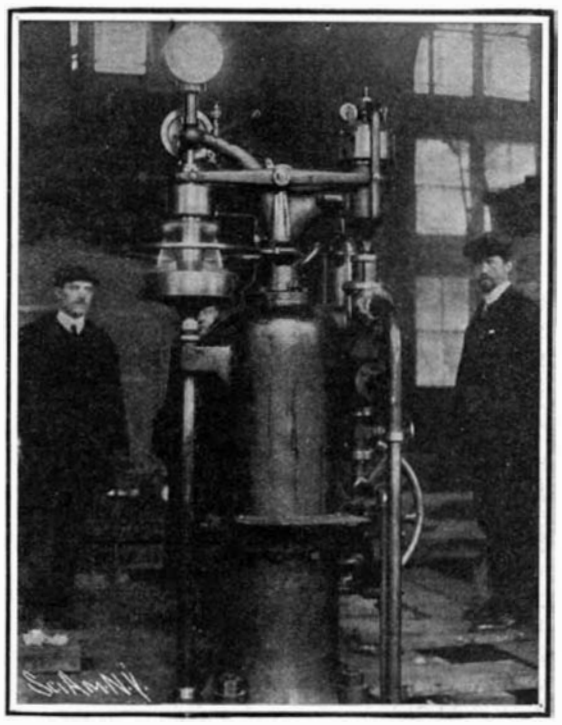
ELECTRIC POWER DEVELOPMENTS AT NIAGARA FALLS.—III.

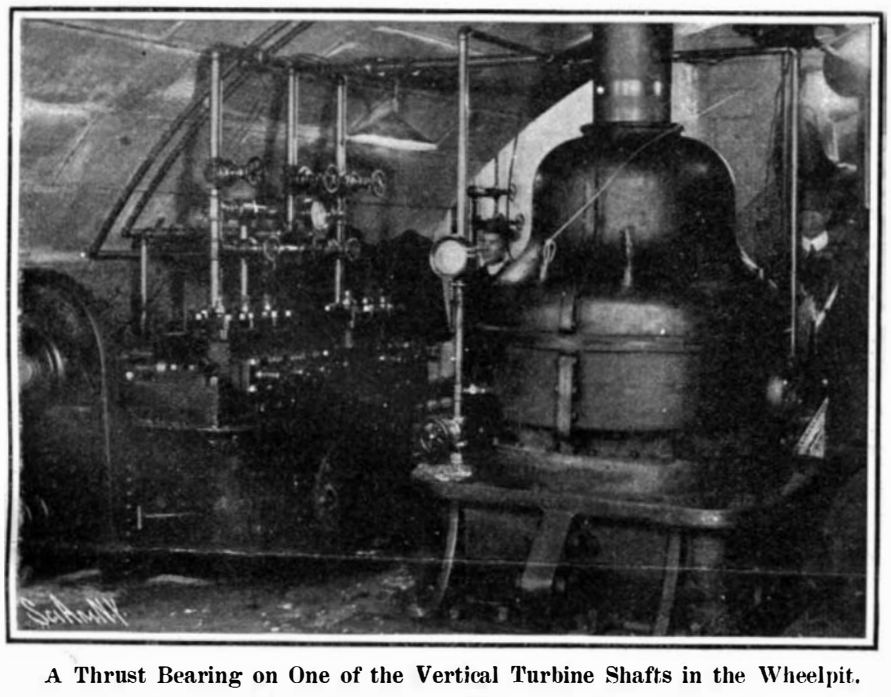
110,000 HORSE-POWER PLANT OF THE CANADIAN NIAGARA POWER COMPANY.

The history of the great electric power developments at Niagara Falls divides itself into two important periods, the first embracing the pioneer work that was done upon the American side of the Falls, and the second dealing with the more recent and far more extensive operations on the Canadian side. If we exclude some minor and scattered water-power plants, the credit for the first development of electrical energy from the Falls, on a scale of any considerable magnitude, is due, perhaps, to the company now known as the Niagara Falls Hydraulic Power and Manufacturing Company, who cut a canal on the American side from the upper rapids to a forebay on the edge of the cliff below the steel arch bridge, and utilized its energy in a power house at the foot of the cliffs. The first installation was modest; but the plant is to have an ultimate capacity of about 40,000 horse-power.

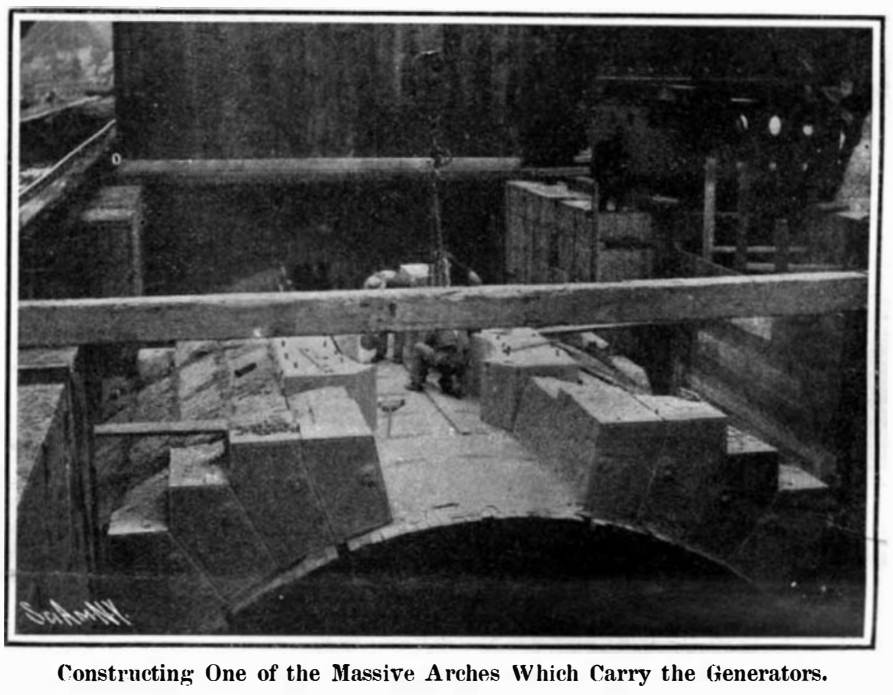
The first development of the power of the Falls on a scale that commanded world-wide attention, was made by the Niagara Falls Power Company, when they built a 50,000-horse-power house, and installed in it ten hydraulic electric units, each of 5,000 horse-power. The success of this plant was so encouraging that, not long after its completion, the company built on the opposite side of their intake canal a second power house, containing eleven units of 5,000 horse-power. This brought up the total capacity of the plant of this company on the American side to a grand total of 105,000 horse-power.



Governor for Controlling the Speed of the Turbines.

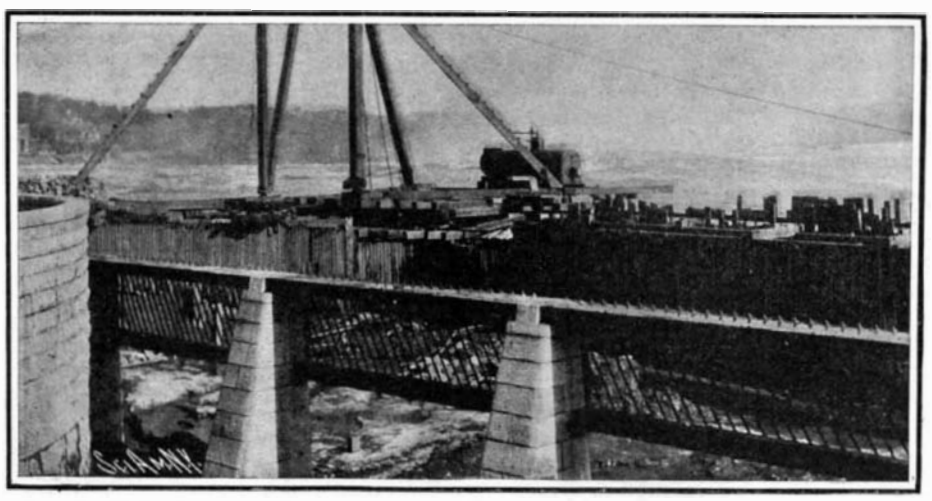


A Thrust Bearing on One of the Vertical Turbine Shafts in the Wheelpit.



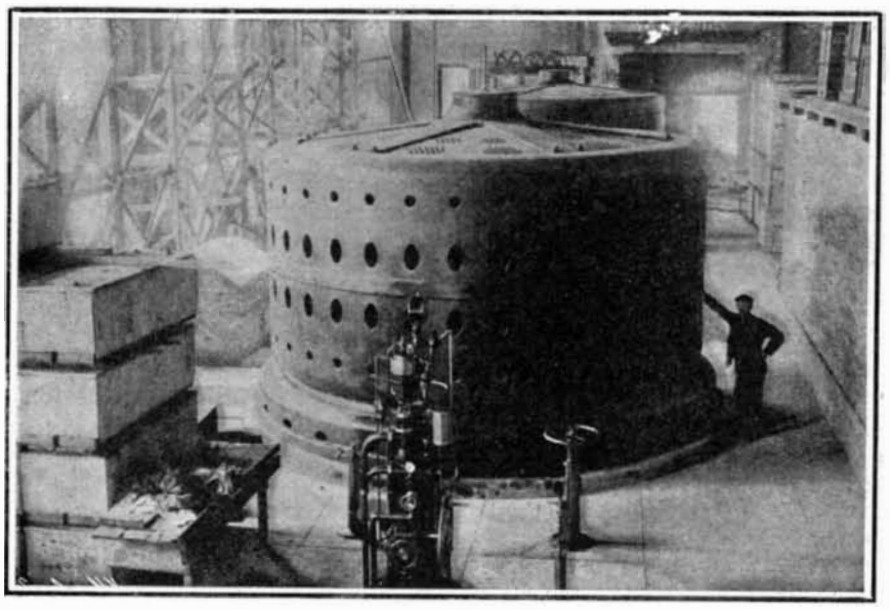
Constructing One of the Massive Arches Which Carry the Generators.

It was inevitable that, in the process of utilizing the energy of the Falls, the superior advantages offered on the Canadian side should raise the question of establishing power plants on the Canadian shore line. The greater volume of water that flows over the Horseshoe Falls, and the fact that the concave form of the shore line tends to place the deepest and swiftest currents within easy reach of wing dams and sluiceways, renders the Canadian side particularly attractive to the hydraulic engineer. Hence it was that the next power plant to be built by this company was located on Canadian soil; and being the first in the field, it was enabled to select the most favorable site for its intake. By reference to the bird's-eye view of Niagara Falls published in our issue of August 12, last year, it will be seen that, of the three power plants on the Canadian side, that of the Canadian Niagara Power Company is the most advantageously located as regards the simplicity and economy of construction of its intake; for while the other two companies have been under the necessity of building large and expensive wing-dams for the purpose of backing up the water and securing a sufficient depth of flow at the intake, the intake of the Canadian Niagara Power Company is built right on the shore line of the river, whose depth at this point is sufficient to insure, at all times, the requisite supply of water.

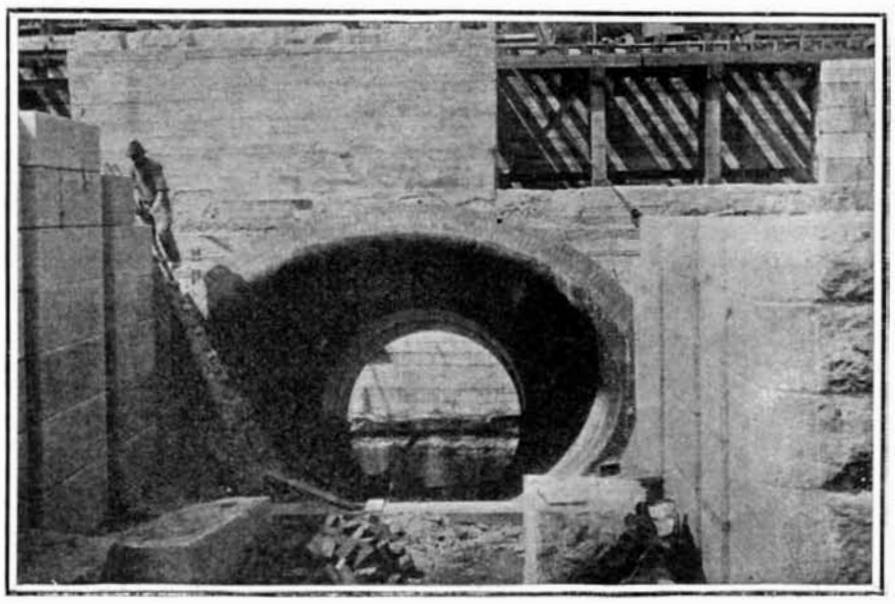


Screen, at Entrance to Forebay, for Preventing Entrance of Driftwood and Ice.

It may be well, by way of recapitulation, to mention the salient features of the other two plants on the Canadian side. The largest of these is that which is under construction by the Ontario Power Company. Its intake is located near the head of the upper rapids, and when the scheme has been completed in its entirety there will be three 18-foot tubes, the first of which is now in place, leading the water from the intake to the top of the bluffs below the Canadian Falls. From these conduits a series of 9-foot penstocks carry the water down to a vast building 1,000 feet in length, located at the foot of the bluffs, in which, ultimately, there will be installed twenty-two units of 10,000 horse-power each. A little more than a third of the mile down the rapids from the Ontario Power Company's intake is located the power station of the Electrical Development Company, whose ultimate capacity will be 125,000 horse-power. The water is deflected by a wing-dam through screens and gates into penstocks which lead to eleven turbines, each of which has a capacity of 13,000 horse-power at three-quarter gate. The turbines discharge into a tailrace tunnel, which leads in a straight line from the bottom of the wheel pit to the Falls, where the water is discharged near the bottom of the cliff and behind the great cur-



One of the Eleven 10,000-Horse-Power Generating Units.



View Showing Brick Ring Around a Penstock Mouthpiece, with the Wheelpit Seen Through the Opening.

ELECTRIC POWER DEVELOPMENT AT NIAGARA FALLS.—III.

tain and between the water and the face of falling water. The total capacity of this plant is 125,000 horse-power.

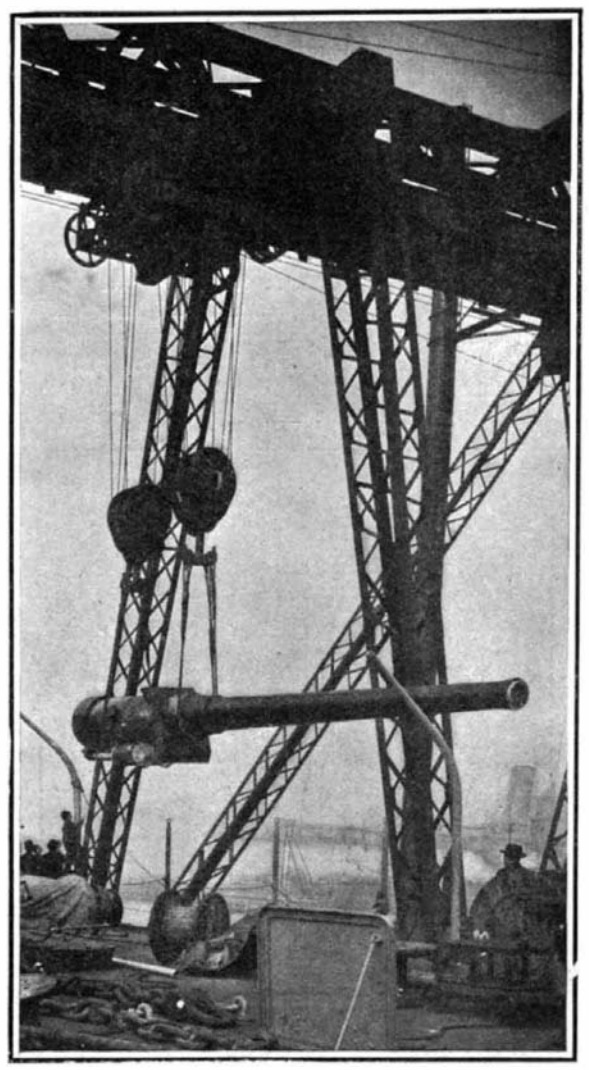
The great work which forms the subject of our illustrations has been built by the Canadian Niagara Power Company, a Canadian corporation which is controlled by the parent enterprise, the Niagara Falls Power Company. At its completion it will have a capacity of 110,000 horse-power. In the general arrangement of its wheel pit, turbines, power station, and tail-race tunnel, it resembles the company's plants upon the opposite side of the river; but in the details of its design it marks the progress which has been made during the decade which has intervened since the first plant was built upon the American side. The power station is located approximately parallel with the shore line of the river, and at a point about a mile from the point where the upper rapids commence. The entrance to the forebay is closed by a strongly-constructed iron screen, carried upon a line of masonry piers, which serves to prevent the entrance of ice and driftwood. Just inside the screen the entrance is crossed by a handsome masonry arch bridge, which has been built to carry one of the driveways of the park. Beyond the bridge the channel widens out into a broad basin 626 x 150 feet in extent, across whose waters one sees the dignified and impressive mass of the great power station. The water flows from the forebay to the penstocks through a series of arched openings, whence it is conducted by eleven great penstocks 10 feet 2¼ inches in diameter to as many turbines located in one long line on the floor of the wheel pit. The effective head of water is 133 feet. From the turbines the water is discharged through draft tubes into a discharge tunnel which measures 25 feet in height by 18 feet 10 inches in width. The tunnel extends from the wheel pit to the face of the gorge, a distance of about 1,700 feet, just below the Horseshoe Falls, where it discharges at the level of the river.

The distinctive feature of this power station is the unusual size of the turbines and the generating units, each of which is of a capacity of 10,000 horse-power, or exactly double that of the units established in the first power plant of the Niagara Falls Power Company on the American side. It was a notable step on the part of the company to increase the size of its units by 100 per cent, and no little credit is due to them for being the first to make so bold a move at Niagara. The advantages of the larger units are many and valuable. In the first place they occupy but little more space than units of 5,000 horse-power, and, consequently, for a given total capacity of plant, there is a great reduction in the length of the wheel pit and the power house. Moreover, 10,000 horse-power generators cost considerably less per horse-power than generators of 5,000 horse-power capacity. The turbines, which were designed and built by Escher, Wyss & Co., are of the vertical type and the power is transmitted by massive vertical shafting, 3 feet 4 inches diameter in the hollow portion and 14 inches in the solid portion, to eleven generators located on the floor of the power house at ground level. The generators are wound for three-phase, 25-cycle current of 11,000 volts potential, the speed of revolution being 250 per minute. This high voltage was selected because of the economy that it secured in local distribution of the power, the cost of underground distribution of three-phase, 11,000-volt current being about one-fifth of that of distribution of a two-phase 2,200-volt current.

The cable connections are so arranged that the Canadian power house can operate in connection with one or both of the American plants. The cables are carried across the Niagara River over the upper steel arch bridge, the total distance between the two plants being about three and one-half miles. The three-phase, 11,000-volt current is changed to two-phase, 2,200-volt current for paralleling, by means of step-down transformers; or, if desired, it is delivered direct to the various manufacturing concerns on the lands of the Niagara Falls Power Company. The output of this great plant will be available for Canadian industries in the Province of Ontario, so far as they lie within transmission distance, and subject to the Canadian demand for power it will be available for American consumers on the American side according as the demands may come in. Our thanks are due to Mr. W. D. Robbins, assistant engineer for the company, for courtesies extended during the preparation of this article.

MOUNTING THE 12-INCH GUNS OF THE "CONNECTICUT."

If it were not for the delay in the furnishing of the armor for her turrets, the United States battleship "Connecticut," which, as our readers are aware, has been constructed at the Brooklyn navy yard, would to-day be a completed ship. As it is, about three or four per cent of the work remains to be done and practically the whole of this relates to the mounting of the guns and the bolting on of the turret armor. The four 12-inch guns and the eight 8-inch are in place, and as soon as the twelve 7-inch pieces are delivered from the gun factory, the work of placing them on their central pivot mounts in the broadside battery will be quickly accomplished. With the exception of these last-named guns, everything below the upper deck is completed.

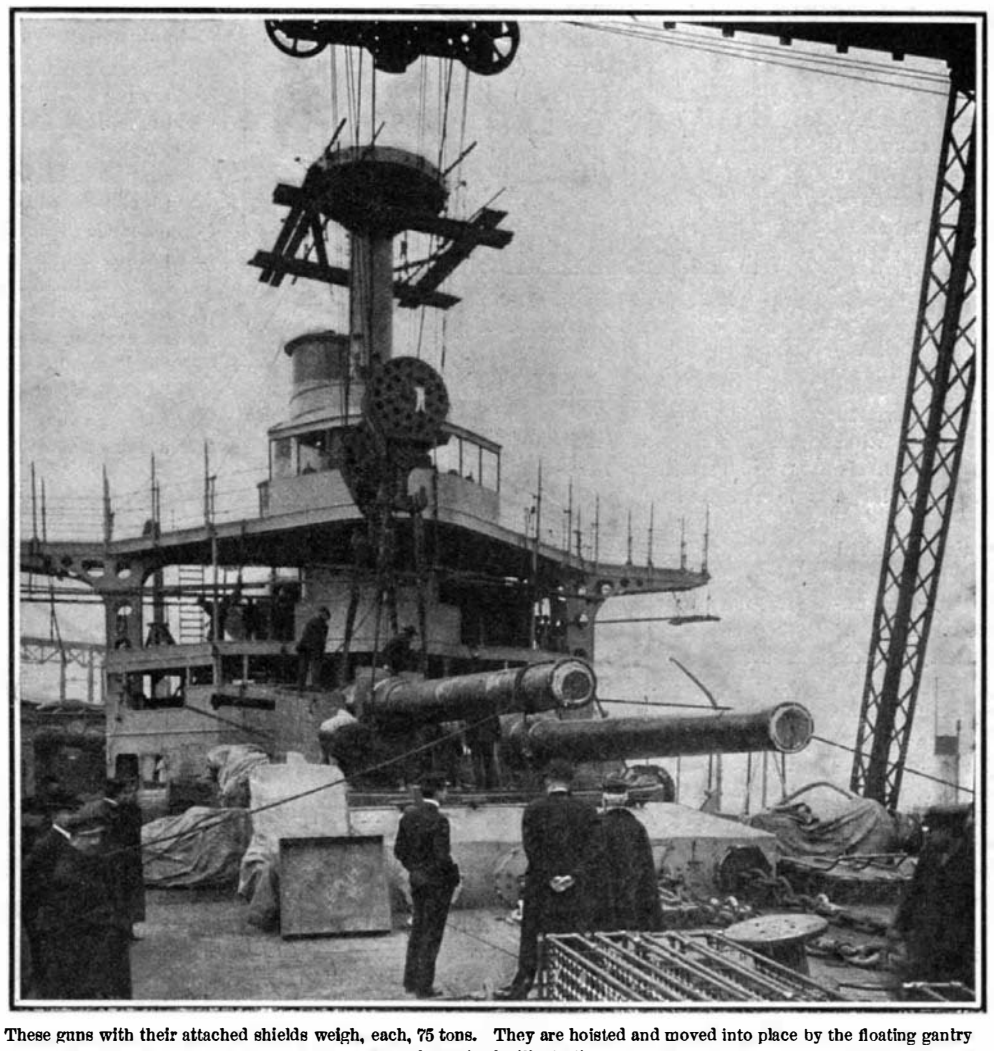


12-Inch Gun Being Transferred from Floating Crane to the Ship.

Pending the final determination and announcement of the plans for our new battleships "South Carolina" and "Michigan" (ships which will be of the same broad type as the "Britannia," carrying only 12-inch guns in the main battery), the "Connecticut" represents the highest development of warship construction in the United States navy. Furthermore, if the naval designers of the world have been too precipitate in the sweeping changes which they have made in their new designs, changes based on the so-called lessons of the Japanese war—if future engagements will not be the long-range affairs that is commonly supposed, and the opposing fleets, keen for the delivery of a crushing and conclusive attack, draw into closer range where the secondary armament can play on the enemy with telling effect—in such event the "Connecticut," with her eight 8-inch and twelve 7-inch guns in effective range, might well prove to be a match for one of the new type carrying a few very powerful, but slow-firing guns.

The "Connecticut" is 450 feet by 76 feet 10 inches, by 24 feet 6 inches, and displaces 16,000 tons. With 16,500 horse-power she is designed to make 18 knots an hour. Her full bunker capacity is 2,200 tons of coal. She carries a continuous belt, 11 inches thick amidships. Her 12-inch guns are protected by 12-inch armor; her 8-inch guns by 8-inch armor, and her 7-inch guns are mounted behind armor 7 inches thick. Her complete armament is four 12's, eight 8's, twelve 7's, twenty 3's, twelve 3-pounders, and fourteen small guns. She also carries four submerged torpedo tubes.

Our illustrations represent the emplacing of one of the four heavy, long-caliber, 12-inch guns, each of which with its saddle and attached port-shield weighs 75 tons. The guns were lifted and lowered into position by the large floating gantry crane which was built three years ago specially for the Brooklyn navy yard for doing this kind of work. The gun is lifted by means of two wire cable slings attached to the lower sheaves of two separate hoisting cables. These hoisting cables lead up to and over a traveling car, which runs upon tracks laid on the lower chords of the cantilever boom. The gun is lifted from the deck of the crane until it is high enough to clear the top of the turret. The carriage is then hauled out by means of cables that run in a sheave at the outer end of the boom, until it is in the correct position over the turret, and the gun is then lowered into position. A new feature in these pieces is the provision of a massive port-shield with parallel, vertical edges, the width of the shield being such that when the gun is in position, the clearance between the shield and the gun port is only about sufficient to allow the insertion of a lead pencil. The shield gives a perfect protection to the gun detachment inside the turret against fragments of bursting shell, and incidentally, it serves to prevent the entrance of gases from the 8-inch guns which are mounted a pair on each beam, astern of the 12-inch turret. The 12-inch gun is an exceedingly handsome piece, and its great length of 45 calibers, or nearly 50 feet over all, gives it an appearance of perfect proportion that is not possessed by the earlier pieces of shorter length. The initial service velocity is 2,700 feet a second, and its 850-pound shell leaves the muzzle with an energy of about 44,000 foot tons—sufficient for the penetration of 16½ inches of Krupp steel at a distance of 5,000 yards, providing, of course, that the projectile carries the usual soft cap.



These guns with their attached shields weigh, each, 75 tons. They are hoisted and moved into place by the floating gantry crane shown in the illustrations.

MOUNTING THE 12-INCH GUNS IN THE FORWARD TURRET OF THE BATTLESHIP "CONNECTICUT."

Through the courtesy of Capt. William J. Baxter, chief naval constructor at the yard, we were given an opportunity to make an inspection of the great battleship, which has left a strong impression of the skill with which the interior arrangements have been planned, and of the absolutely first-class character of the work. The great size of the ship has enabled the designers to provide accommodations for the officers and crew which are exceedingly liberal and comfortable, and marked by careful attention to the latest sanitary requirements. Particularly interesting is the care with which this provision has been car-