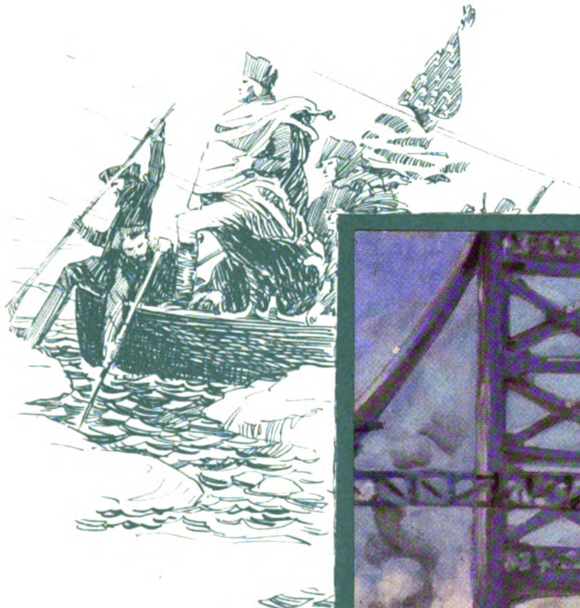
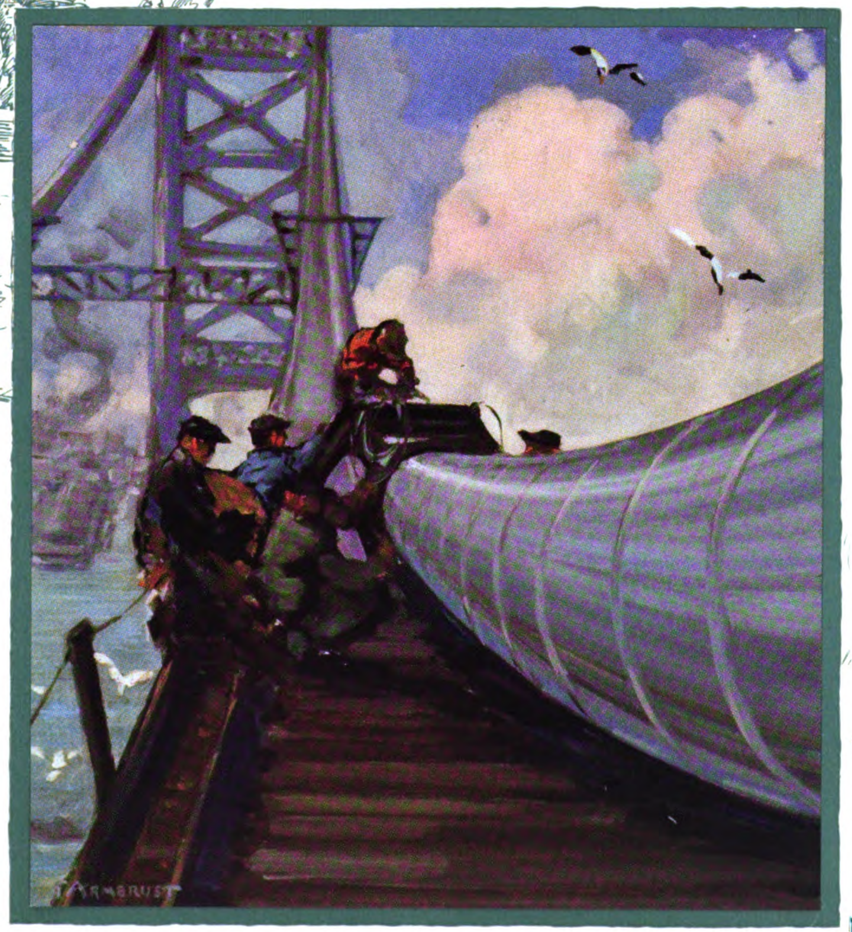
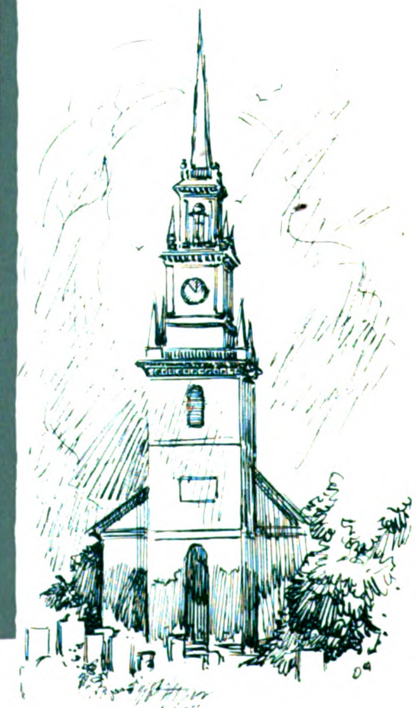






The WORLD'S GREATEST SUSPENSION BRIDGE

Philadelphia to Camden

THE PART PLAYED IN
ITS CONSTRUCTION BY

The American Cable Company, *Inc.*

105 Hudson Street, New York City

District Offices: Chicago - Cleveland - Philadelphia - Tulsa

All wire for this bridge made by

PAGE STEEL *and* WIRE COMPANY, BRIDGEPORT, CONN.

DELAWARE RIVER BRIDGE JOINT COMMISSION

PENNSYLVANIA

Gifford Pinchot, *Chairman*
W. Freeland Kendrick
General Ed. Martin
Samuel S. Lewis
Thomas B. Smith
Richard Weglein
Samuel M. Vauclain
Samuel D. Lit

NEW JERSEY

Theodore Boettger
Thomas J. S. Barlow
John F. Boyle
Weller H. Noyes
Isaac Ferris, Jr.
John B. Kates
Robert S. Sinclair
Frank L. Suplee

Joseph K. Costello, *Secretary & Treasurer*
Charles R. Bacon, *Assistant Secretary*

COUNSEL

David J. Smyth
T. Harry Rowland

BOARD *of* ENGINEERS

Ralph Modjeski, *Chief Engineer*, *Chairman*
George S. Webster
Laurence A. Ball

CONSULTING ENGINEERS

Daniel E. Moran
Edward A. Byrne

ARCHITECT

Paul P. Cret

SOME OF THE PRINCIPAL CONTRACTORS ARE:

Keystone State Construction Company
American Bridge Company
Bethlehem Steel Company
Page Steel and Wire Company
American Cable Company, Inc.

FOREWORD

THIS is a story of achievement—of hopes and dreams realized, and the fulfillment of an ideal toward which men have worked and planned for over a century—a tale of the realization of the greatest suspension bridge in the world, how it was conceived and finally materialized.

Among the many interesting features in connection with the mammoth undertaking is the part played by the American Cable Company, which was awarded the contracts for supplying all of the wire and cable entering into the construction of this bridge.

The uniting of two states and two great cities by a mighty span has become a fact, the story of which may worthily take its place in American history.

HISTORY

ONE cannot picture the Delaware River without the historic figure of Washington in the background. History tells of no more daring or graphic an incident than that in which he played a leading part on that Christmas night in 1776—when, with the fate of the nation resting on his shoulders, he marshalled together 2400 ill-clad and half-freezing men and with horses, guns and paraphernalia crossed the swift and dangerous river filled with cakes of floating ice.

Perhaps it was the courageous energy and divine conviction within this great leader that has been absorbed by the sons of the new America and made manifest by another crossing of the river—another feat as great in another way.

In the course of time, on opposite sides of the Delaware, two great cities, Philadelphia and Camden, sprang into being. As years passed their economic development as well as that of the nation, demanded that the river's barrier be pushed aside—that a broad highway connect them.

Not new, however, is either the need or the plan. Back in 1812 two engineers, White and Hazard by name, conceived the idea of a foot-bridge across the fall of the Schuylkill, above Philadelphia. They had the courage of their convictions, and in the face of what, in those days, were tremendous handicaps, succeeded in carrying out their project.

Dusty records covering this feat say—"This was a foot-bridge whose cables were of six wires one and three-eighths inches in diameter. The span of the structure was 408 feet—its cost was $125, and a toll of one cent was charged for passage. Only eight passengers were allowed on it at a time. This bridge remained in service for several years, but in the course of a severe winter broke apart under the weight of snow and ice which rested upon it."

From that time on, engineers, challenged by the elements and pressed by the economic necessity for such a structure have planned to overcome all obstacles and build a bridge that would endure and provide adequate transportation facilities.

These plans finally crystallized into action and on July 1st, 1926—150 years after the signing of the Declaration of Independence—the world's greatest wire suspension bridge, which connects Philadelphia with Camden—Pennsylvania with New Jersey—was officially opened to the public, and will play an important part in future development of the two cities and surrounding territory.

Across this great structure will pass an endless stream of traffic. Not packed together in crude boats buffetted by ice and snow—but in the comfort of modern conveyances.

FACTS

IT IS indeed a far cry from the little bridge which Messrs. White and Hazard erected across the Delaware at an expenditure of only $125.00—to the majestic structure which now stands complete at a cost of $37,211,000.

The building of the Philadelphia-Camden Bridge required not only tremendous monetary resources, but called into play all of the engineering skill that a century of progress has developed. The problems connected with its construction were many and varied and the amount of preliminary detail work tremendous—so much so that volumes could be written concerning it. For the purpose of this chapter, then, a brief summary covering the design of the structure must suffice.

Because ships, large and small, from all corners of the world, enter the port of Philadelphia, it is quite obvious that a bridge high enough for them to pass beneath at all times would have to be constructed. After careful study the War Department issued a permit which specified a clear span between pierhead lines and a clear height of 135 feet above high water for 800 feet at mid-river.

The total length of the bridge is 9500 feet. The main span —the longest of its kind in the world—covers a distance of 1750 feet. The width of the structure is 125′ 6″ and accommodates two 10-foot sidewalks, a 57-foot motor drive, two trolley tracks and two rapid transit tracks; 6000 automobiles an hour can be accommodated.

The live load is calculated at a maximum of 12,000 pounds per lineal foot of bridge—while the structure itself is more than a mile in length, the suspended structure, which is 3253 feet long, adds enormously to the weight that is carried by the cables.

This tremendous weight is upheld by two main cables 30 inches in diameter and by 596 suspender ropes. These combined have a total weight of 7,400 tons.

Each great cable has a tensile strength of over 118,000,000 pounds or 223,000 pounds per square inch. They rest on two towers 385 feet high.

25,100 miles of wire were used in constructing these enormous cables. To gain a clearer idea of what this distance means picture in your mind a strand of wire circling the earth at the equator and then stretching from Pittsburgh to New York. The wire used was manufactured at the Monessen plant of our affiliated company, the Page Steel and Wire Company of Bridgeport, Connecticut, shipped in coils to the bridge site and there reeled onto large spools.

The weaving of this wire into each cable was done on the job and was a task that took on enormous proportions. It required the handling of 122 endless lengths of spliced wire, each approximately 1,083,000 feet long, to make the component strands— 61 for each main cable and each 3540 feet long when completed—and with a total weight of 6,750,000 pounds. It was necessary to exercise the greatest of care in laying the strands so that not a single wire was allowed to shirk its strain. This was successfully carried out and not one wire failed to fall into its intended place.

How the work was done and the bridge completed is graphically pictured by many illustrations with accompanying text, which appear on the following pages.

The AMERICAN CABLE COMPANY

THE American Cable Company is proud of the part it has played in the construction of the world's greatest suspension bridge—and it is equally proud of the service it has rendered to industry—where wire rope plays an important part in the world's work.

Success lies not alone in great achievement—but on the solid foundation of work well done—where neither the magnitude of the job nor the spectacular nature of it play an important part.

For many years engineers of the American Cable Company have been endeavoring to bring the service obtained from wire rope to a constantly higher standard. East, West, North and South—on ships, in mines, on construction work—in short wherever problems arose, they have worked unceasingly to solve them.

An appreciation of their efforts is shown by the fact that concerns engaged in almost every type of endeavor where wire rope plays an important part, are specifying American Cable Company products as standard equipment.

The knowledge and experience that these men have at their command are placed unreservedly at the disposal of wire rope users. Whether it is the proper selection of wire rope for elevator use or the problem of weaving cables for a mighty bridge, they and the organization back of them will co-operate to the utmost.

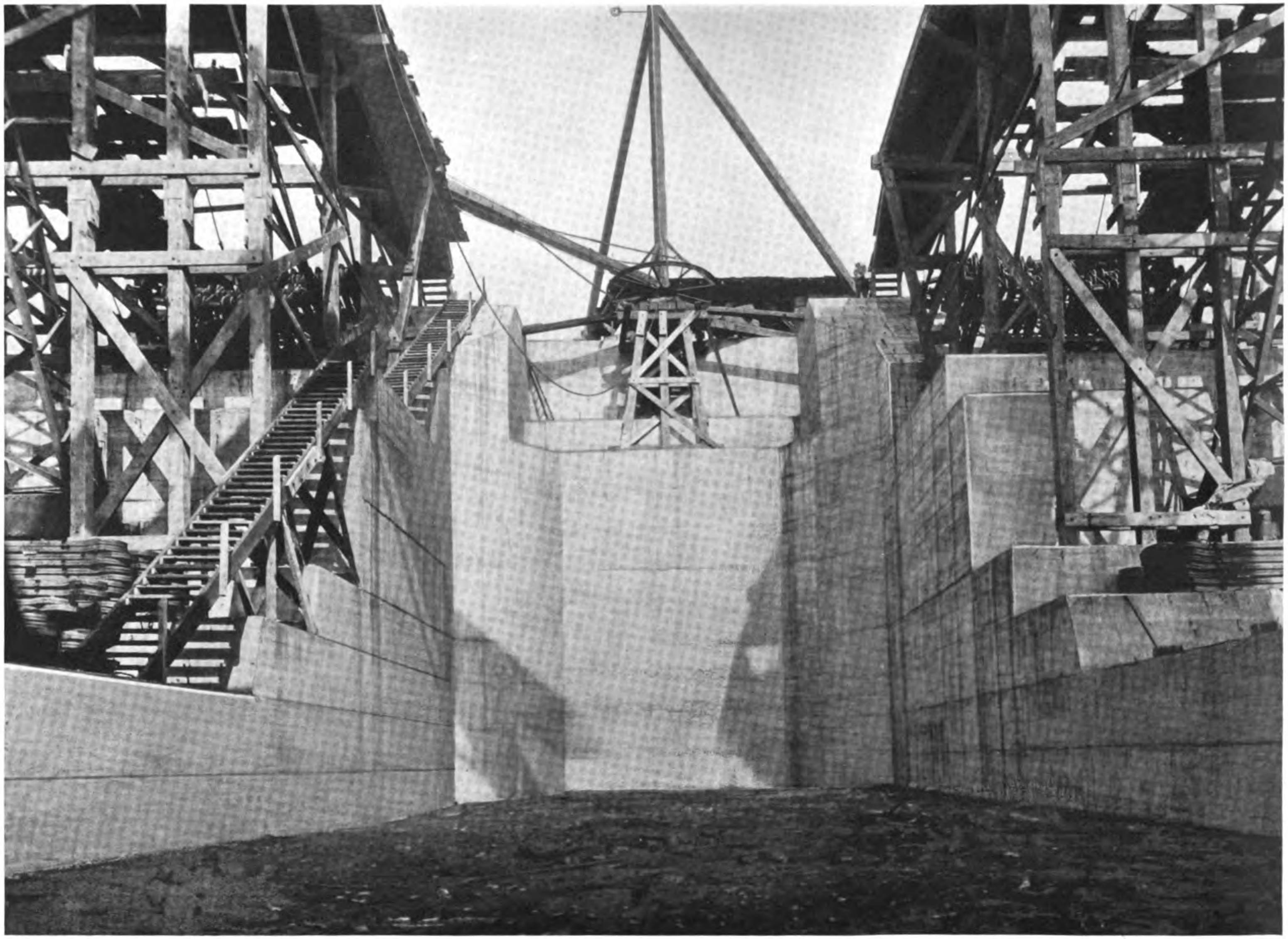
HOW THE BRIDGE WAS BUILT

IN REVOLUTIONARY times, great achievements were preserved for posterity through the written word—or by sketches and pictures drawn by hand.

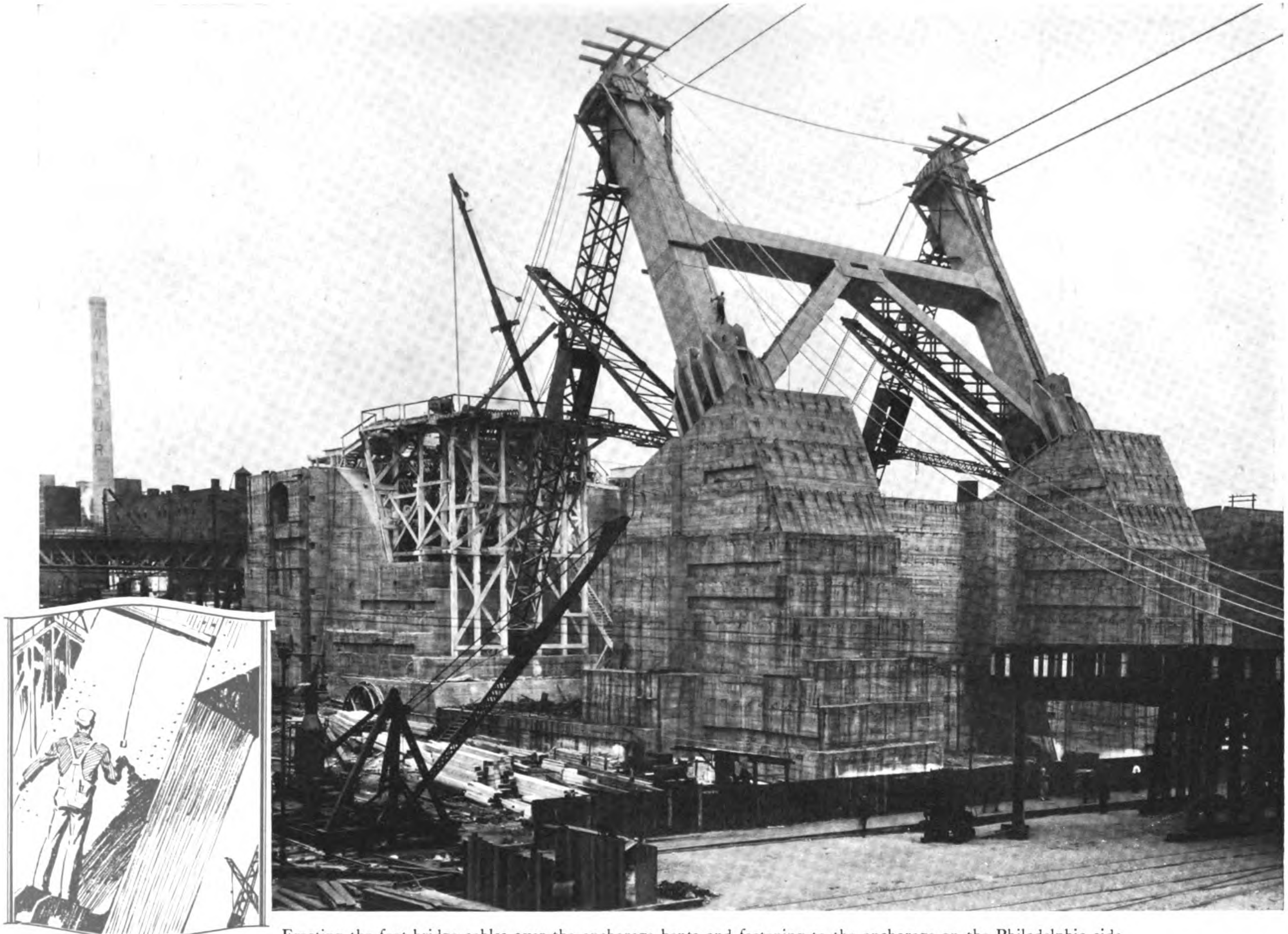
Today, the art of photography has made possible the visual recording of events, just as they occur and in their natural sequence.

The story of how the bridge was built is graphically portrayed by the illustrations which appear on the following pages. They offer a continuous picture of the progress of the work from its beginning until the completion of the structure.

Saddles for main cables and for temporary foot-bridge in place on both the main towers shown in the distance and on the anchorage bent shown in the foreground. The towers are 385 feet in height

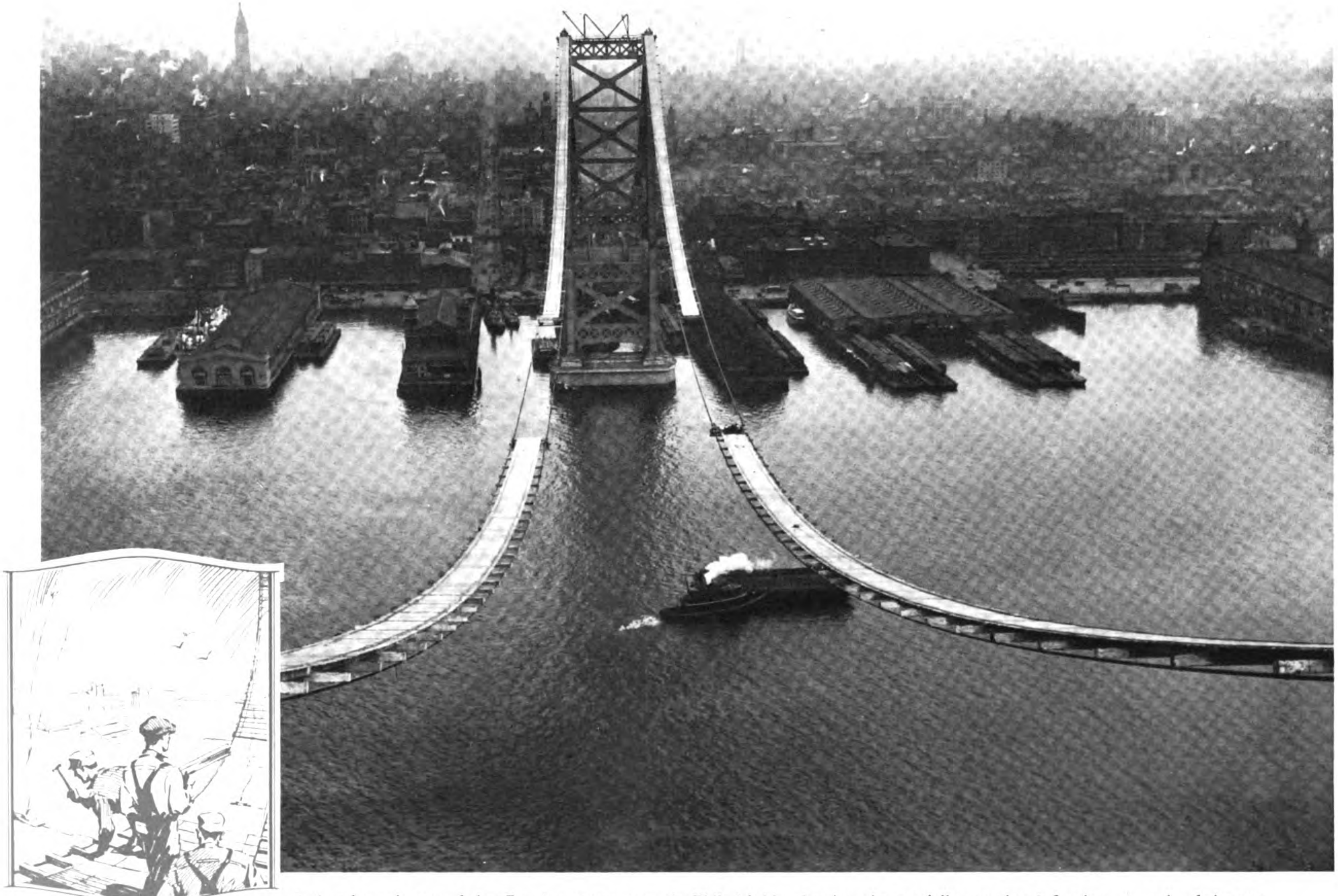


Camden anchorage before facing with granite, showing in the upper right-hand and upper left-hand parts of the anchorage, the protruding ends of the eye-bars which are used for holding the ends of the strands which go to make up the main cables. There are 61 pairs of eye-bars on each side of the anchorage

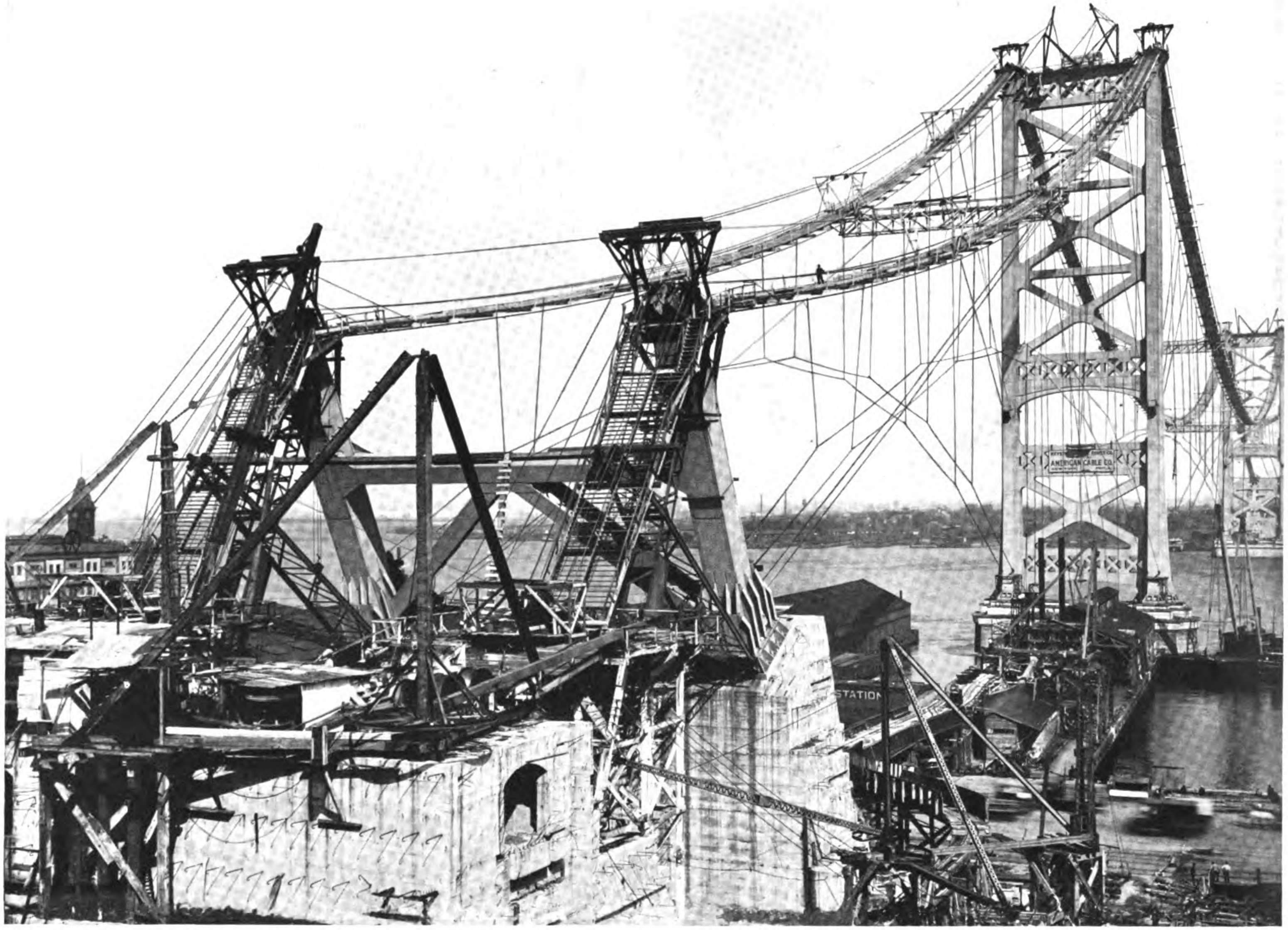


Erecting the foot-bridge cables over the anchorage bents and fastening to the anchorage on the Philadelphia side

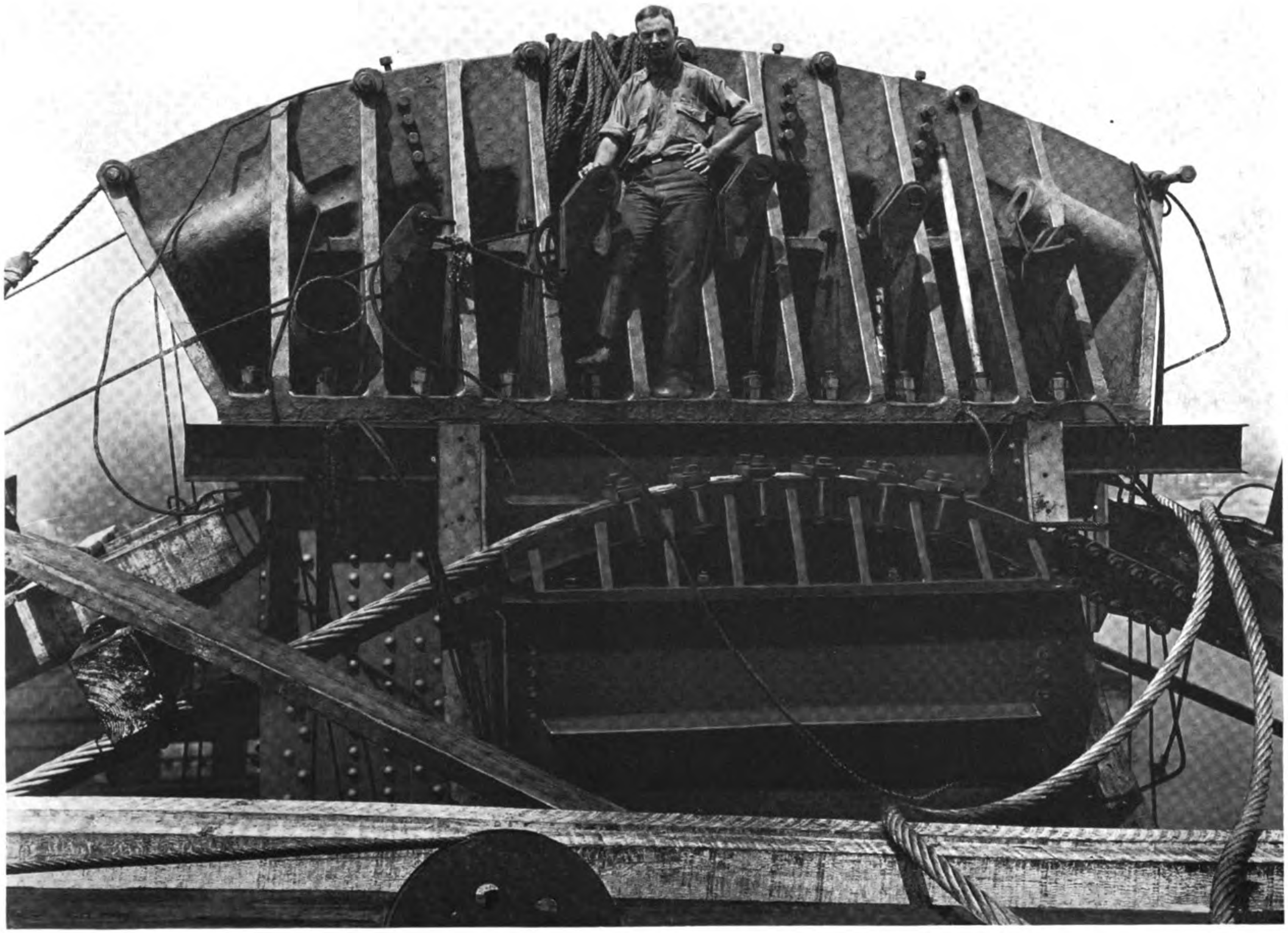
Looking towards the main tower from the anchorage bent on the Camden side with some of the foot-bridge cables in place



A view from the top of the Camden tower towards Philadelphia, showing the partially completed flooring on each of the two foot-bridges. Each foot-bridge is supported by two groups of cables, each group consisting of three 2¼" diameter wire ropes

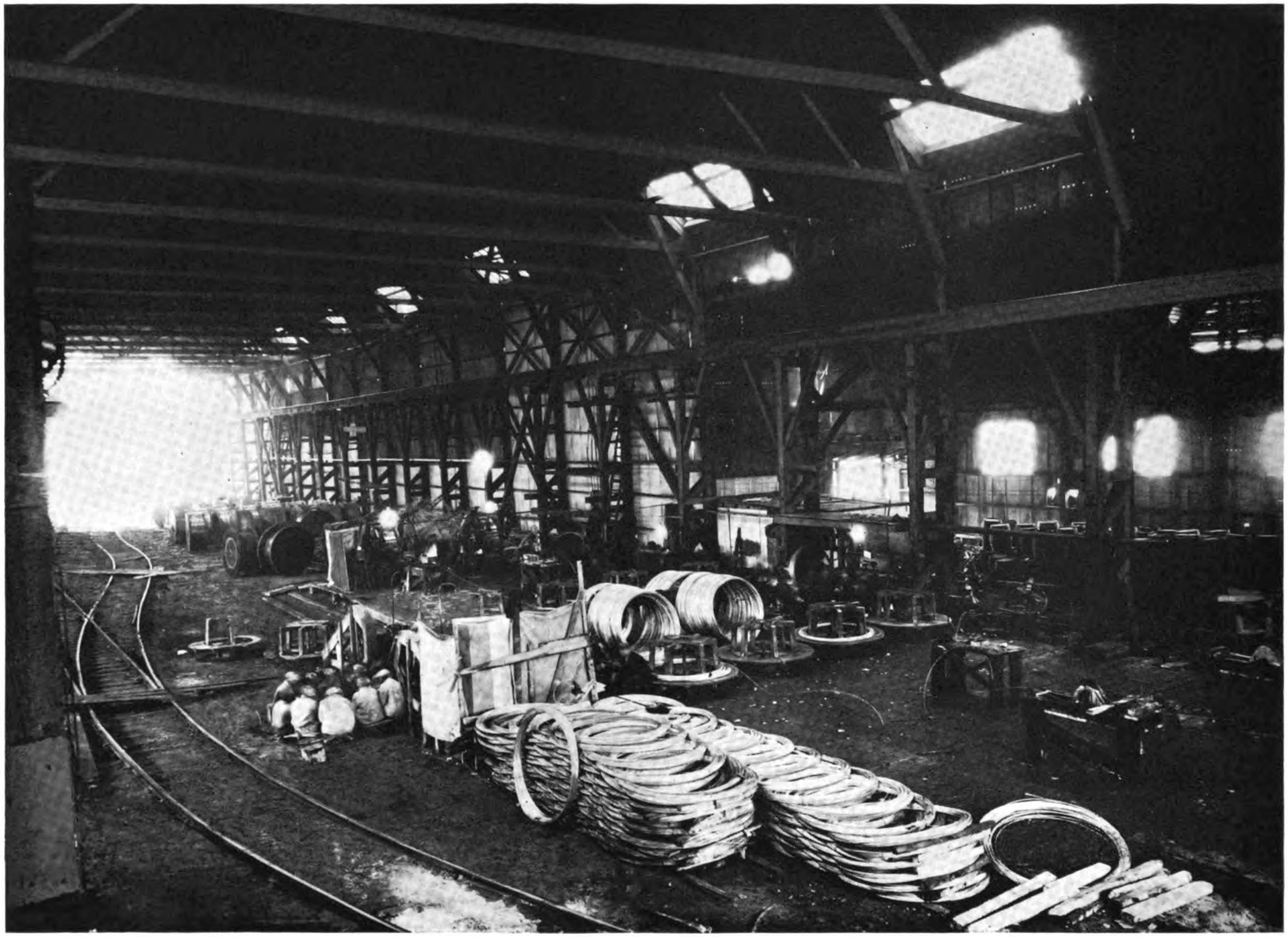


A view from the Philadelphia side, showing the flooring completed on the two foot-bridges but no hand-rails yet in place. The tower guys for pulling back the tops of the towers towards the anchorage and the storm cables to the foot bridges are seen in this view

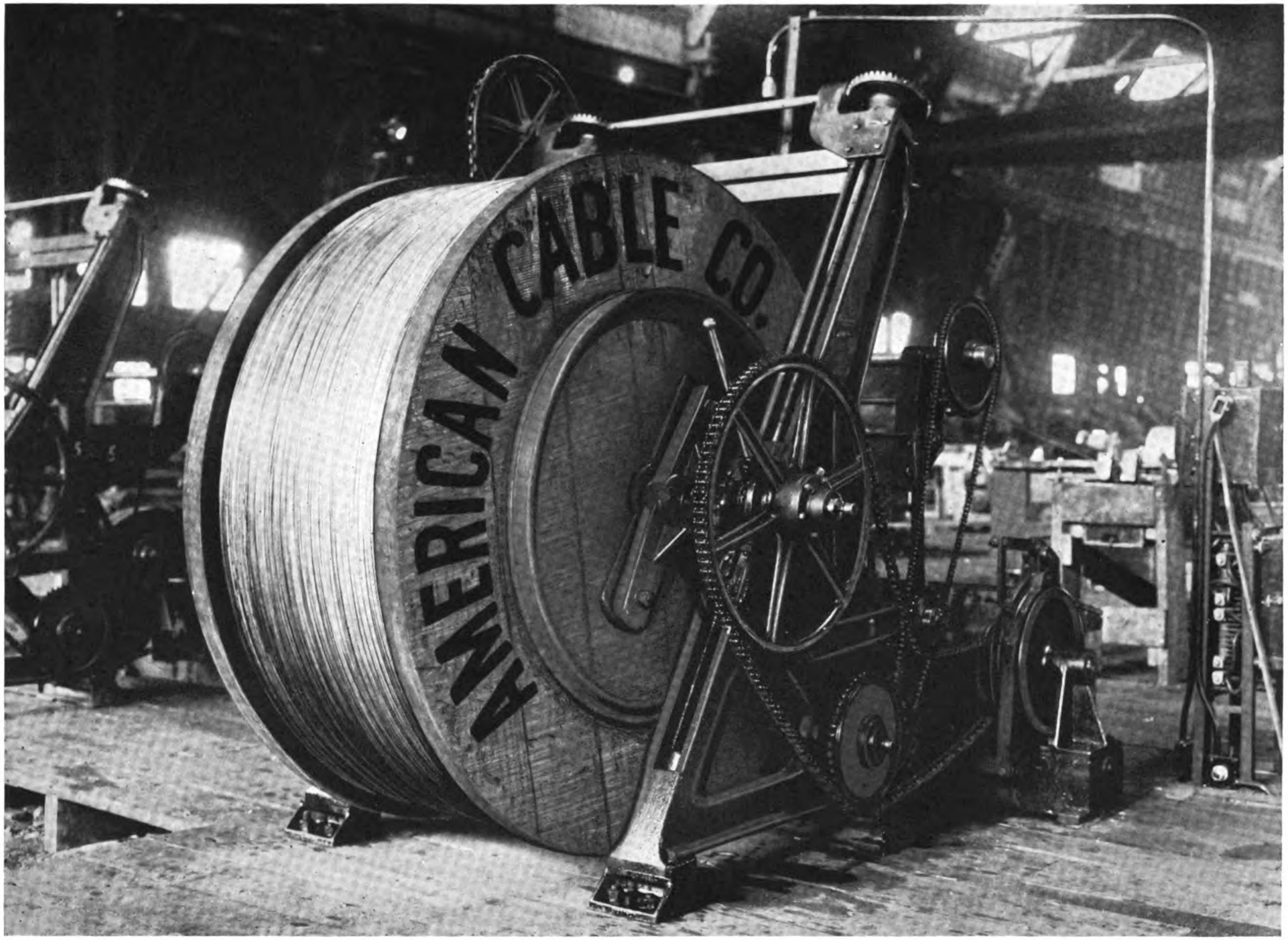


The top of one of the main towers, showing the large saddle for the main cable and also the smaller temporary saddle for the foot-bridge cables with the foot-bridge cables in place

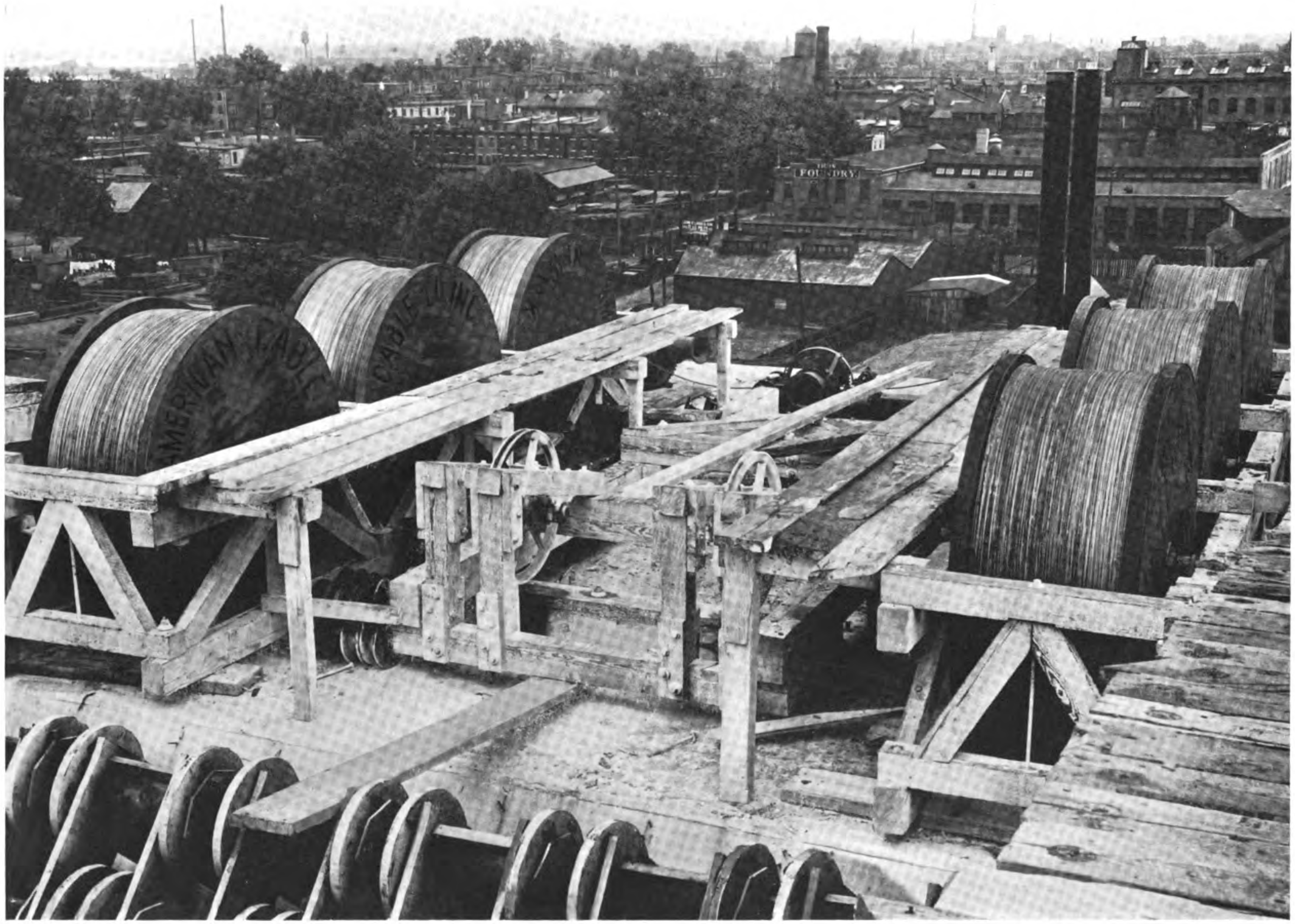
A view from the top of the Philadelphia tower, showing the flooring completed on the foot-bridges with storm cables below the foot-bridges in place and some of the cable spinning rope supports in place on the foot-bridges



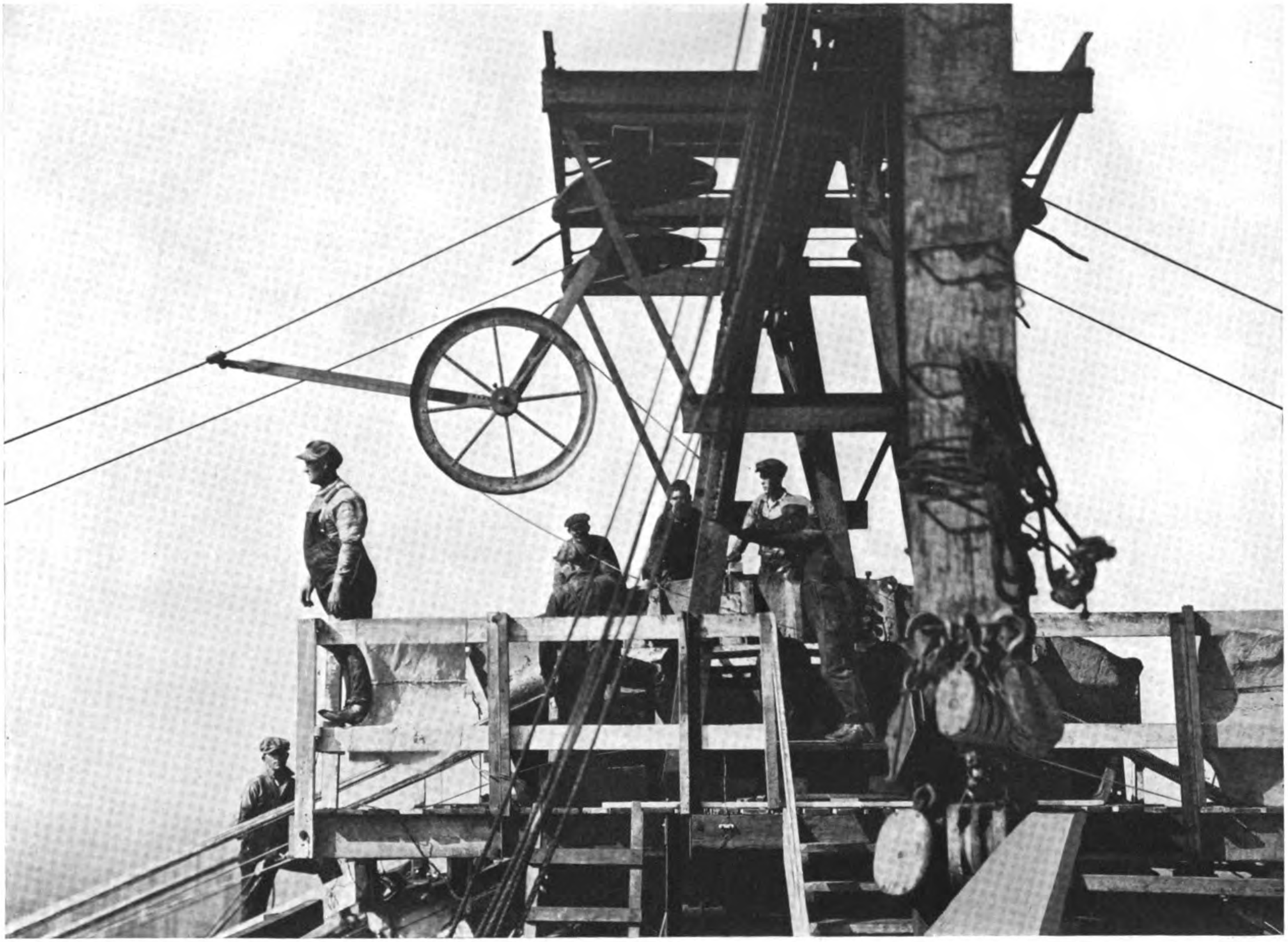
Wire reeling equipment in the Camden storehouse where the coils of galvanized wire are spliced by a special sleeve connection and wound onto large reels preparatory to spinning the main cables



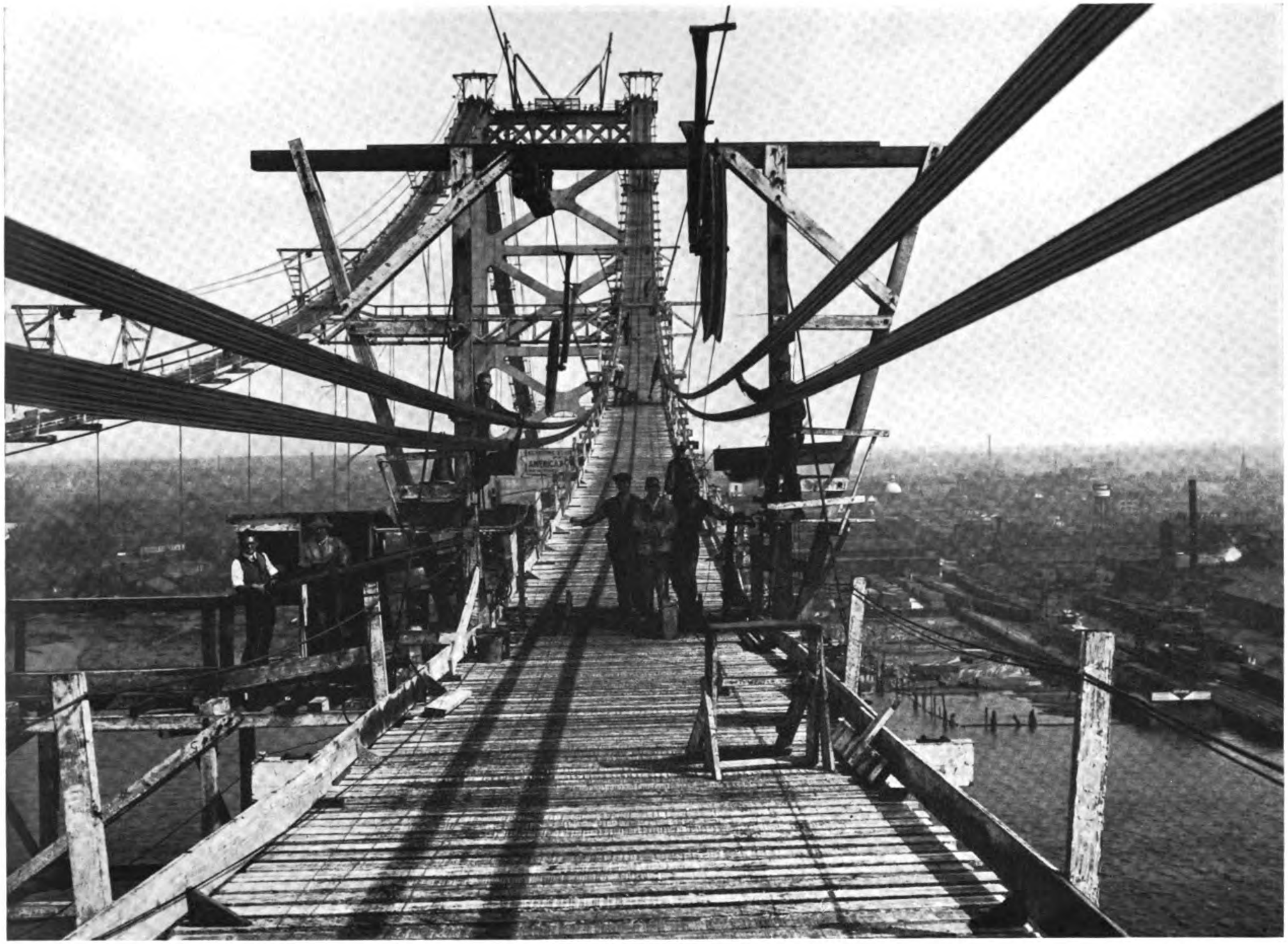
One of the wire reels filled with about 100,000 feet of spliced galvanized wire supplied in continuous length. The reels are shown in the reeling jack preparatory to taking up to the bridge site



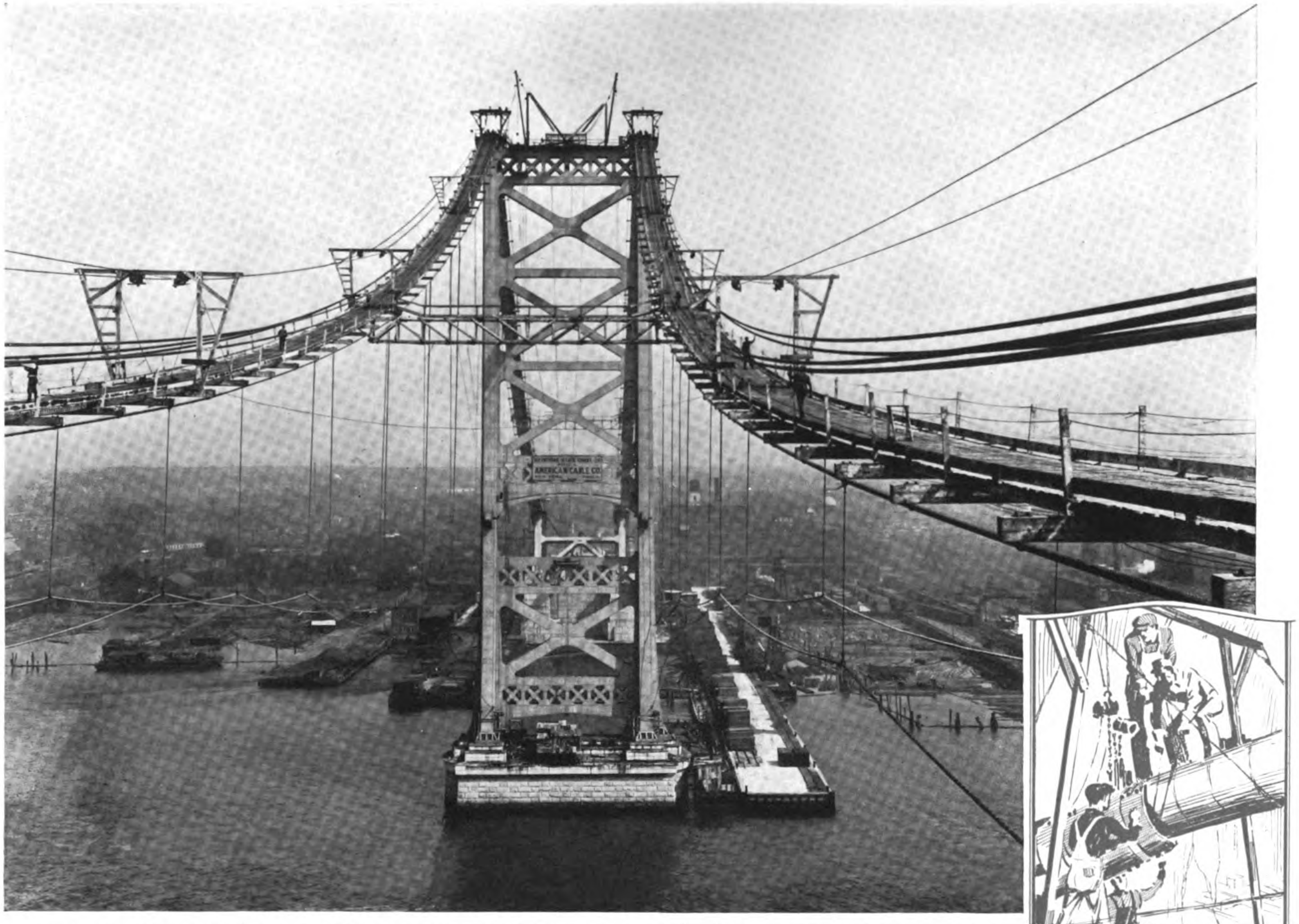
Wire reels in position on the racks at the corner of the bridge ready for spinning into the main cables. Note the anchorage eye-bars in the lower left-hand corner to which the completed strands will be fastened



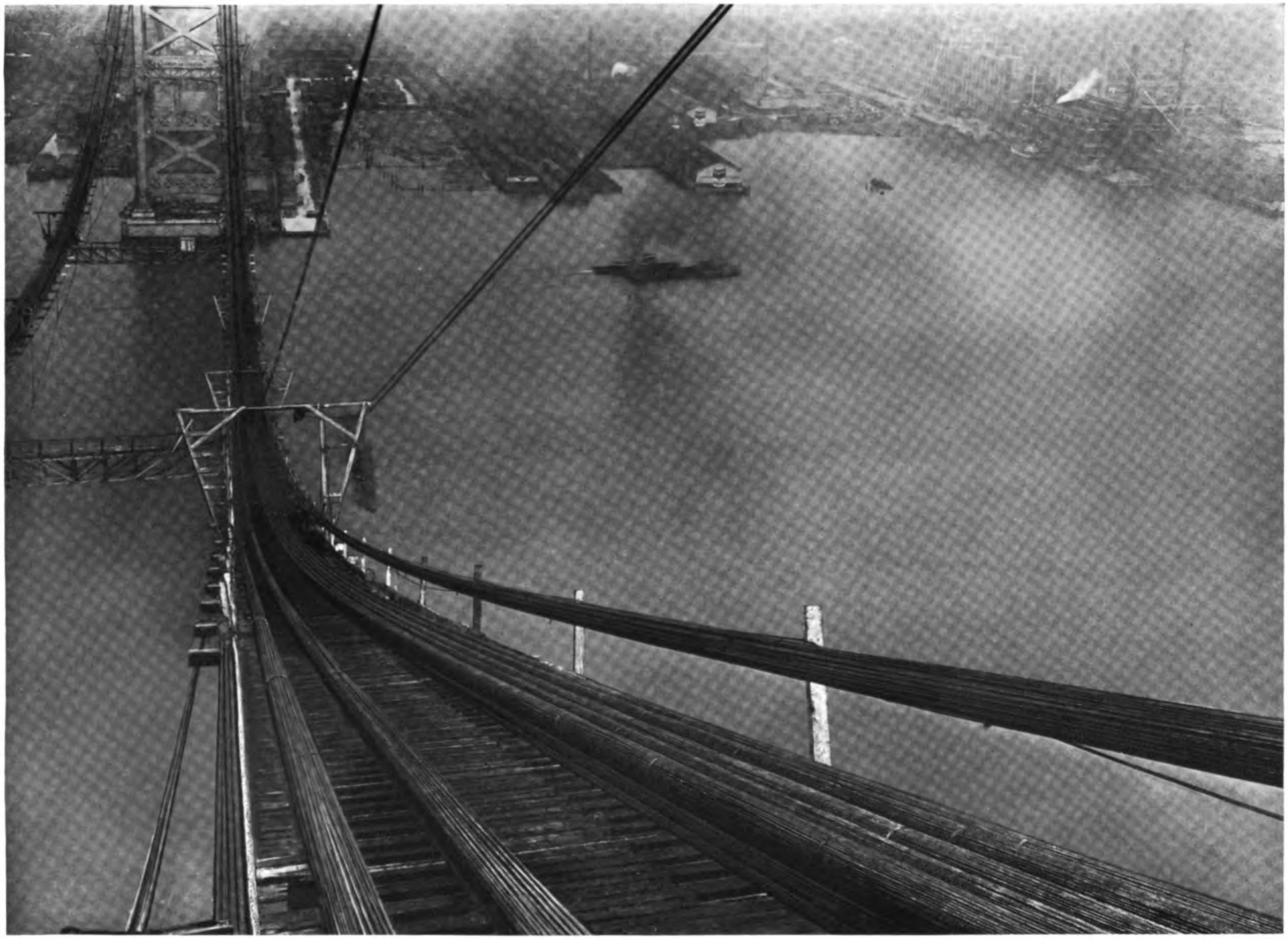
On top of one of the towers with wire carrying trolley passing over the cable support during the operation of spinning the wire. Notice the two parts of wire coming from the trolley, this wire being pulled from anchorage to anchorage across the river by means of motion of the rope supporting the trolley



A view on the foot-bridge showing four strands which are being made simultaneously, showing also the two trolleys on the same endless rope which are used for spinning the wires from anchorage to anchorage across the river

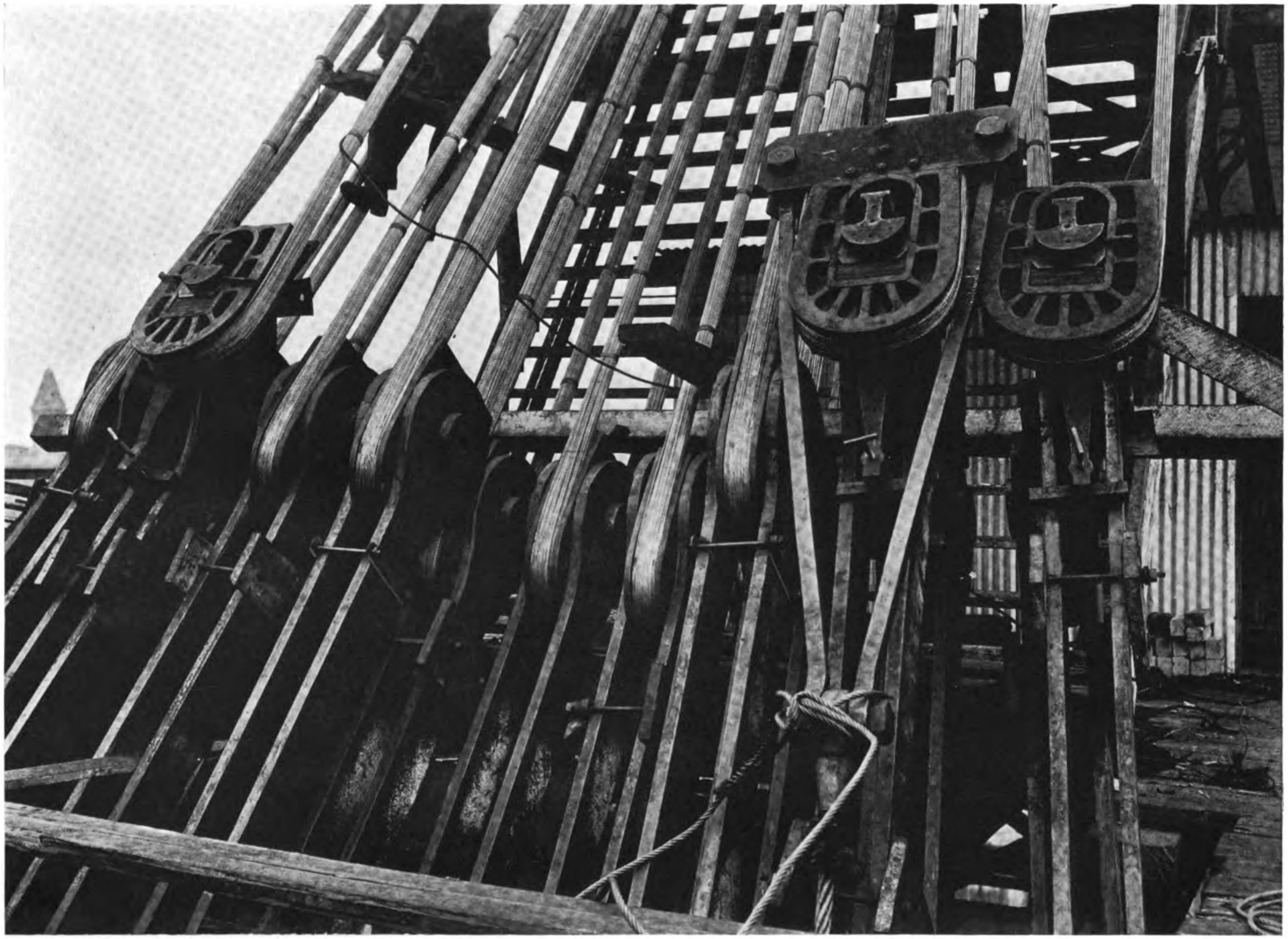


Another view of four partially completed strands on each of the foot-bridges, showing also the storm cables on the bottom of the foot-bridges and showing the supporting towers along the foot-bridges for carrying the endless wire rope to which the trolleys carrying the cable wire are attached



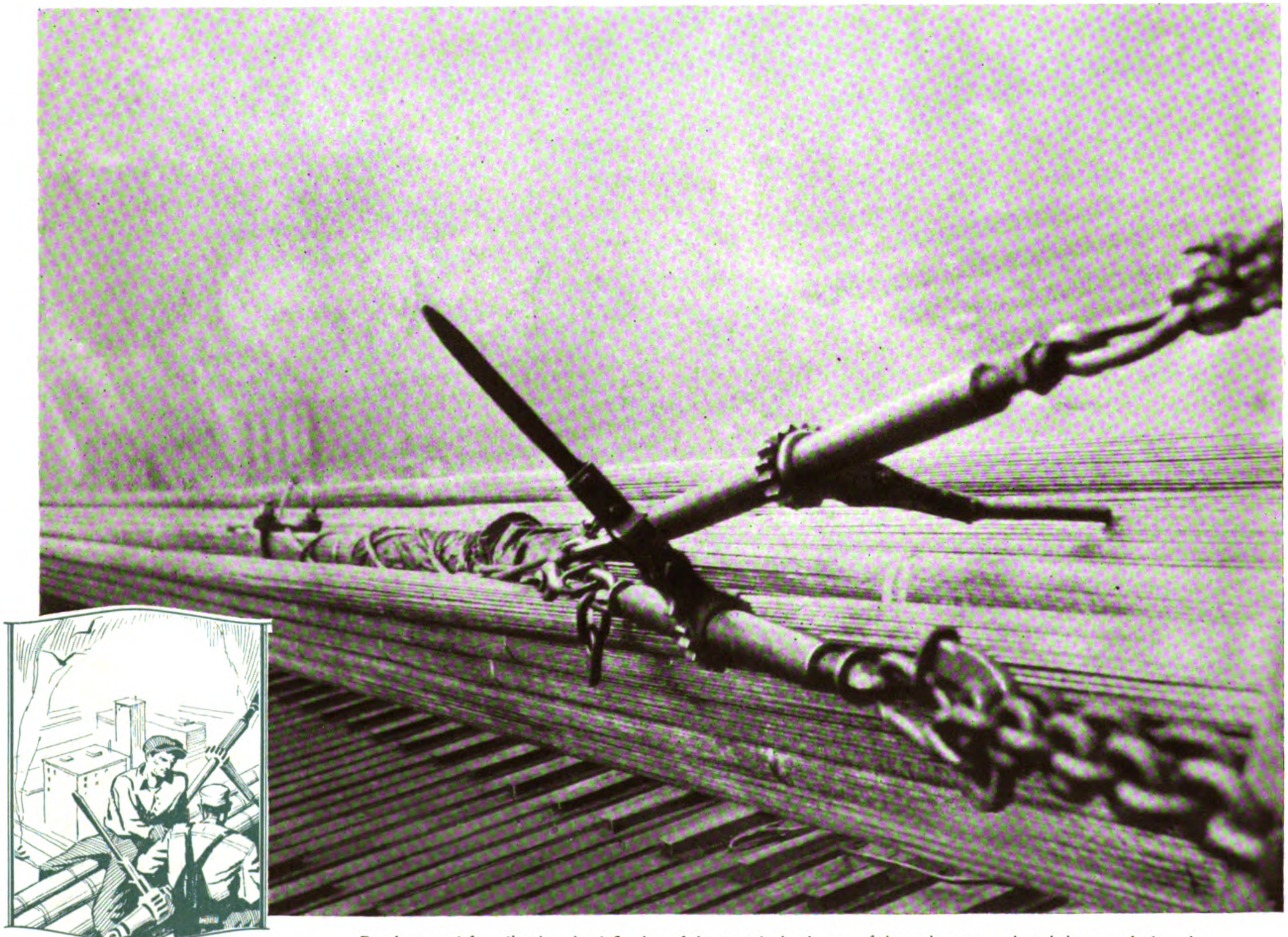
A view showing a number of completed strands, which are bound every five feet with a flat tie-band and showing also four additional strands partially completed. These finished strands do not rest upon the foot-bridge, but are hung in their final position just above the foot-bridge

Another view of some finished and some partially finished strands for the main cables. Note, also, the cross-walks between the two foot-bridges at intervals for getting from one foot-bridge to the other



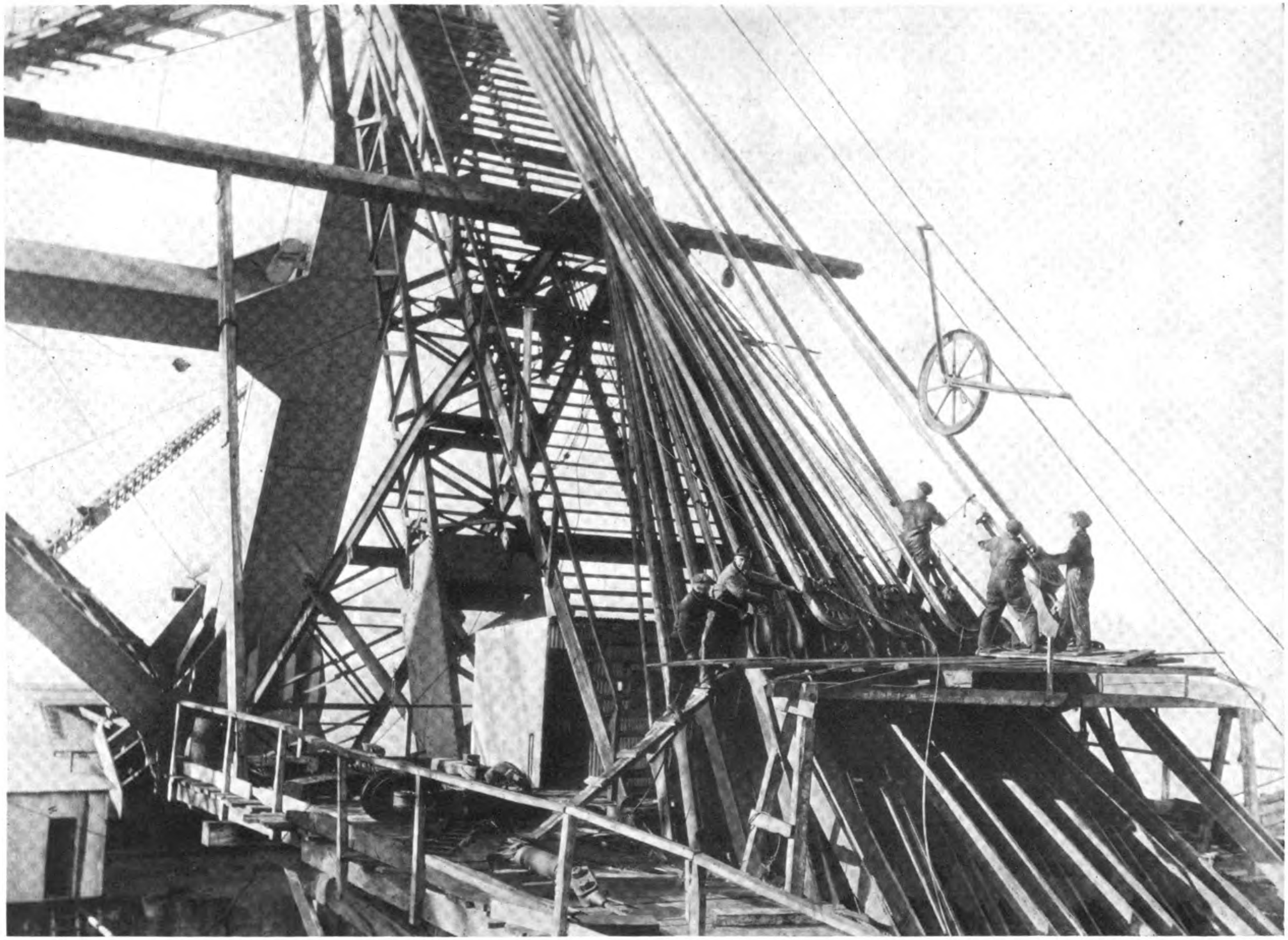
A number of completed strands in position between their respective eye-bars and also several strands just finished but not yet set into position, one of which is just ready to be turned and set between its eye-bars

Temporary clamps for holding the strands into their proper position after having been adjusted for proper sag, this view being at the center of the main span

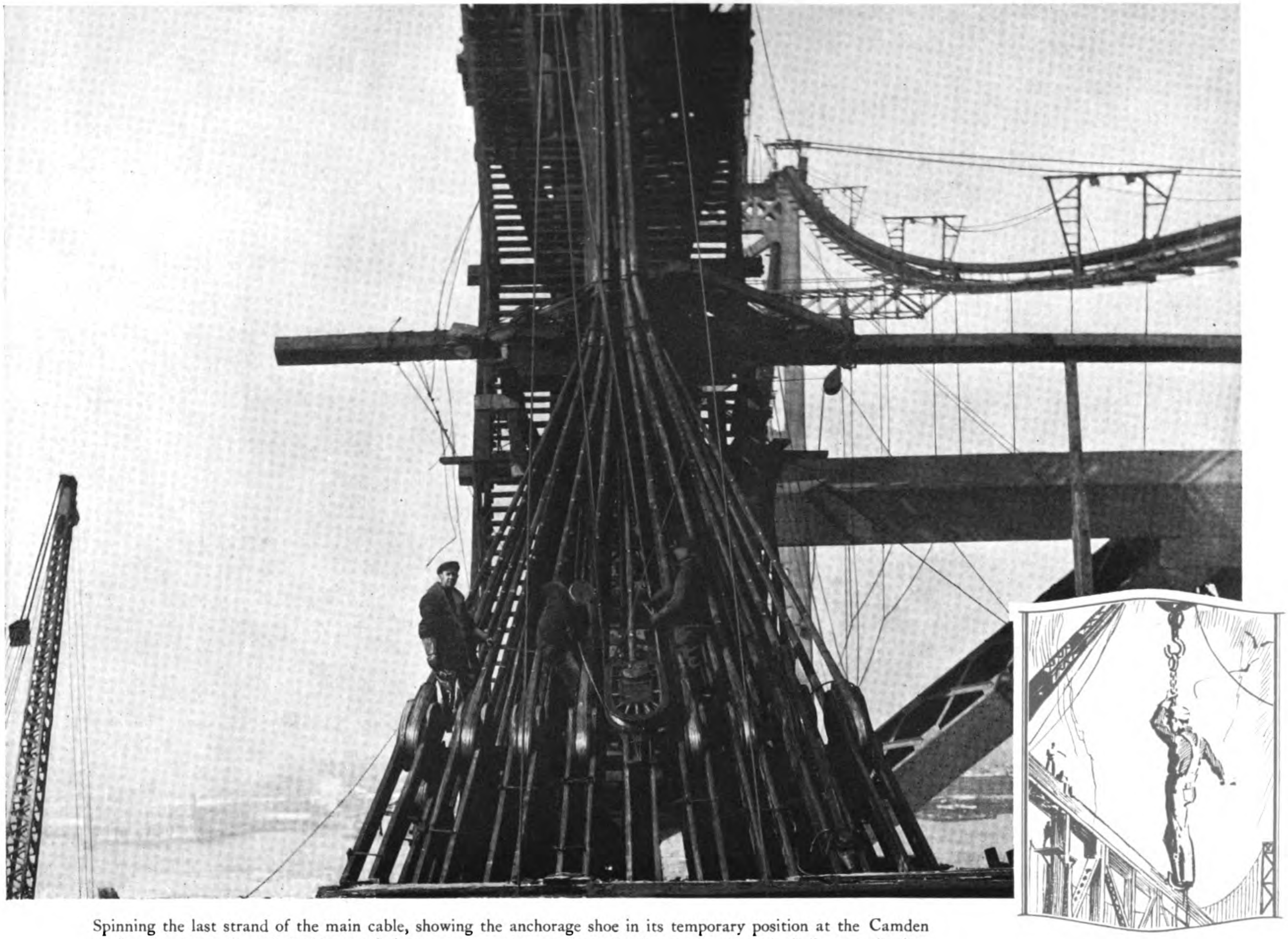


Ratchets used for adjusting the deflection of the strands in the top of the main towers, these being attached to the strands by means of a cable grip wrapped around the strands after they are suitably protected from scratches

A completed strand being taken from its temporary position, in which it was fabricated, and ready to be lowered to its final position in the saddle on top of the cable bent



Adjusting the single wire in one of the strands at one of the anchorages just after the wire had been looped around the anchorage shoe



Spinning the last strand of the main cable, showing the anchorage shoe in its temporary position at the Camden anchorage. Approximately 7,000 tons of wire were spun and erected to make these two main cables in five months time

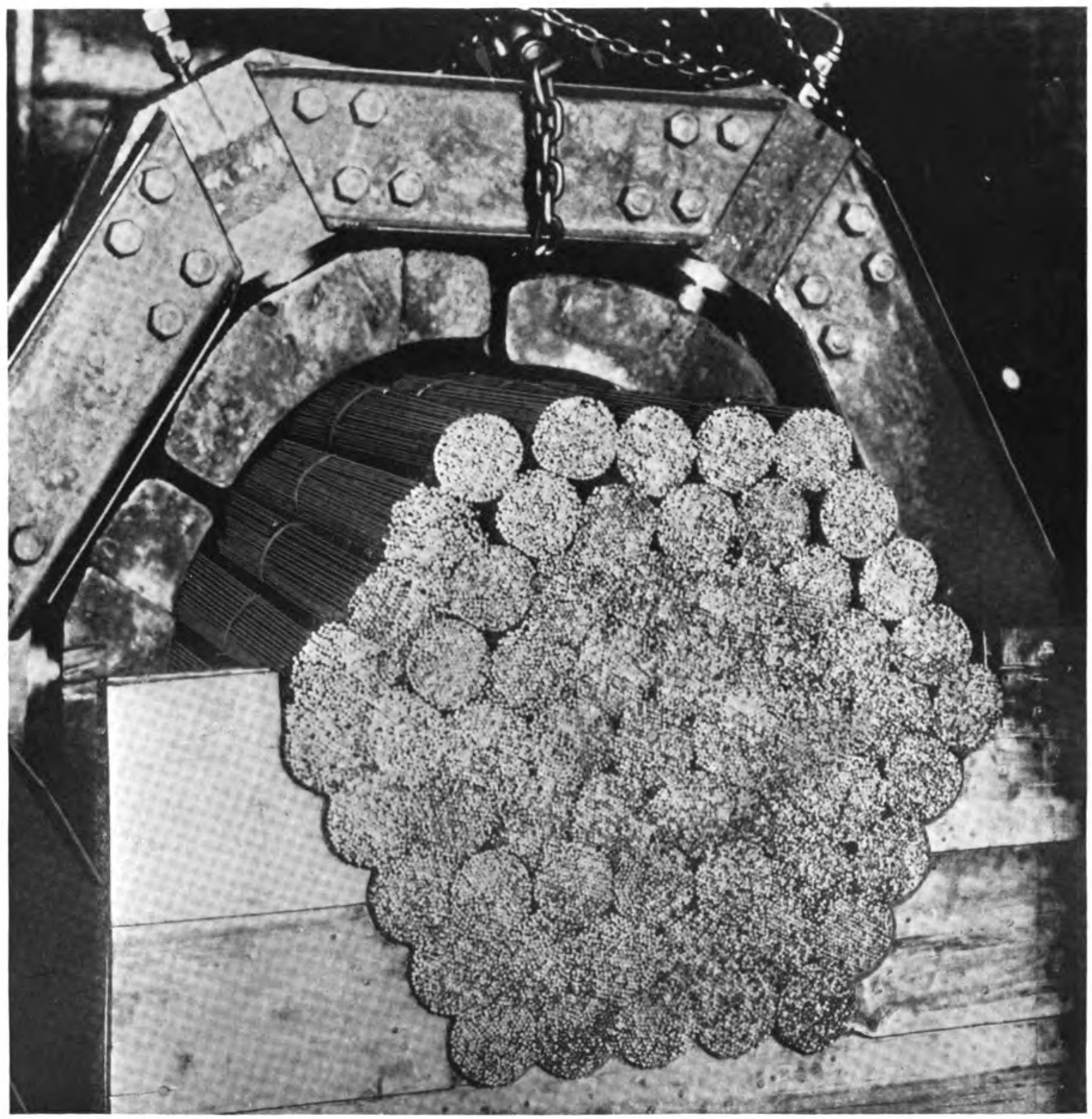
Placing the various sections of the cast steel bell-mouthed throat clamp on the cable at the anchorage. See page 38 for the completed throat clamp

Jack at one of the anchorages for adjusting the strands so that each strand hangs with the same deflection in the main strand, thus being under the same tension. This jack is attached to the pins at the lower end of the first set of eye-bars, to the other end of which the strand shoes are attached

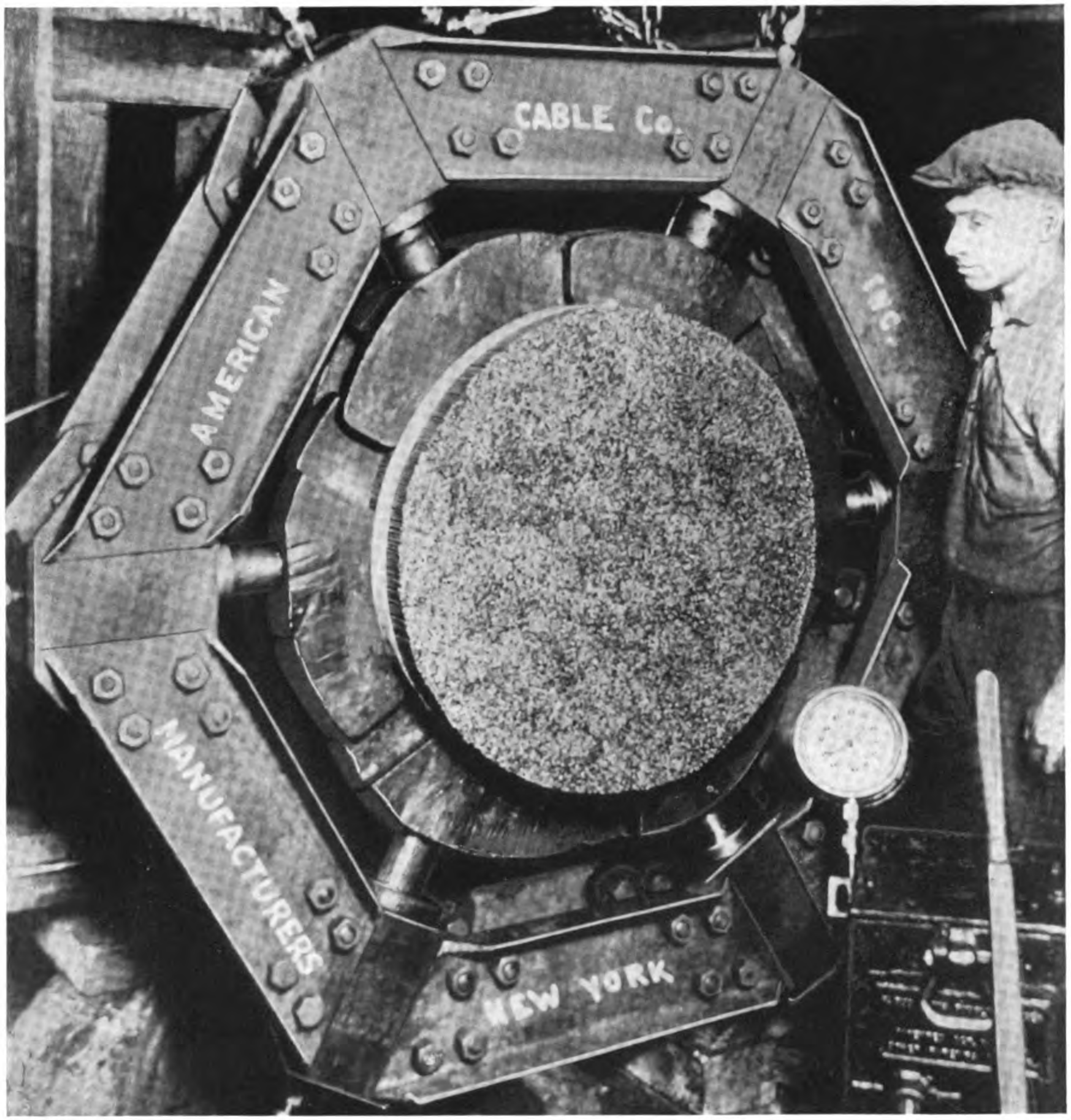
The hydraulic compressing frame mounted around the cable, compressing this cable from 35½ inch original diameter to 30 inch compacted diameter, under a total radial pressure of 30 tons

Showing the manner of using the cable squeezer by means of pumping the hydraulic jacks, three of which are used on this device, each acting on two compressing shoes

In the past, where suspension bridges were designed to sustain heavy loads, it has been the custom of engineers to specify four cables. The Manhattan bridge, for instance, has four cables of 20¾ inches in diameter each. The Philadelphia-Camden Bridge presents a great advancement in engineering by utilizing two cables 30 inches in diameter.

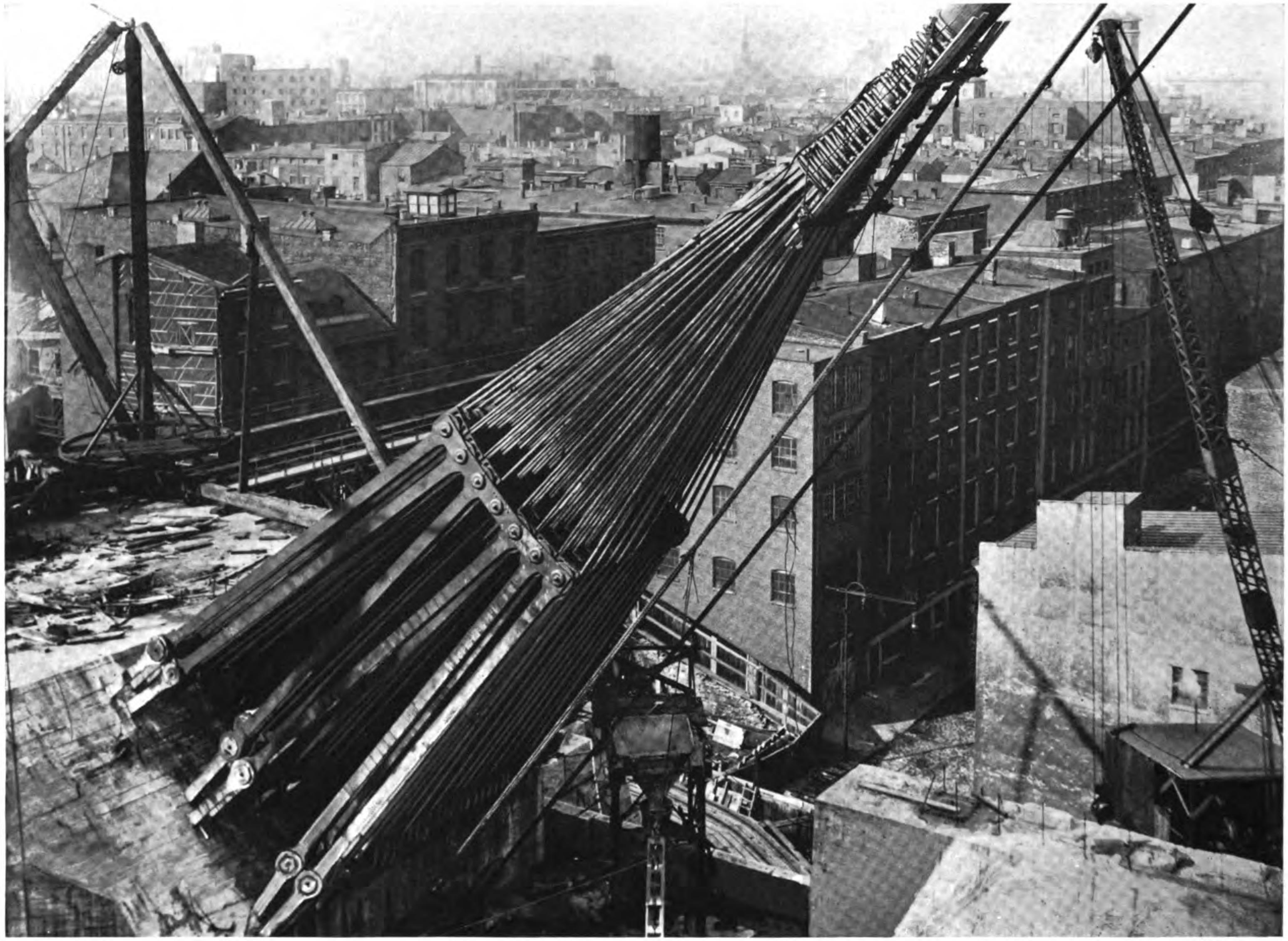


A section of the main cable measuring 35½ inches across, showing the compacting machine before pressure was applied

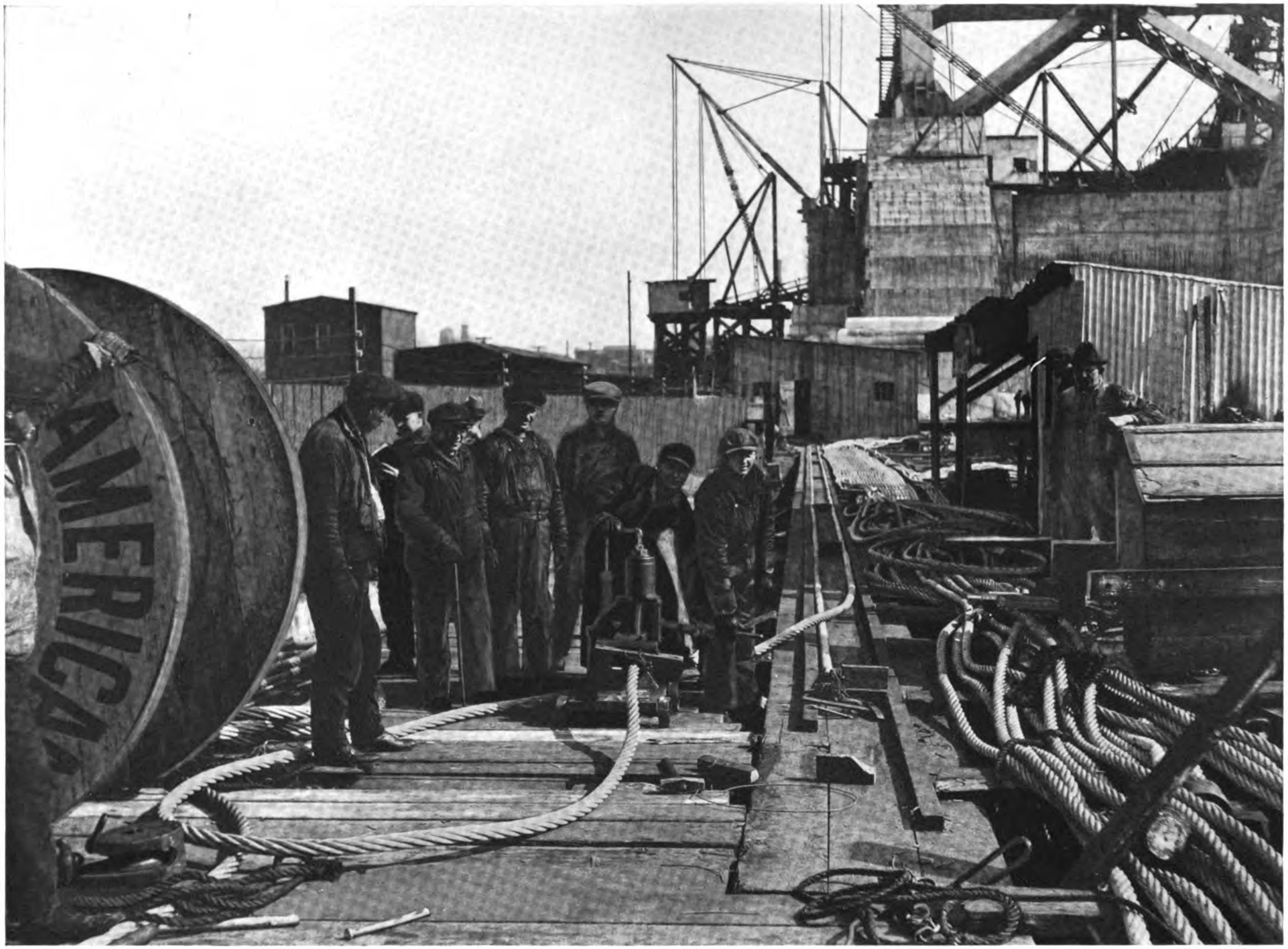


The end of the cable section measuring 30 inches in diameter after a total radial pressure of 30 tons, after which the compacted cable was bound or seized with tie-wires

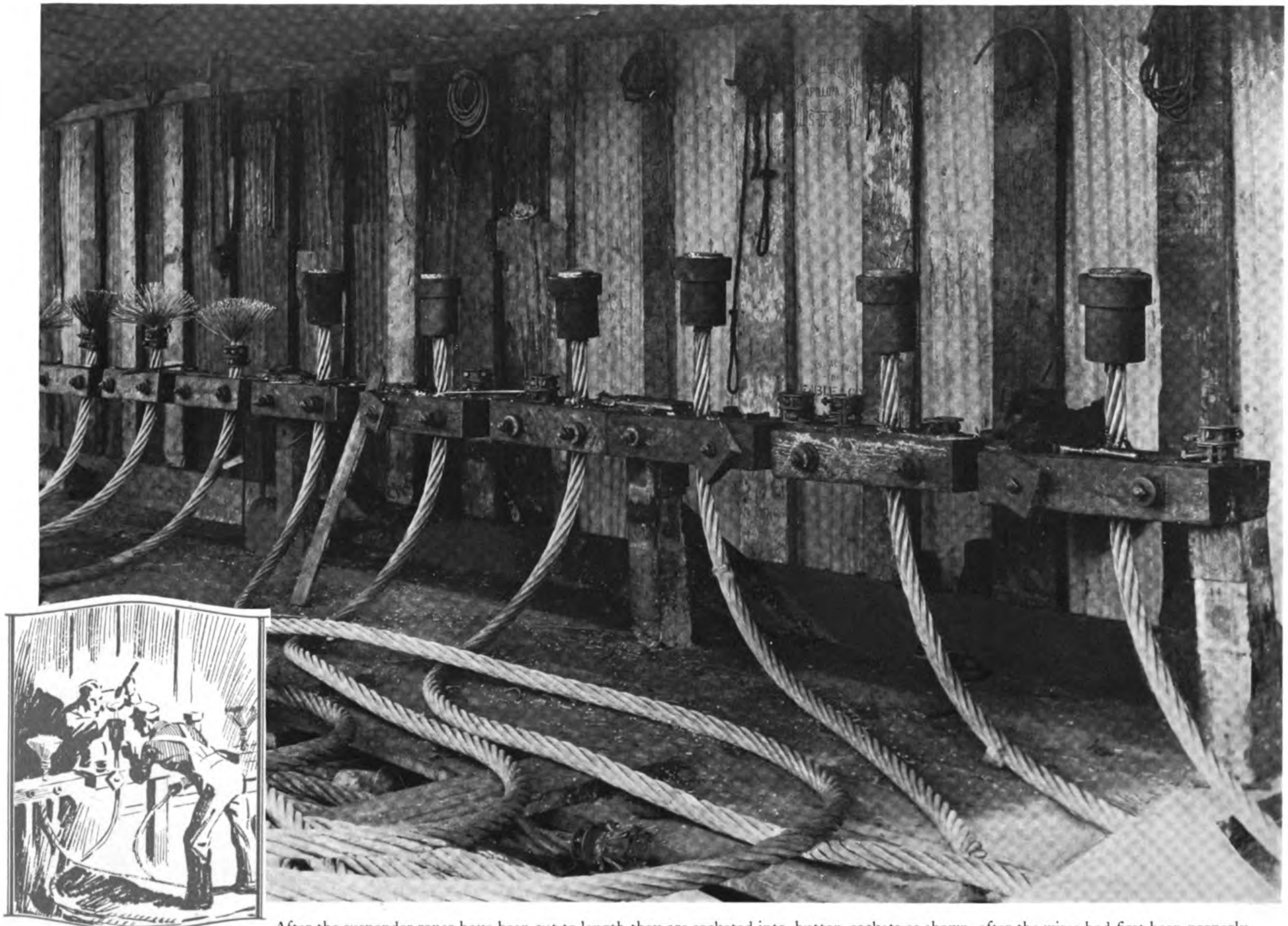
No other members of a suspension bridge are quite as important as the cables. The entire dead and live load of the structure is suspended by them and transmitted to the towers and anchorages. The stability of the entire bridge depends on their ability to carry with a large margin of safety the full continuous load over the entire structure.



A view of the anchorage connections, showing the throat clamp where the cable changes its shape from the 30 inch diameter round cable to the diverged position of the separate anchorage shoes in their respective anchorage eye-bar connections. This entire section of the cable will be housed so as to be protected against weather when the bridge is completed



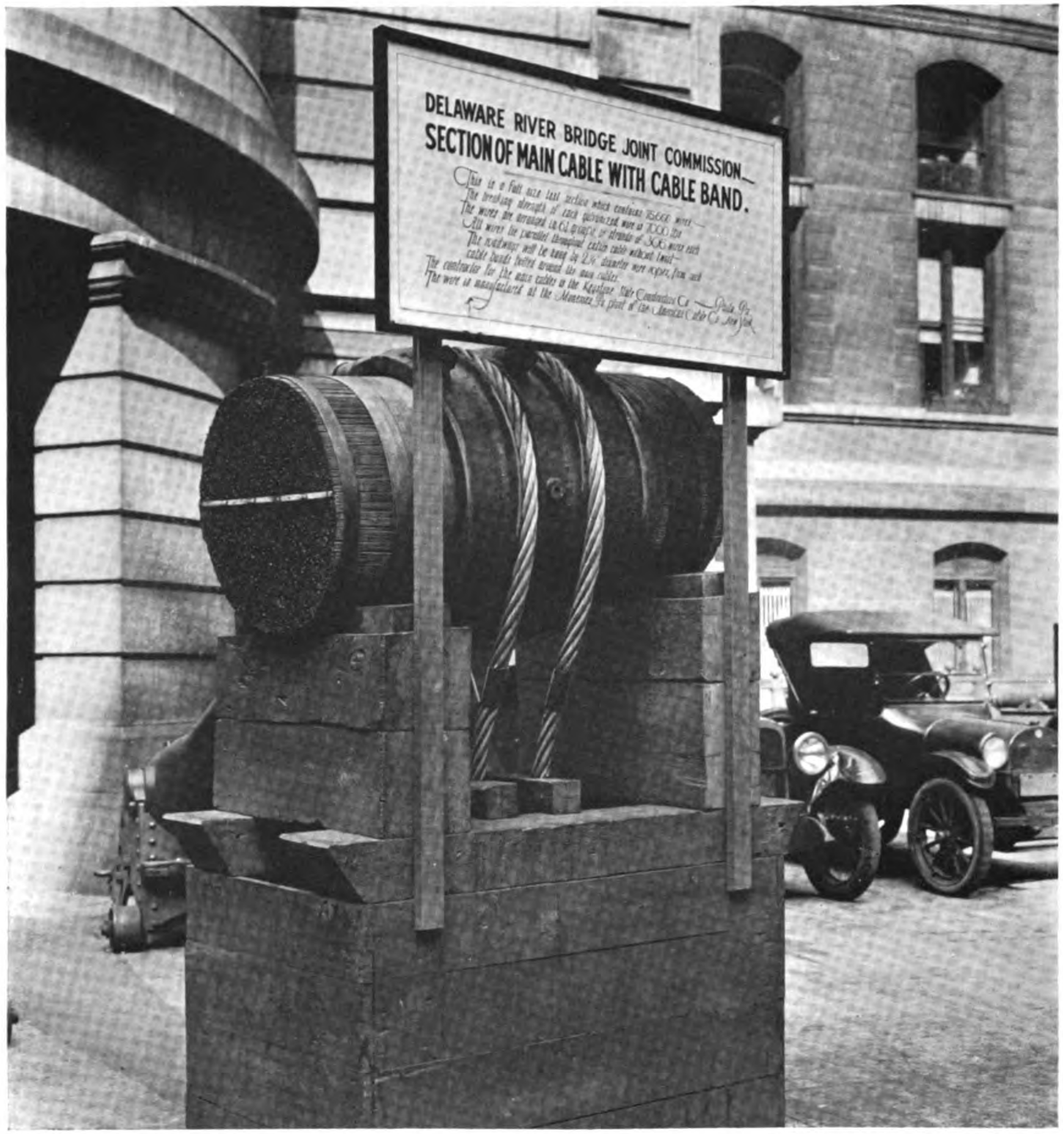
After the main cables are completed, the foot-bridges are taken down and the 2¼ inch cables, which supported the foot-bridges, are cut up into suitable lengths and used as suspender ropes for supporting the suspended structure from the main cables



After the suspender ropes have been cut to length they are socketed into button sockets as shown, after the wires had first been properly separated, as shown on the left-hand side of the picture, and properly cleaned with acid, the wires again brought together and inserted through the smaller end of the tapered hole in the socket. Pure zinc or spelter is then poured in to completely surround the wire ends and to fill the button sockets, thus making a connection that has the full breaking strength of the wire rope. The average strength of each of these 2¼ inch diameter ropes is 218 tons

A view showing the two suspender ropes which are placed over each of the cable clamps. The lower ends of these ropes support the entire suspended structure by means of the button sockets shown on the opposite page. Note, also, the hand rails which are 1 inch diameter, 37 wire, galvanized steel strands which are left permanently in place for future inspection of the cables

The general public, as well as those interested in engineering, took a tremendous amount of interest in the development of the structure. A cross section of one of the great cables was prominently displayed and viewed by thousands of spectators. The sign accompanying the exhibit gave a brief outline of the magnitude of the work.



A 5-foot section of the cable with a cable clamp in place, and also the two suspender ropes in place on the grooves made in the cable clamp

A view from the top of the Camden tower, showing the partially completed flooring system with a view of the traveling crane used for erecting the steelwork in the trusses

As the bridge neared completion the majestic beauty of the structure became apparent and the hopes and dreams of its builders fully realized. Towering against the sky it presents not only a means of rapid transportation across the Delaware River but a monument to the history and progress of American development.

The steelwork completed in the main span looking towards Philadelphia from the Camden side

A view showing the Philadelphia anchorage after it had been cased with granite, showing also the completed suspended structure looking from Philadelphia

The

PAGE STEEL *and* WIRE COMPANY

THE history of the Page Steel and Wire Company is closely akin to the industrial development of the nation. Its foundation dates from the year 1883, when J. Wallace Page became interested in the need for a more economical and permanent form of fence for agricultural communities.

This interest was turned into action and over 40 years ago at Adrian, Michigan, he developed and manufactured on a small scale the first woven wire fence. Public response was instantaneous and an industry was born that soon grew to vast size.

As the years passed the business developed in size and scope and additional plants were located at Monessen and York, Pennsylvania; Niagara Falls, Canada; with Main Offices and Research Laboratories located at Bridgeport, Connecticut.

It was only natural that the Page Steel and Wire Company, as the originators of woven wire fence, should also pioneer in the development of woven wire chain link fencing for the protection of every type of property. Today Page Protection Fence, because of its high quality and exclusive construction features, is recognized in almost every state in the Union as a standard of comparison.

When the exceptional qualities embodied in Page-made wire became known to industry, there sprang up many demands for its use in products foreign to fence. To meet these demands various items have been added from time to time to the list of Page-made products. They embrace: Wire for Cable Construction, Page Hi-Way Guard, "the Lifeline of the Highway," Page Welding Wire and Electrodes for all ferrous welding, Page Strand Wire, Page Bond Wire, Page Farm Fence and numerous other items made from Page wire such as spokes, needles, rivets, nails, etc.

STEEL AND WIRE PAGE QUALITY PRODUCTS

An INVITATION

WE WISH you could visit with us—that you could see for yourself the manner in which Page Products are made from start to finish in our own mills. You would then realize why items bearing the Page trademark are always uniform and always render the utmost in service.

Wire may look alike in appearance, but there is a vast difference in its ability to withstand hard usage. To assure quality material and absolute uniformity every bit of wire used by Page is rolled and drawn in the Page Mills—among the most modern and completely equipped of their kind in the world. From crude ore to furnaces where the raw material is converted into copper-bearing steel, and from the billet mill to where the wire is drawn and galvanized and woven—every operation is carefully guarded by experts who place quality above every other virtue.

There is no guess work about Page-made wire. Every inch of it is exactly the same.

And back of Page Products stands a national service organization that is placed unreservedly at the command of industry. Trained engineers, backed by complete laboratory and shop equipment, will gladly render the utmost in co-operation. You are invited to place your problems squarely up to them.

PAGE STEEL AND WIRE COMPANY
Bridgeport, Connecticut
An Associate Company of the American Chain Company, *Inc.*
District Offices: **Chicago New York Pittsburgh San Francisco**