Gate, Ward's Island, Little Hell Gate, Randall's Island and Bronx Kills. It will be not only the longest, but considerably the heaviest steel bridge in existence, over 80,000 tons of steel being needed for its construction. With its completion, the city of New York will find itself in possession of an all-rail route between New England and the South and West. Through trains from Boston may then run to New York, Philadelphia, Baltimore, and Washington, Palm Beach, New Orleans, Chicago, St. Louis, or any other southern or western city without leaving the rails. Hitherto cars for such through trains have been ferried around Manhattan Island from the Bronx to Jersey City.

The steel arch which will span the waters of Hell Gate will have a clear span between abutments of 1,000 feet, made up of twenty-three panels of about 42½ feet between centers. The depth of the truss at the ends will be 140 feet; at the center, 40 feet; and at the quarters 66 feet. The reverse curve of the upper member of the arch at either end is explained by the necessity of raising the top member of the portal to a sufficient height above the tracks to allow head room for the trains. At the quarters, the height has been purposely made such that no increase in the sections of the arch members is required to meet the bending strains due to one-sided loading. To this end the height, here, has been made greater than one-quarter the rise of the arch, which latter is 220 feet. From this it will be understood that the reverse curve of the top member of the arch is strictly the result of the contingencies of the design. The lower arch member has a section of 9 feet by 6 feet at the bearing and 5 feet by 5 feet at the center, the width decreasing evenly from the bearing to the crown. The struts are all riveted box sections, and the suspenders consist of eight heavy angles laced together.

The floor system is built on the customary method of heavy cross girders and longitudinal stringers. The floor beams are 8 feet in depth by 80 feet in length. The main arches are placed in vertical planes 60 feet apart, and the longitudinal portion of the floor system consists of eight lines of stringers, or two beneath each of the four lines of railroad track. Above the stringers is laid a solid wood floor of creosoted 8 x 8-inch timbers, packed tightly together, and calked. Upon this is 14 inches of stone ballast, in which are imbedded the cross-ties of the regular Pennsylvania Railroad standard track system. It should be mentioned here that the floor beams are the heaviest ever built for a bridge, the section of the bottom flange of the girders at the center being 6¼ by 24 inches, or 150 square inches.

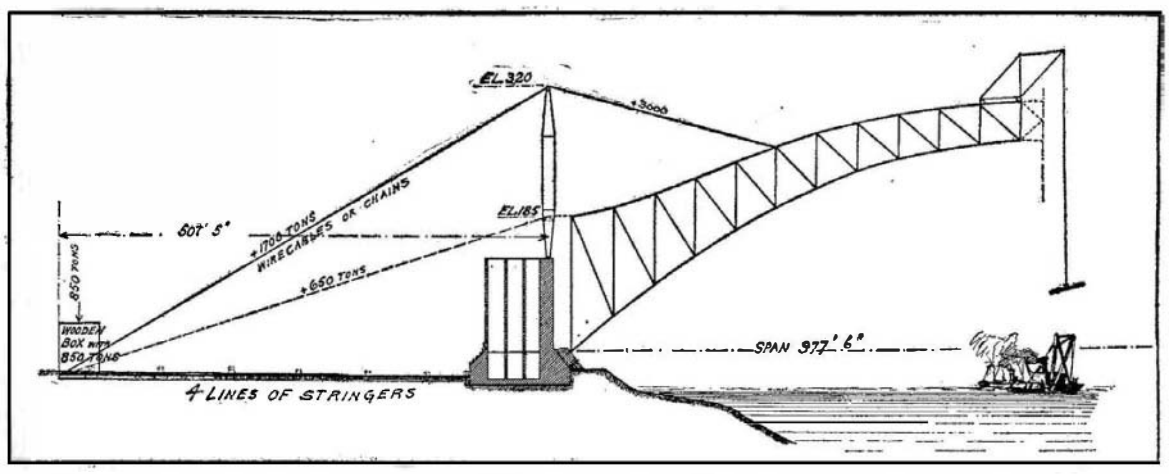


Diagram Showing the Arrangement of the Anchorage, Cables, and Rocker Tower to be Used in Erecting the Arch by Overhang.

Wind bracing is carried in the plane of the upper and lower arches from bearing to crown; but the main wind bracing is carried in the plane of the roadway, and it is arranged as a cantilever truss system. The contra-point and expansion joint of the cantilever are located six panels from each end of the arch; so that the temperature strains of the suspended floor system will in no way affect the arches—in other words, the temperature stresses of the arch and the floor have been made independent of each other. The maximum compression in the arch is found at the bearing, where it amounts to 16,800 tons, decreasing from that to 13,600 tons at the crown. This compression is that due to the combined dead and live load, wind pressure, and temperature stresses.

The abutments of the arch will be monumental stone and concrete towers, which will serve to divide the arch bridge proper from the steel viaduct which forms the approaches to it. The base of the tower will be built of granite; and it will rest on foundations of a very hard gravel at a depth of 20 feet below the surface. The upper portion of the towers will be built of molded concrete, and, as will be seen from our illustrations, the design of these towers is simple, massive, and dignified, and altogether harmonious with the design of the great arch itself.

An interesting feature of this bridge is the method of erection, which will be carried through without the assistance of any false work in the whole 1,000 feet of its length. The arch will be built out in two halves simultaneously from each abutment, the steel work being guyed back to an original system of anchorage constructed in the following manner: At a distance of 507½ feet inshore from the abutment two huge wooden boxes or caissons, 12 feet wide, 42½ feet long, and 50 feet high, will be erected on the surface of the ground and each loaded with 850 tons of pig iron. Four lines of the stringers, which will subsequently be built into the floor of the bridge, will be laid in the planes of the arches in a straight line from each box to the abutment. Upon the top of the abutment will be erected two temporary rocker posts, and over these will pass the wire cables or eyebar chains, as the case may be, which will be used during erection to carry the load of the arches until they meet at the center of the span. The four lines of stringers will act as compression members, and prevent the movement of the dead-weight anchorages under the pull of the erection cable, which latter will reach a maximum figure, when the arches are well out to the center of the span, of 3,000 tons for each arch. The overhanging arches will be held against wind pressure during erection by means of two cables carried down to anchorages, on each side of the main abutment.

After the closure of the arch, the suspenders will be attached at their upper ends to the panel points of the arches, and to their lower ends will be riveted the floor beams. Upon the floor beams will be built in the whole floor system, with its stringers, wind bracing, wooden floor, etc.

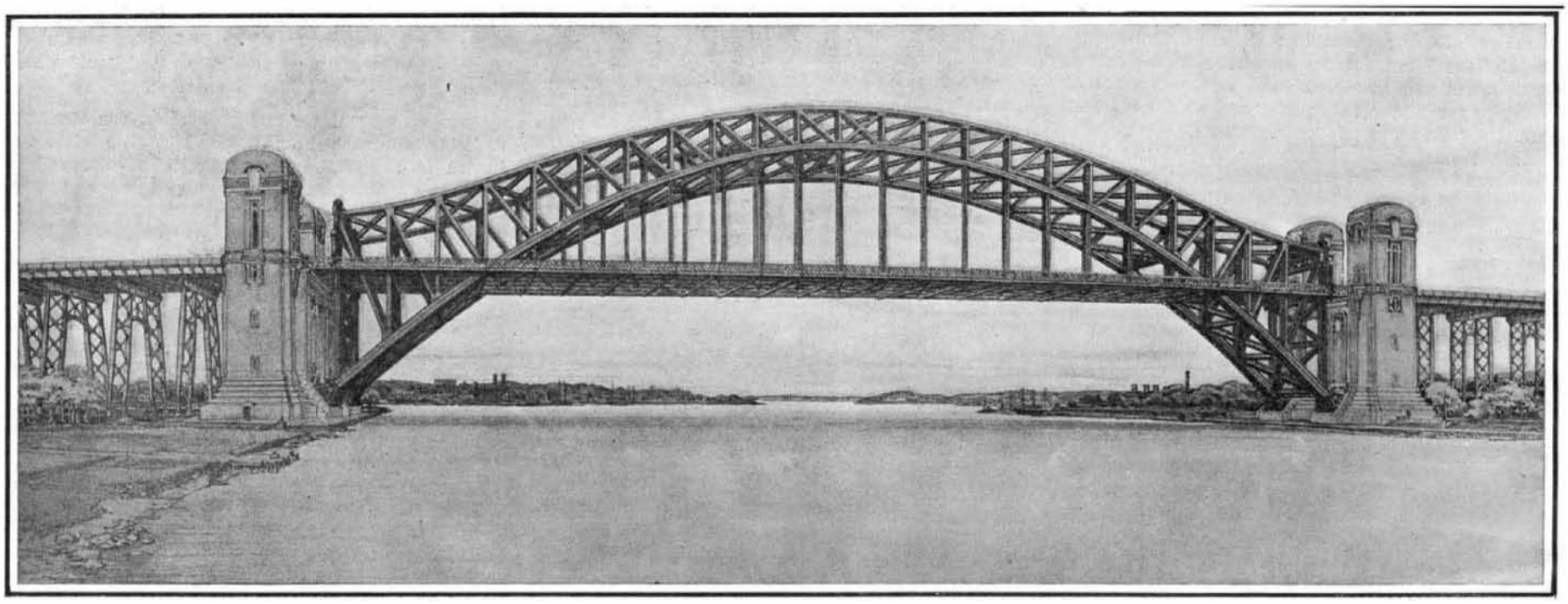
The bridge has been designed to carry on each of its four tracks a load equivalent to two locomotives, each with a concentrated load of 52,000 pounds on each of the four drivers, the total weight of each of the two engines being 190 tons, followed by a train load of 5,000 pounds to the lineal foot. This would be equivalent to loading the whole of the four tracks from end to end of the arch with trains made up of heavy freight locomotives; and so stiff is the arch that under this load, the deflection at the center would be only three inches.

The three-mile viaduct will be made up of spans of from 70 to 100 feet, carried mainly on four-column rocker steel bents; but at every 800 feet of the viaduct there will be a massive stability pier of concrete, and also an expansion joint. It is estimated that the bridge can be built in two and one-half years, and at a probable cost of $12,000,000.

This handsome structure was designed by Mr. Gustav Lindenthal, the former Bridge Commissioner of this city, to whom we are indebted for assistance in the preparation of the present article.

Gold Varnish for Gilding Picture and Mirror Frames.

a. 1,250 parts by weight of pale shellac, 500 parts of sandarac, 250 parts of gamboge, 175 parts of the palest red sanders, 130 parts of Venice turpentine,



Span 1,000 Feet, Width 81 Feet, Rise of Arch 220 Feet, Maximum Depth of Truss 140 Feet.

THE LARGEST ARCH BRIDGE IN THE WORLD. CROSSING EAST RIVER AT HELL GATE.

5,000 parts of alcohol. *b.* 1,250 parts of pale shellac, 500 parts of sandarac, 5 to 8 parts of aniline yellow (or better, chinolin yellow), 175 parts alcoholized red sanders, 130 parts of Venice turpentine, 5,000 parts of alcohol. The coloring substances and shellac solutions to be filtered through filter paper, the resinous solutions, after settling a few days, to be passed through a closely-woven fabric. Each ingredient must be dissolved separately, then, after filtration or settling, mixed with the others, and the whole thoroughly stirred together.

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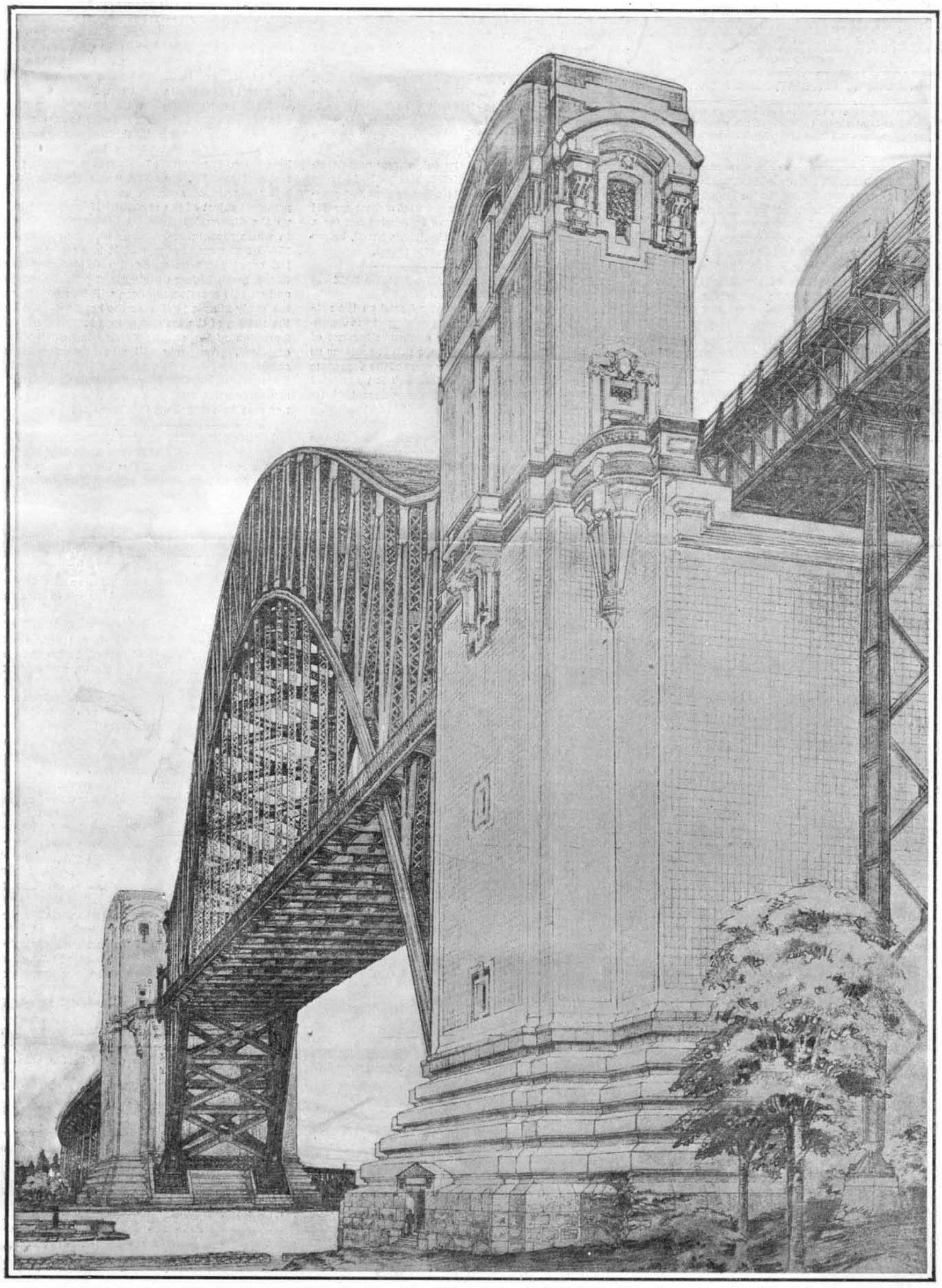

THE ONE-THOUSAND-FOOT FOUR-TRACK ARCH BRIDGE OF THE CONNECTING RAILWAY WHICH WILL SPAN THE EAST RIVER, NEW YORK.—[See page 468.]