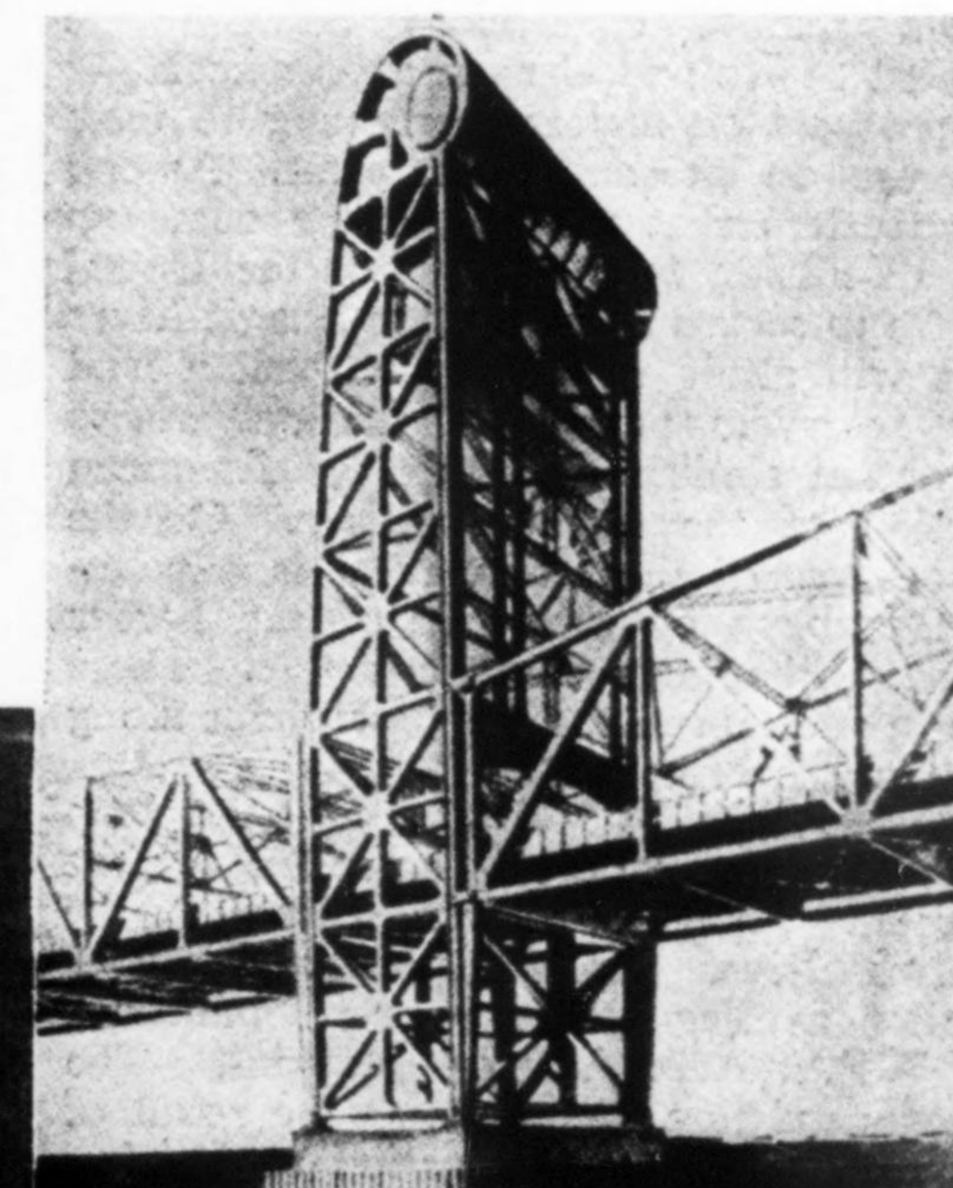
SECOND LONGEST LIFT SPAN PLACED AT NEW YORK

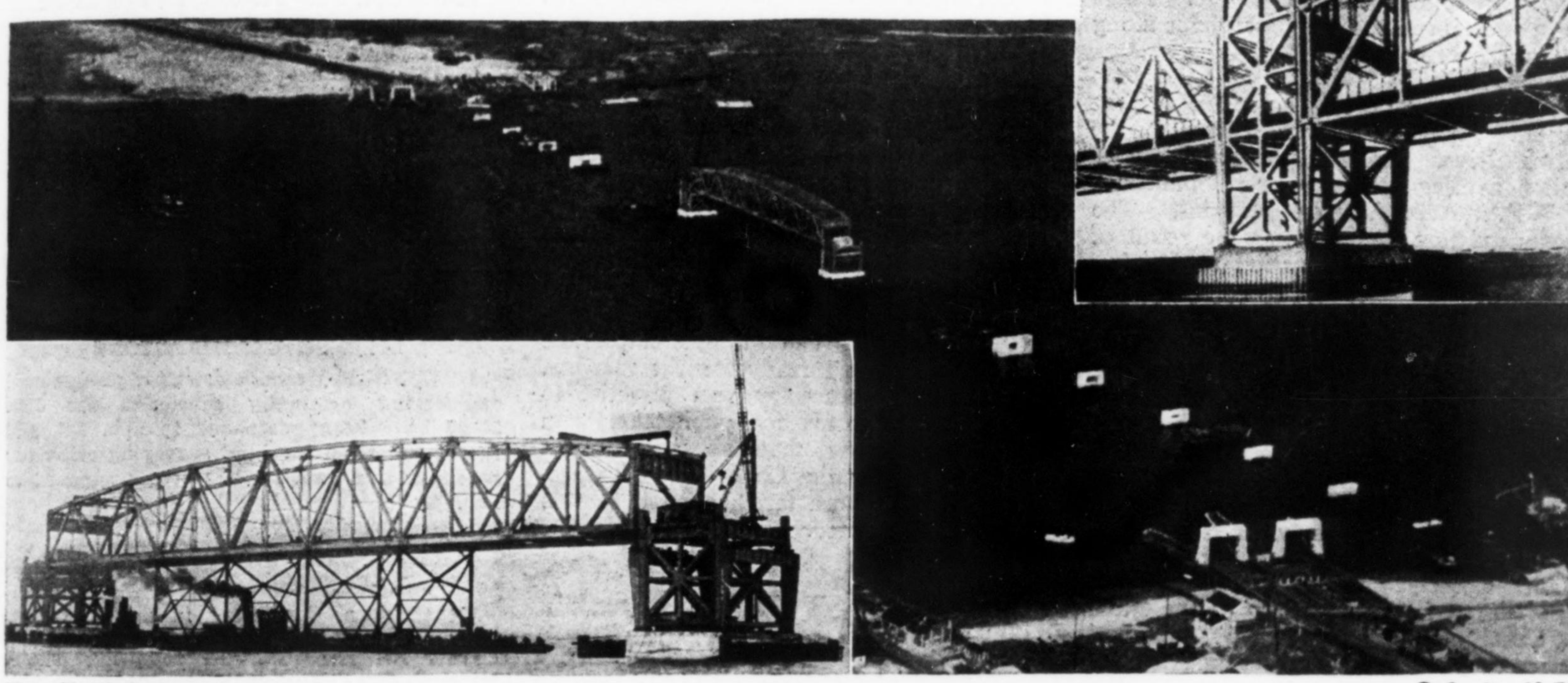
WHEN the 540-ft. lift span of the Marine Park bridge, second longest ever built, was floated into position across the channel entrance to Jamaica Bay in the early morning of Jan. 12, the Rockaway Inlet crossing which will connect Brooklyn with Jacob Riis Seashore Park in Queens began to define its ultimate shape. As shown in the air view, the lift span is at the center of the bridge. From the lift span to each shore, there will be a 540-ft. through truss (duplicate of the lift span), a continuous deck truss of two 214-ft. spans, a continuous deck truss of three spans (190-176-160 ft.), and a simple span of 97 ft. Exceeded in length only by the 544 ft. Cape Cod Canal railroad span and in weight only by the Albany-Rensselaer highway span (2,250 as against 2,750 tons), the Marine Parkway lift span is of major importance. It is further notable because of its open-mesh steel deck and the unusual architecture of its towers.

Erection of the lift span is following a somewhat different procedure than has heretofore been used, based principally on the desire of the erector to use the lift span as a platform to support temporary erection towers whose derricks will build the bridge towers to their full 200 ft. above the masonry. Ordinarily these temporary towers would be placed on the flanking spans, and the bridge towers would be erected before placing the lift span, but in this case one of these openings had to be maintained for shipping while the lift span was being assembled. Also, the piers for the flanking spans were not completed at the time it was desired to start steel erection.

As shown in the lower view, the towers were built initially only to deck level, slightly above the brackets which support the lift span end-derricks. The stiffleg derrick shown was used to assemble the lift span on four 50-ft. high supporting bents set on two 325x38-ft. car floats, the fabricated members being brought in by barge and the span moved past the derrick until assembly was complete. Tugs then maneuvered the span into position at high tide, and jacks placed on the lower brackets lifted it clear and then lowered it into position. The two flanking spans will be erected in the same way. The deck truss spans will be assembled complete on car floats at the railroad yard about five miles away and towed to the site.

The bridge is being erected by the American Bridge Co. The Frederick Snare Corp. built the foundations. The bridge was designed by Waddell & Hardesty, consulting engineers, New York City. For the Marine Parkway Authority, Robert Moses is commissioner, Madigan-Hyland consulting engineers, and Aymar Embury II, consulting architect.





Wide World Photo *Rudy Arnold Photo*

Armco Plans Unusual Building To House Research Work

Porcelain enameled steel sheets, stainless steel trim, and glass blocks will supplant more conventional materials in the walls of a new research laboratory to be built by the American Rolling Mill Co. at Middletown, Ohio, according to an announcement made by Charles R. Hook, president, on Nov. 16. The one-story laboratory building, to cost $260,000 will cover 42,000 sq.ft. and has been designed and will be erected by the Austin Co., of Cleveland. The frame will be welded.

Six hundred lineal feet of porcelain enamel side walls, cream colored with contrasting decorative pilasters and bands of stainless steel, will enclose the three street sides. Between the pilasters there will be broad areas of glass blocks in which horizontal steel sash with clear glass will be set. Additional daylight will be furnished through vertical saw-tooth monitors closed in with glass blocks in continuous sections, 175 ft. long and 10 ft. high. The entire building is being equipped for summer and winter air conditioning.

A massive square central entrance tower will dominate the principal facade. Vertical shafts of glass blocks, recessed between narrow strips of porcelain, will extend upward for its full two-story height from a semi-circular marquee of stainless steel at the portal.

Army to Establish Laboratory In New York City

The ordnance department of the U. S. Army will establish, early this year, a precision gage instrument laboratory for the New York area at New York University. The laboratory, which will be the only one of its kind in the metropolitan area, will be used in the testing of various tools, instruments, mechanisms, and other equipment for military purposes. It will be available also to students of engineering.

Prof. Carlos De Zafra of the department of mechanical engineering at N. Y. U. and chief of the gage division of the New York Ordnance District of the Army, will be the director of the laboratory.

Waterworks Section Forms Sewerage Works Group

At the recent Denver meeting of the Rocky Mountain section of the American Water Works Association steps were taken to form a Rocky Mountain Sewage Works Association, which is to hold meetings at the same times as the section and in conjunction with it. R. W. Gelder, consulting engineer, Greeley, was elected president, and Dana E. Kepner, Denver, secretary-treasurer. Representatives to the Federation of Sewage Works Associations are L. C. Osborn, city engineer, Loveland, Colo., and J. W. McCullough, consulting engineer, Denver.

A heavy majority affirmative vote was cast for licensing of water superintendents and plant operators. The section voted unanimously to approve the action of the general policy committee with reference to reorganization of the staff at AWWA headquarters. Paul S. Fox, state public health engineer, New Mexico, is the new chairman and B. V. Howe, Colorado state sanitary engineer, was reelected secretary-treasurer.

HE ENGINEERING CONSTRUCTION WEEKLY ·

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Engineering NEWS-RECORD

March 10, 1938

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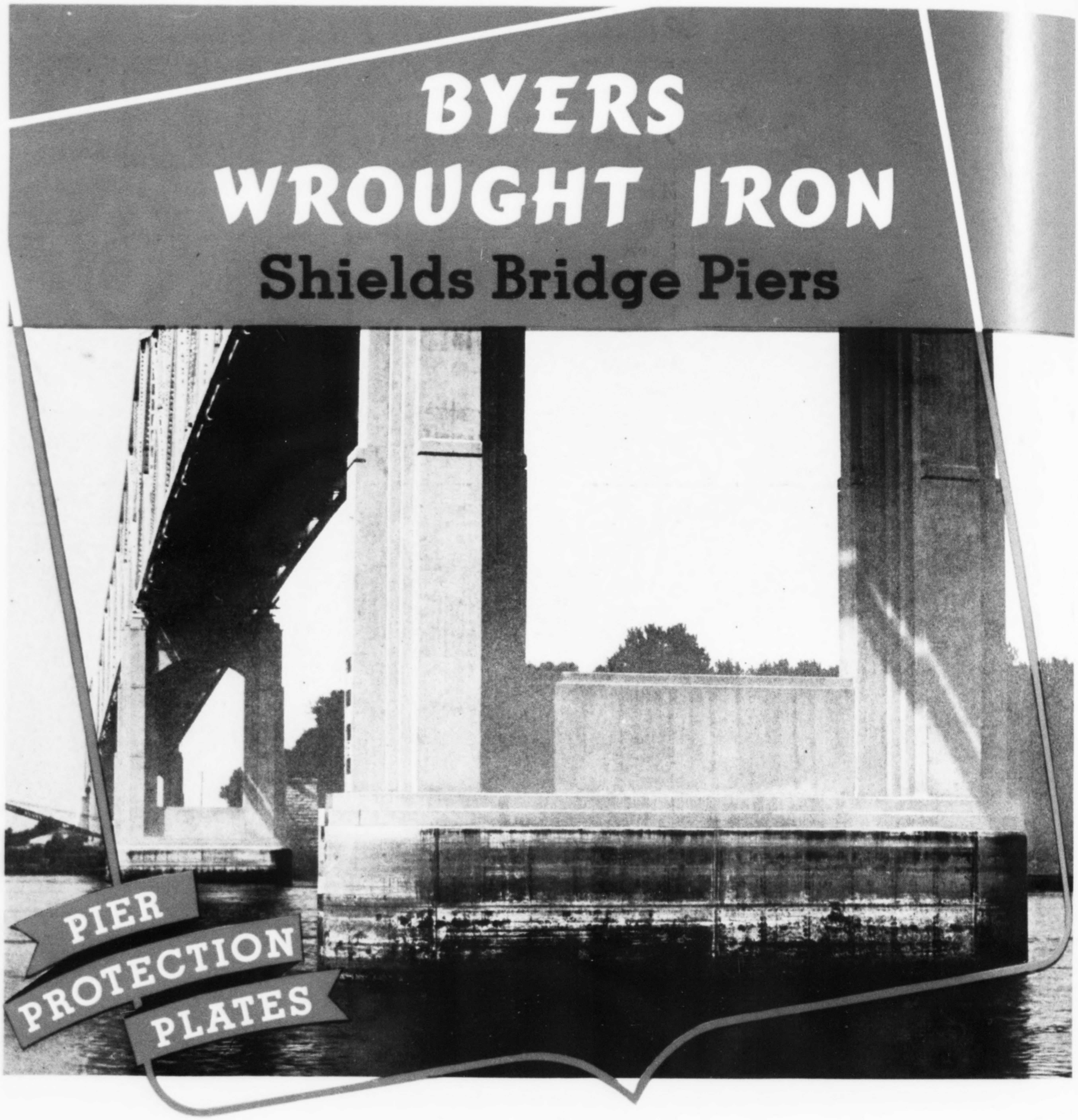

● Concrete bridge piers are constantly subjected to deteriorating influences such as the abrading or cutting action of the water, sudden shock from floating objects, or spalling caused by freezing and thawing.

Leading engineers are forestalling these destructive actions by protecting the concrete with Byers Wrought Iron because of its long-life, low-cost performance record under these and similar conditions.

Illustrated is an interesting, recent installation—one of many on the Illinois River, designed by the Illinois Division of Highways. On this bridge, at Havana, Illinois, casings of Byers Wrought Iron Plates protect the ice breakers of the piers. These 9-foot-high wrought iron casings were fabricated in units and all joints between units were made with continuous welds to provide a water-tight covering for the concrete.

You will find many other applications showing how wrought iron is being used to protect bridge structures, in our special report, "Wrought Iron in Bridge Construction." Ask our nearest Division Office for a copy or write our Engineering Service Department at Pittsburgh. We will also be glad to furnish information regarding fabrication, methods of attachment and estimating prices. A. M. Byers Company. Established 1864. Pittsburgh, Boston, New York, Philadelphia, Washington, Chicago, St. Louis, Houston, Seattle, San Francisco.

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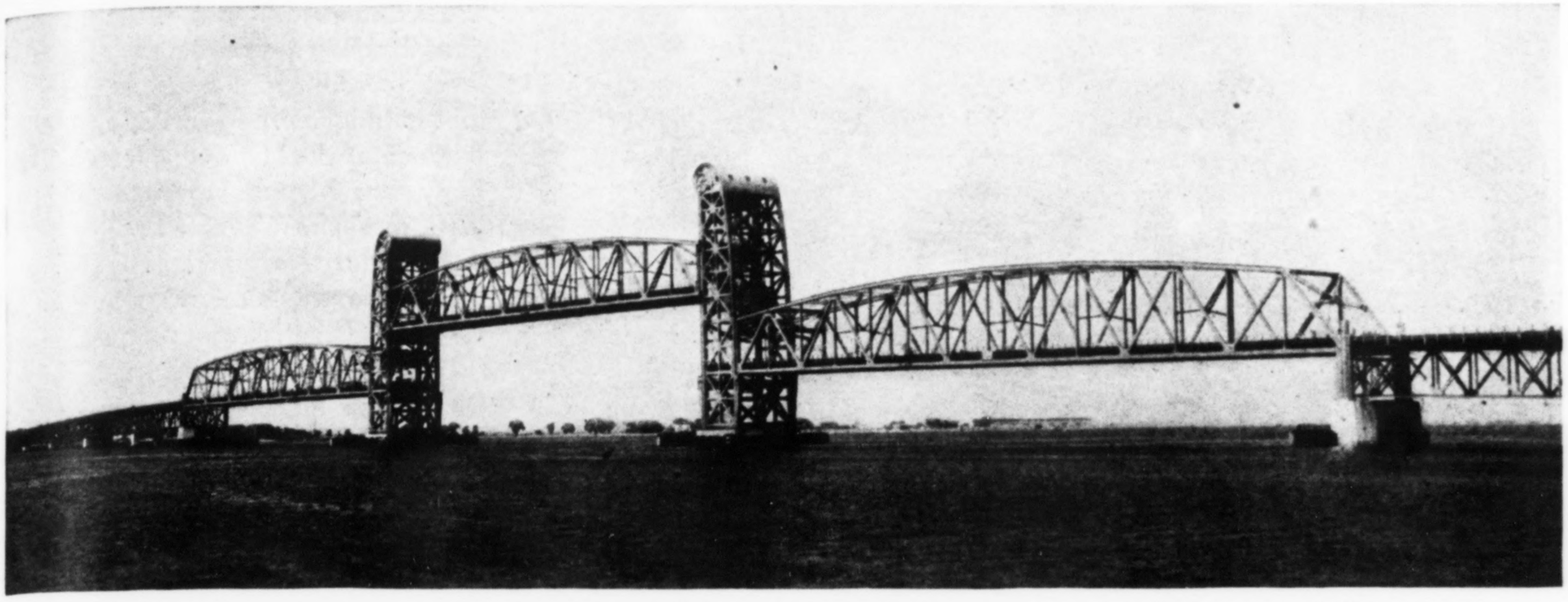

LONGEST HIGHWAY LIFT-SPAN RISES 95 FT. FOR JAMAICA BAY SHIPPING AT NEW YORK. IT IS 540 FT. LONG

Erecting the Marine Parkway Bridge

by W. K. GREENE AND E. E. MCKEEN
Assistant Engineers, American Bridge Co., New York, N. Y.

Fourteen of 15 spans in New York City structure assembled on barges and floated into place. Bridge includes longest highway lift-span

SPANNING ROCKAWAY INLET in New York City is a new highway crossing that literally floated into place, for of the fifteen spans in the Marine Parkway Bridge, fourteen were erected on car-floats or barges and, on them, moved to their final positions in the structure. Free use was also made of floating equipment in erecting the towers for a 540-ft. lift-span, central unit in the bridge and the longest highway lift-span yet built. The erection of the superstructure of this bridge in the record time of 7½ months was made possible by the floating method of erection, and was one of the most extensive operations of its kind ever undertaken.

Marine Parkway, which passes over the new bridge, connects Flatbush Ave., Brooklyn, with highways on Rockaway peninsula and provides ready access to Jacob Riis Park on the oceanfront. The bridge, 3,839 ft. long, contains, as stated, a 540-ft. through-truss lift-span, and this is flanked on each end by a 540-ft. through truss fixed span and six deck-truss spans varying in length from 97 to 214 ft. The deck spans are arranged in a two-span continuous unit, a three-span continuous unit and a simple span. About 13,000 tons of structural steel was required, of which 3,400 tons is silicon steel, which is used in the through spans and the towers.

The crossing provides for both vehicular and pedestrian traffic on a four-lane, 44-ft. roadway and a 6-ft. sidewalk. The walk on the entire structure and the roadway on the deck spans are of reinforced concrete, while the roadway on the through spans and towers is of open-type steel grating construction.

Plan of attack

On account of the short time allowed for field operations, it was necessary to start the complicated tower and lift-span work first. In general, the plan was to erect with a derrick boat the first tier of the towers, which reached to and included the roadway. A stiffleg derrick was then erected on the north tower roadway. Two steel car-floats, 325x39 ft., braced together and fitted with steel falsework, to support the lift-span slightly higher than its final position (55 ft. above high water), were moored on the north side of this north tower. The lift-span was erected on these car floats by the stiffleg derrick on the tower, steel being brought in by barge. After being assembled, the span was floated to final position between the towers and transferred to the bridge seats.

Temporary triangular towers surmounted by stiffleg derricks were next erected, one at each end on the top chord of the lift-span, and these derricks completed erection of the towers. Finally, a mast and boom were placed on the north face of the north tower to erect first the south and then the north flanking through-truss spans in a manner similar to the procedure used for the lift-span.

Simultaneously with much of the above work, the deck spans, one by one, were erected on barges at a place remote from the bridge site and floated to final position in the structure. The only variation from the floating procedure was for the north 97-ft. span which was only partly over water and therefore had to be erected on falsework.

The car-floats used for erection of the through spans were placed 55 ft. on centers and parallel to the span

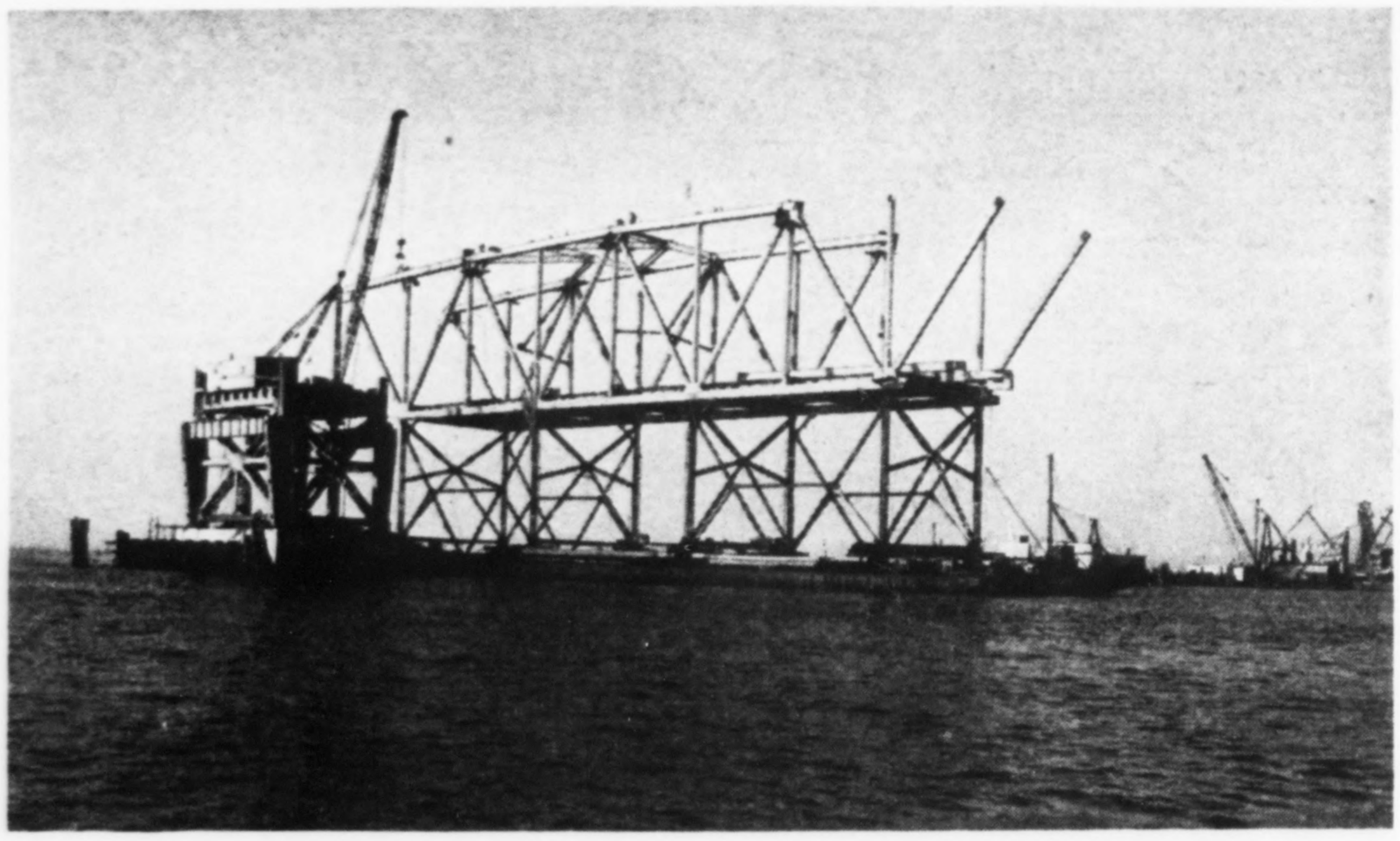

Fig. 1. The 540-ft. lift span was assembled on car-float falsework by a derrick mounted on the partly-completed tower.

to receive the 50-ft. high steel falsework which rested on three-tier beam grillages symmetrically placed. Bracing of timber and wire rope lashing secured the floats against relative lateral or longitudinal movement, but no effort was made to restrain other movement which might result from wave action. The bottom ends of the falsework columns were pivoted to provide for reasonable variations in elevations of the floats resulting from inequality of load or wave action, and at the top of the columns the span was carried in bearings so as to facilitate release of the car-float after the span was placed. The only positive fastenings between the span and the falsework were small knee braces (to take longitudinal forces) and the wire rope lashing; and these connections were released as soon as the span was in position. The same falsework and car-floats were used for all three through spans.

Since the derrick on the north tower and later the mast and boom were in fixed positions, the car-floats were moved from time to time as erection progressed, to make the work accessible. Erection proceeded both ways from the center of a span, with the maximum unbalanced condition being about two panels. The bottom chord splices and the bottom ends of the diagonals and verticals were riveted prior to floating to avoid loss of camber in the permanent structure.

The spans were erected complete on the falsework except for the floor grating, walk and handrail. One through-span ready for floating weighed 1,800 tons, and with car-floats and falsework formed a structure 540 ft. long, 94 ft. wide, and 125 ft. high, weighing 5,000 tons, which is comparable in size and tonnage to many ocean-going ships.

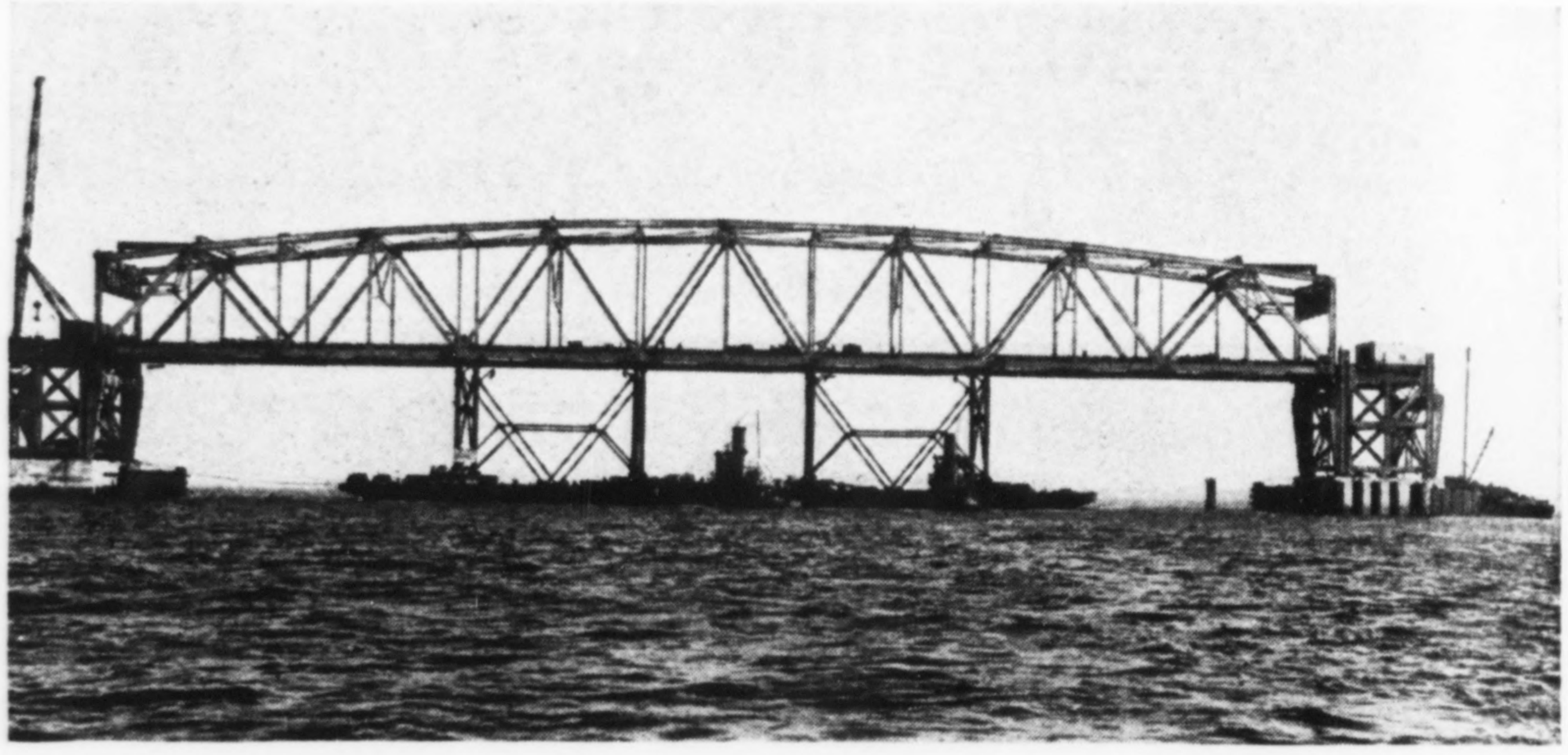

Fig. 2. The second step was to float the span into position at high tide and transfer it to the towers during an ebbing tide.

Floating-in

Rockaway Inlet at the bridge site is only a few miles from the Atlantic Ocean and has an average tide of about 5 ft. All spans were floated in at high tide using tug boats aided by anchor lines connected to air-operated winches. After the lift span, for example, was lashed in position, it was raised about 2 ft. (using hydraulic jacks set on the piers) and blocked on shims; special stiffeners were provided on the end floorbeams to permit this jacking. Then, as the tide ebbed, the load on the falsework was reduced, and finally the barges floated free, to be returned for the erection of the next span.

The total movement of the through-truss bearing points relative to water level (combined jacking of the span and ebbing of the tide) necessary to overcome the truss deflection and buoyancy of the car-floats and release the span was 2.9 ft.

Procedure for the flanking through-truss span was similar, with one exception. This relates to jacking at the ends remote from the towers where the ends of the trusses are pinned to the tops of rocker bents about 23 ft. high. At these points the jacking was done at the bottoms of the bents where a temporary guide giving both lateral and longitudinal support was installed. These guides (one for each leg of the bent) permitted rotation of the bent about the bottom end, which was necessary since the bottom chord of the truss elongated about 3 in. in changing from compression on the falsework to tension as a simple span.

Deck span procedure

Barges 114 to 186 ft. long by 34 ft. wide were used to erect the deck spans, two barges of the same length being placed side by side and lashed with wire rope bracing, as for the through spans. The loads of the deck spans were relatively small, and the falsework, which varied from 4 to 20 ft. in height, was made of timber. A grillage of steel beams carried the load from the trusses, spaced $31\frac{1}{2}$ ft. on centers, to the falsework located centrally on the barges.

Mill Basin, adjacent to Flatbush Ave. and about 5 miles by water from the bridge was the site for erection of the deck spans. All material was trucked to this location for erection on the barges by a stiffleg derrick set up on land. This procedure proved to be ideal for rapid completion of the work as the barges and falsework could be used with minor modifications for one span after another. The main truss connections were riveted as far as possible before floating to position. A completely-erected span was towed to the bridge site by tug boats, where the procedure for transferring the span to the piers was similar to that followed for the through spans. The deck spans weighed from 150 to 400 tons each and required a relative movement of jacking points to water level of 2 to 3 ft. to release the barges.

As mentioned previously, most of the deck spans are of continuous construction. Some special details, therefore, were required to permit jacking and to obtain the proper stress condition in the finished structure. The jacking was provided for by connecting the spans with an auxiliary gusset at continuous points. This gusset consisted of one plate placed on the center line of the truss connecting to the bottom chord and end diagonal so as not to interfere with the permanent plates located on the outside of the members about 15 in. apart.

Proper stress conditions were assured by weighing the reactions. Taking the 3-span unit as an example, each of the 3 spans was floated to position and set on the piers as a simple span. The bottom chord joints at the continuous points were connected, leaving the top chord joints at these points open. The extreme ends of the 3-span unit were then jacked up an amount equal to the deflection of these points for zero stress in the top chords at the open joints. The connections were made for this condition, thus insuring correct reactions. As a precaution the splice plates were not fabricated until check measurements had been made.

Open mesh floor

The open grating floor used on the through spans and towers in order to reduce dead load is a source of interest. This grating, the carrying members of which are $2\frac{1}{2}$x$\frac{1}{4}$ in. bars on edge and $2\frac{9}{16}$ in. on centers, is supported on transverse 7 in. I-beams spaced 16 in. on centers. The grating was delivered to the site in sections about 4 ft. wide and one panel or 38 ft. 7 in. long. These sections placed longitudinally on the bridge were riveted together to form a floor of continuously uniform pattern. The transverse joints located at each floor beam were made with shouldered rivets and a washer to provide an expansion or adjustment point. The grating was fastened by welding to the supporting 7 in. beams at $10\frac{1}{4}$ in. centers, the welds on adjacent beams being staggered.

The lift span is the longest highway lift span in the world. Complete ready for operation, it weighs 2,180 tons. The counterweights are of ordinary concrete placed in a steel box. Since the lift span was erected in the down position the counterweights were placed in the up position and utilized to raise the lift span to provide a navigation channel before floating the north or last through-span to final location.

Operation of the lift span is by electricity for both the normal and auxiliary movements. All operating machinery is located at the tower tops and synchronized electrically so that the span is always maintained level. The normal driving motors, one on each tower, are 200 hp., and the synchronizing motors are of the same size. The auxiliary motors, both driv-

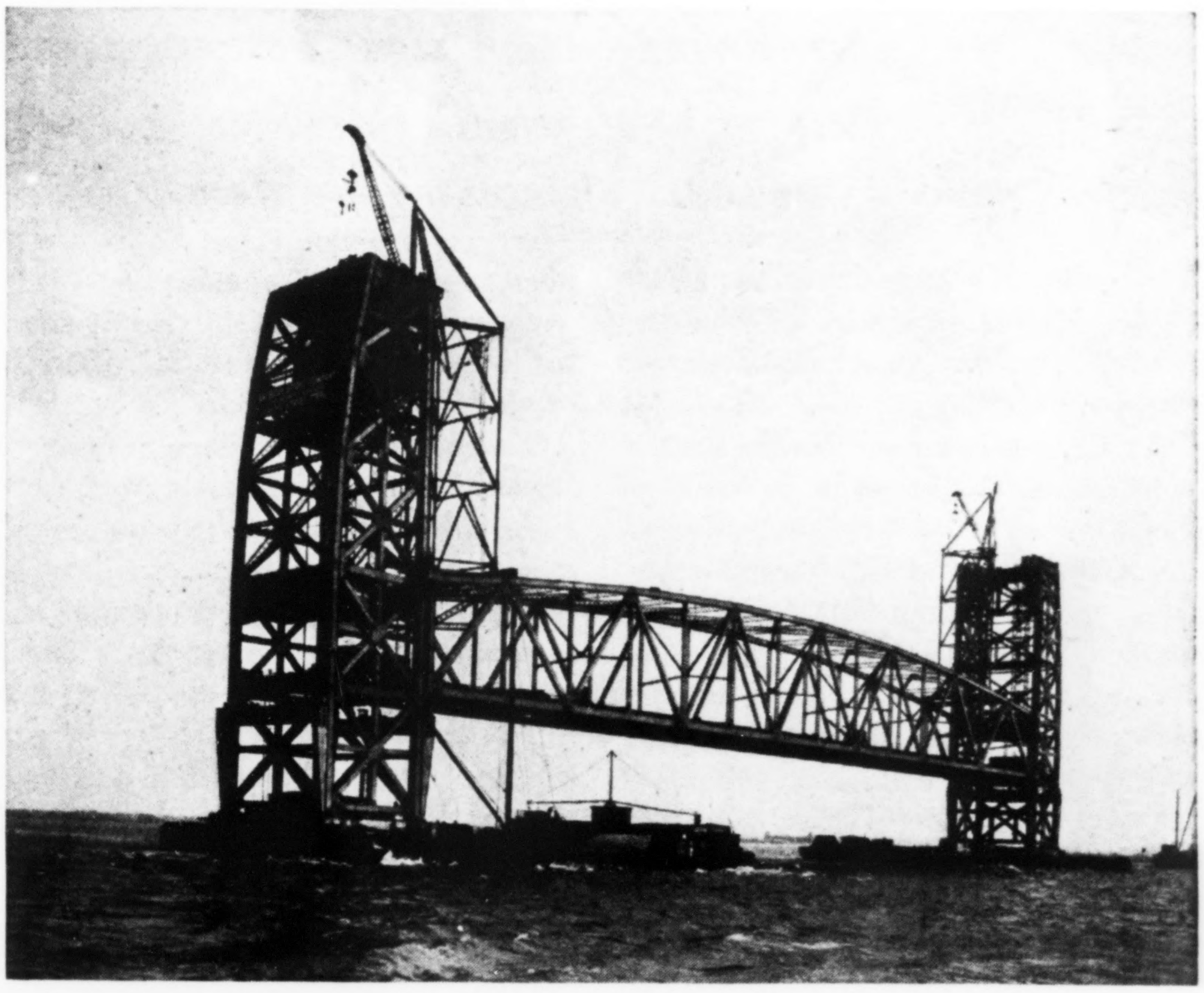

Fig. 3. The towers were raised to full height by derricks on triangular towers set on the top chord of the lift span.

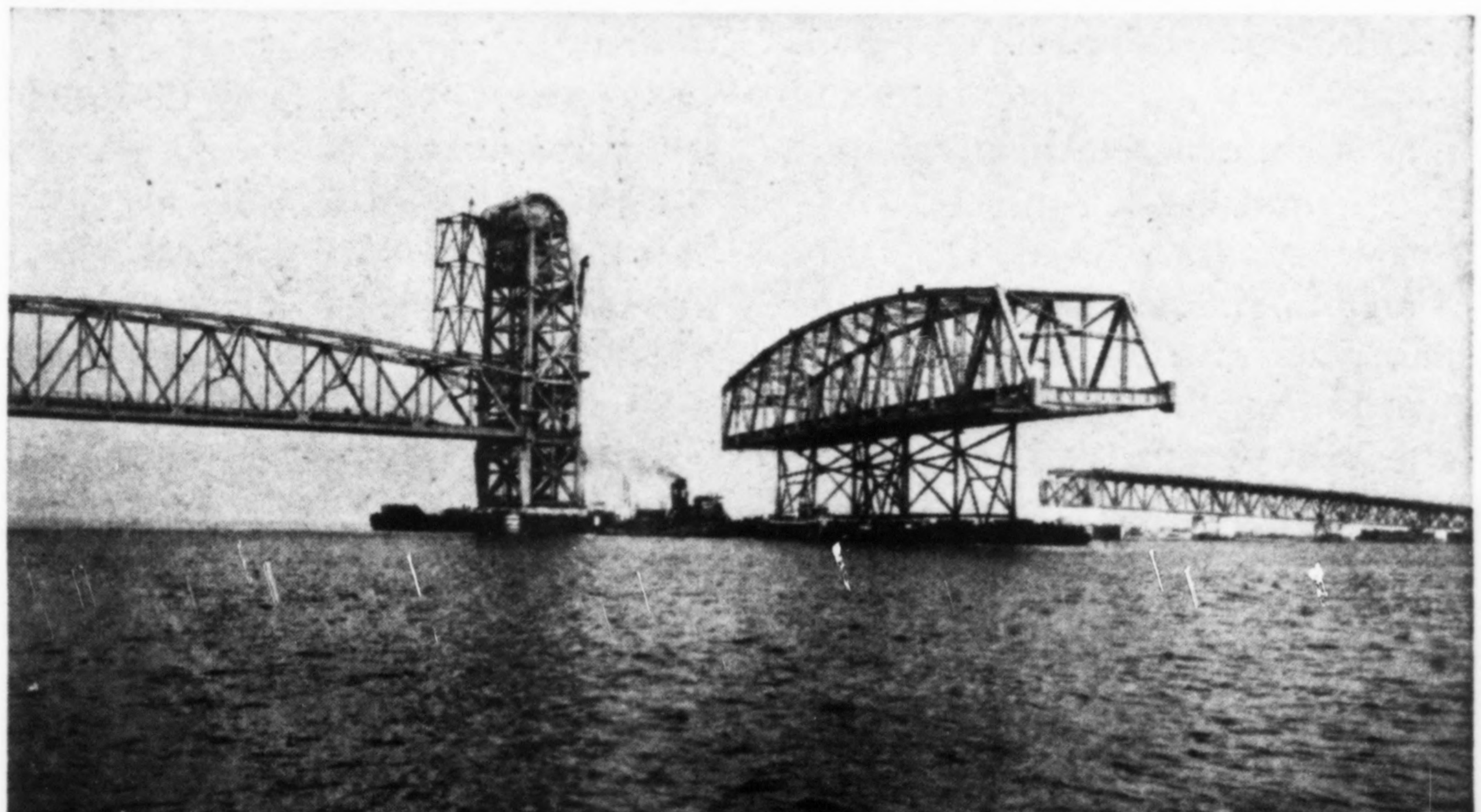

Fig. 4. Masts and booms on the tower face were used to assemble the 540-ft. fixed spans that flank each end of the lift span.

ing and synchronizing, are 50 hp. Time of operation is 2 min. for normal and 7 min. for auxiliary operation.

The architectural treatment of the tower tops is noteworthy. Plates ¼ in. thick were used for the covering which forms a housing for the machinery. The curve of the top is a form of spiral continuing the line of the rear tower columns. Fins or ribs and openings in the outer plates on the sides of the towers are used for embellishment. The structure is painted a gray-green and in order to accentuate the main lines of the towers, the counterweights, elevator shafts, operator's house and other secondary parts were painted with aluminum paint.

Robert Moses is the sole member of the Marine Parkway Authority. Madigan-Hyland were engineers in charge of construction for the Authority. The designing engineers were Waddell & Hardesty for the through spans and towers and Robinson & Steinman for the deck spans. The American Bridge Co. had the contract for the superstructure, including the concrete deck and all electrical and mechanical equipment for the lift span.

Concrete Knowledge and Practice

New facts brought out at American Concrete Institute meeting include data on mass concrete, strength of eccentrically loaded columns and rigid frames

MAJOR CONTRIBUTIONS to better concrete practice made at the meeting of the American Concrete Institute at Chicago, Feb. 22 to 24, as briefly reported last week, related to thermal cracking in mass concrete, strength of columns under eccentric load, and rigid frame tests. Other matters of practical character covered the action of curing compounds, construction methods on the San Jacinto and Edison memorial towers, and the corrosion of mortars and concretes. Theory and design were also represented.

Condensed abstracts of the principal papers, below, give a general survey of the facts brought out. For the full details of the investigations reference may be made to the forthcoming issues of the *Journal* of the institute.

Mass concrete heating and crack control

Careful examination of a large number of existing concrete dams, reported by F. R. McMillan, director of research, Portland Cement Association, Chicago, revealed wide differences in the integrity of different structures and indicated some definite conclusions on the value of construction practices.

At Crystal Springs Dam of the Spring Valley water system, San Francisco built 50 years ago, everything was favorable for mass concrete construction—low water-cement ratio, dry consistency, slow progress, small units, slow-hardening cement; the dam is virtually crack-free. In Elephant Butte and Arrowrock dams of the Bureau of Reclamation the high temperature rise which makes the problem of mass concrete so difficult was largely avoided by the active content of the sand cement of which they were built, and these dams also have few if any cracks, though they are not wholly resistant to erosion and corrosion. In more recent dams, with rates of placing greatly in excess of any of the earlier work, "success has been achieved just about in proportion to the advantage taken of the opportunities offered in the materials and workmanship to obtain watertight concrete and prevent cracking or leakage at the joints. The poorest results are those obtained where the work was carried out rapidly but with little appreciation of the importance of high temperature rise or the evils of poor workmanship." Morris and Boulder dams were found practically free from cracks, while some other western storage dams showed very extensive cracking.

J. W. Kelly, of the University of California, Berkeley, analyzed the effects of adiabatic temperature rise of the hardening concrete as modified by surface cooling, plastic flow and change of *modulus*. The results are, of course, affected by the temperature at the time of placing the concrete, the amount of cement per unit volume, and the strength of the concrete. He concluded that all factors in the case argue for lowest placing temperature. Tension due to temperature change may be reduced, Mr. Kelly concluded, by use of low-heat concrete, low temperature and favorable rate of placement, and concrete of favorable thermal, elastic and plastic properties.

Study of temperature changes in mass concrete by Prof. R. W. Carlson, Massachusetts Institute of Technology, Cambridge, was carried out for three types of cement, 0.9 bbl. per cu. yd., 70 deg. F. casting temperature, a working rate of one 5-ft. lift every four days, and 1 sq. ft. per day diffusivity of the concrete. Under these conditions the temperature rise in the interior of the mass reached 43 deg., 36 deg. and 24 deg. respectively for rapid-hardening, modified and low-heat cement. Reduction in cement content had an equivalent percentage effect in the way of temperature reduction. Thickness of lift was not as important a factor as over-all rate of construction. Each degree of precooling resulted in 0.6 deg. reduction of concrete temperature. Removal of thick side forms after two days was found to result in a serious temperature drop, going into a depth of 12 in.

A comprehensive review of the relation between concreting methods