THE COOPER HEWITT MERCURY VAPOR CONVERTER.

BY A. FREDERICK COLLINS.

The extended use of electric vehicles in cities has heretofore necessitated an equipment comprising a motor generator set in garages where an alternating current only was available, but these electro-mechanical combinations are not only costly in their initial installation, but in their upkeep as well, since any machine having revolving elements is subject to wear, requires oil and more or less attention. Herein lies the merit of the mercury vapor converter, for it has no running parts, being purely an electrical device, has a higher efficiency than a motor generator set, and requires no attention whatsoever. The direct current from the converter may ordinarily be used for any purpose for which a direct current is suitable, but various apparatus require different arrangements of circuits.

While the converter lends itself admirably to the operation of vapor lamps, etc., the commercial converter shown in the illustration is intended for charging storage batteries and for electrolytic work, though it will operate on a resistance load, such as incandescent lamps, very nicely. The outfit can be readily installed in any garage or automobile stable where only alternating current is available.

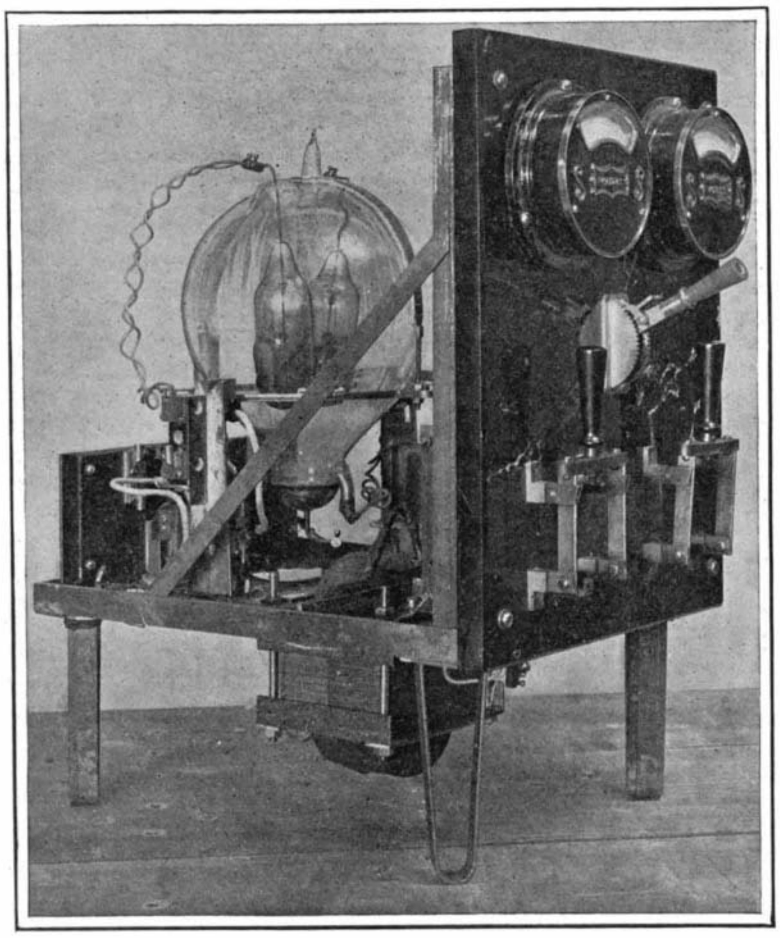
As there are practically no movable parts, the chance of anything getting out of order is reduced to a minimum and hence the converter will be found a simple, convenient, and feasible means for charging electric vehicles. The apparatus may be left running over night provided the batteries be not overcharged thereby.

The mercury vapor converter is automatic, namely, it starts on the closing of the alternating current and direct current switches. Should the converter go out, for any reason, it will start itself again provided the conditions of voltage, etc., are such as to make its operation possible; in other words, the apparatus may be left running with the assurance that, should it go out through any momentary failure of the alternating current supply, it will start again of its own accord on the return of voltage.

The apparatus may be made non-automatic by the opening of a switch, the current may be adjusted while running throughout the full range, and, further, it will operate through any reasonable range of voltage, rendering the equipment a stable and practical affair.

The converter consists of a glass bulb about 9 inches in diameter mounted in a suitable holder, which is entirely inclosed, with a small switchboard mounted in front. On the front of the board are placed a direct current ammeter, voltmeter, two double-pole switches, and a regulator to give current adjustment. The entire apparatus occupies a space of about 15 inches wide by 2 feet long by 20 inches deep; it can conveniently be placed on the floor or mounted against the wall.

With alternating current voltages not exceeding 400 volts, an auto-transformer is used for obtaining the proper potential for operating the converter. On higher voltages a transformer with separate primary and secondary is used. The maximum capacity of the converter is 30 amperes, continuous running, and the converter is adjustable to as low as 6 amperes. It may be adapted to any current up to 115 volts. Its efficiency is, at 30 amperes and 115 volts, approximately 90 per cent; and this efficiency tends to increase as the current falls off. The apparatus is designed for any single-phase constant-potential supply circuit of 60 cycles. In its general characteristics the converter has features in common with the mercury vapor lamp. In both devices the voltage is nearly constant for current of any amperage until a certain very small value is reached. Unlike the lamp, however, the purpose of the converter is not to give light, and so the distance between its metal positive and mercury negative electrodes is made exceedingly short and by this means the potential is reduced to about 115 volts.



COOPER HEWITT MERCURY CONVERTER FOR CHARGING STORAGE BATTERIES.

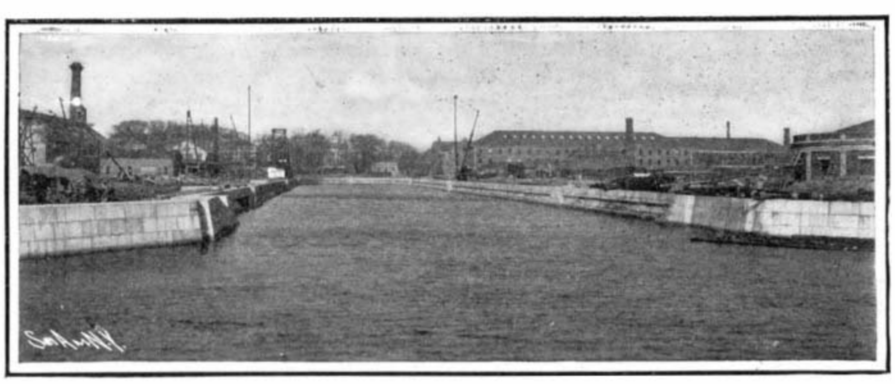
Where heavy currents are converted heat is developed to a considerable extent, and this naturally means loss of energy; to circumvent this undesirable condition the globe or container is given a large diameter and in this way a larger cooling surface is obtained. While the converter is in operation the mercury is carried upward in the form of a vapor, and this on condensing falls to the bottom again.

The converter just described is another practical application of a new series of distinct phenomena that have been evolved by Mr. Hewitt in the physics of electricity, of which the first is his well-known mercury vapor lamp.

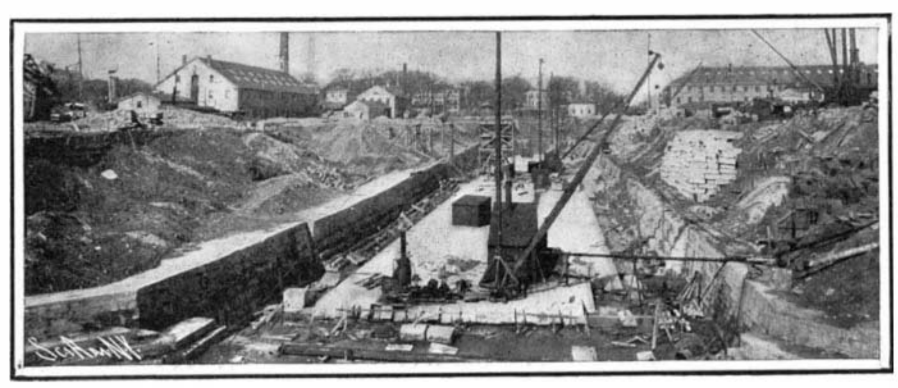
NEW MASONRY DRYDOCK AT THE BOSTON NAVY YARD.

The handsome stone-and-concrete drydock recently completed at the Boston navy yard is one of the largest docks in the world, and has taken about five years to construct. It embodies all the modern improvements which have been incorporated of late years in first-class dock construction, and it is built on such excellent natural foundation, and of such first-class materials and workmanship, that its period of life may be looked upon as practically indefinite. Not always has the United States government built its drydocks as wisely and well as this one has been built. For a period of many decades the navy was, unfortunately, obliged, by ill-advised motives of economy, to build its important drydocks of timber; and although some of these have given good service, others have been exceedingly troublesome, mainly because of leakage; the most notable case being the big drydock No. 3 at the New York navy yard. All of these docks, moreover, are, from the nature of the material of construction, perishable; and there must be a constant element of expense attached to them because of continually-recurring repairs and renewals.

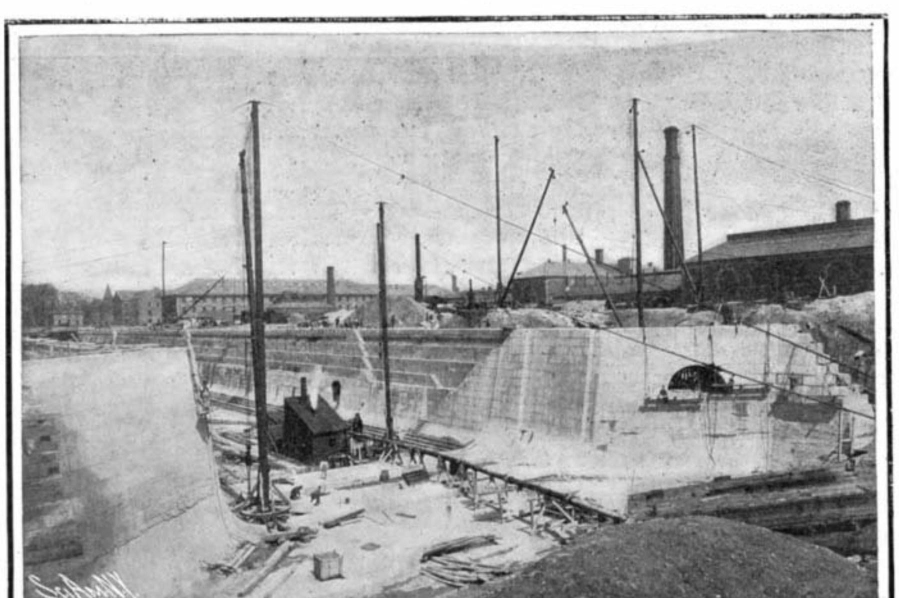
The new dock has a total length on coping, from head to outer end of table, of 788 feet; from head to outer gate sill of 750 feet; and the length on floor, from head to outer gate sill, is 729 feet. The width on the



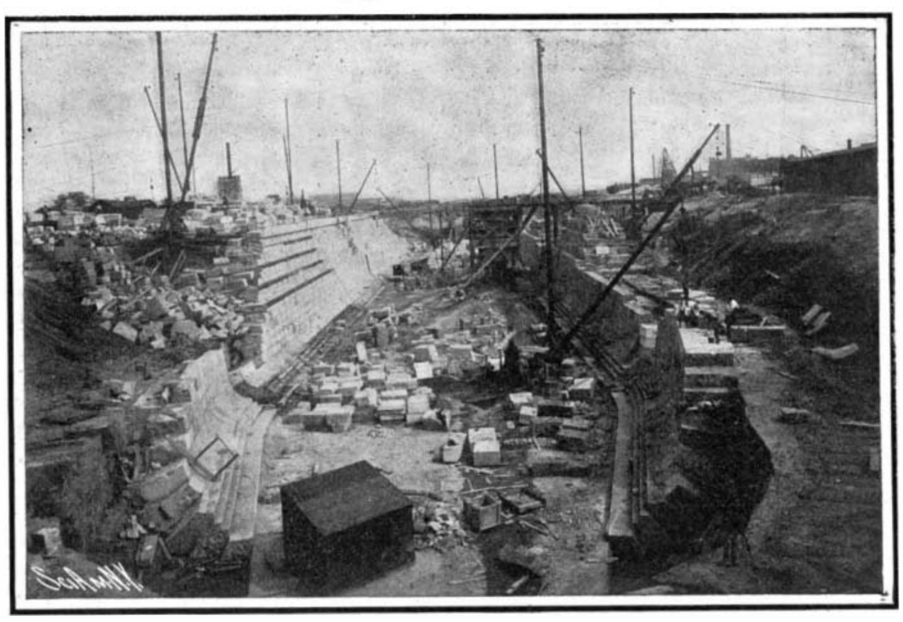
The Finished Dock from the Harbor.



View Looking from the Dock Bulkhead.



Entrance and the Inner and Outer Abutments, Which Receive the Caisson Gate.



Looking Toward Dock Entrance.

THE NEW GRANITE DRYDOCK, BOSTON NAVY YARD.

coping is 114 feet, and the width on the floor of the body of the dock is 72 feet. The depth from the coping to mean high water is 5 feet 2 inches, and the depth of water over the sill at mean high water 30 feet.

The site selected for the drydock was an old basin that had been used in the earlier days of the dockyard; and, of course, this made a considerable reduction in the amount of necessary excavation. The site, moreover, was fortunate in being founded everywhere upon a very good quality of hardpan; and although the specifications called for piling where it was necessary, the foundation, as the work proceeded, proved to be everywhere so good, that no piling whatever was used. The excavation was carried on, first by means of scrapers, and then by floating dredgers working inshore from the water front. After the dredgers had taken out the material to a certain depth, a massive bulkhead was carried across the entrance to the excavation, the water pumped out, and the excavation carried on, in the dry, by means of derricks and by hand labor, down to the subgrade. This bulkhead was one of the most important features of the work. It necessitated the driving of two lines of 12 x 12 tongued and grooved sheet piling, spaced 30 feet apart, and the filling of the interval with clay. The sheet piling was driven down to a firm bottom, and the whole structure was thoroughly stayed and braced. In spite of the great hydraulic head, when the excavation had been carried to its lowest depth of nearly 50 feet below extreme high water, the bulkhead remained tight, with the exception of some trouble at one of the abutments which was ultimately remedied. The total width of the dock excavation was about 130 feet, and its greatest depth over 50 feet.

The masonry portion of the structure consists of a monolithic mass of concrete covering the whole of the floor and the sides of the dock, upon which is laid the cut granite facing which forms the finished interior. On the floor, the concrete has a maximum depth below the keel blocks of 11 feet, and the maximum thickness of the concrete in the side walls is 18 feet. This granite masonry is 4 feet in thickness over the floor and has a maximum thickness of 7 feet in the side walls and altars. The masonry of the walls and entrance of the dock is of ashlar, in continuous courses. The beds and joints are smoothly dressed in true planes to form ⅜-inch joints. All of the stonework is laid in Portland cement mortar, made of one part Portland cement and two parts clean, sharp sand, and all joints between the ashlar and concrete packing are thoroughly filled with mortar and grouted up at every course. The coping stones are 2 feet in thickness, 3 feet in width, and never less than 4 feet in length. The concrete backing consists of one part Portland cement, two parts sand and five parts broken stone or gravel. The keel blocks, bilge blocks, and bilge block slides are of oak. In the building of the dock it was necessary to excavate 170,000 yards of blue clay and hardpan, and to build in place 61,800 cubic yards of concrete and 21,000 cubic yards of cut granite. The finished dock is a splendid piece of work, and, as can be seen from our photographs, the lines of the granite work are particularly true and fair.

The caisson for closing the dock is a steel vessel, 104 feet 2½ inches long, 22 feet in molded breadth, and 36 feet 5 inches in depth from bottom of keel to under side of upper deck. It is designed to be in stable equilibrium on an even keel under all conditions of flotation or submergence. It is fitted with a centrifugal pump, boiler, vertical engine, feed tank, gate valves, capstans, and the other fittings and furnishings of a dock caisson.

The pumping plant for emptying the dock is located in a well, which is 45 feet in diameter and whose concrete base is 60 feet below the coping of the dock. The installation in the well consists of two 48-inch centrifugal Morris pumps, driven by two 500-horse-power Westinghouse induction motors, which can develop, if necessary, as high as 750 horse-power each. These are the main pumps and motors for emptying the dock. In addition to these there are two 12-inch Morris drainage pumps, driven by two 75-horse-power vertical-shaft motors. The contract requires that the dock shall be emptied in three hours. This pump well also serves another dock, known as No. 1, which is very much smaller than the new dock. In order to pump the two docks there is a complicated system of piping and valves installed below the floor level of the well. The power house for supplying the current is located about 2,000 feet from the well, and because of the dampness in the well, it was decided to step down the 2,200-volt current to 220 volts for the motors. This is done by three 375-kilowatt transformers, which are also located in the well. There is also a 20-horse-power motor, direct connected to a five-stage centrifugal Worthington pump, which supplies water for the operation of the hydraulic valves. When we bear in mind that the well is only 40 feet in diameter, it can be seen that we have here quite a remarkable aggregation of machinery for the very limited space in which it is installed.

In conclusion we express our indebtedness to Lieut. C. W. Parks, the engineer in charge of this work at the Boston navy yard, for many courtesies extended during the preparation of this article.

A New and Simple Welsbach Lamp.

Quite recently there has been introduced in France and Germany a new form of portable lamp, as compact and light as an ordinary kerosene lamp and more easily operated, which has for a fuel supply wood alcohol.

The burner, as compact as the usual kerosene burner, and adapted to fit any regular fount, is of a novel regenerative type, to which the wood alcohol is conducted by a wick. The latter needs no trimming, as the alcohol by the heat is gasified, and then being mixed with air, produces an intense flameless heat above, which renders brilliantly incandescent the usual netted Welsbach mantle, suspended from above and inclosed in a cylindrical slender glass chimney similar to the student lamp type.

This gives in very small compass an intense illumination, equal to forty-five candle-power with the small mantle, and a smokeless light of remarkable steadiness and brilliancy, and which can be perfectly regulated, with the advantage of being odorless even when lowered to bare incandescence.

One of the points of novelty is an automatic device for feeding a minute quantity of alcohol from the fount to the burner in starting, which is done much in the same way as the usual mechanical extinguishing devices are operated on kerosene lamps. The small amount of alcohol thus brought up is simply ignited by a match, as in an ordinary lamp. In about a minute the light burns brilliantly.

On the Continent, where alcohol is made cheaply, a source of illumination is produced fully as economical as kerosene, and much more easily handled.

It has been stated that in this country it is possible to produce wood alcohol more economically than in Europe, because of our large forests, which form an abundant source of supply of wood.

As a light for photographic and projection purposes, it becomes very efficient, inexpensive, and convenient.

The Drydock at Sparrow's Point.

If man reckoned the size of the "Cavite" floating drydock, which the Maryland Steel Company is building for and will deliver to the United States government early next month, as he measures land, he would say that this big and curiously formed vessel had a superficial area of a trifle more than 1½ acres, for, from stem to stern and from port to starboard, the dock covers a marine equivalent of that space.

Nor is its "ground plan" unrivaled by the altitude of its steel walls, which rise some 64 feet from its as yet unbarnacled bottom, towering 58 feet clear above the rippling waves when the dock is without a burden. These side walls approach in breadth the great stone barriers the Mongolians built to keep out the northern invader, and upon which, we are told, two chariots could be driven abreast. Upon the 14-foot wide top of the dock's tall sides automobiles could race side by side from end to end of the craft; or two mogul locomotives harnessed to trains of cars each 500 feet long could stand together on each of the walls without causing the dock the least inconvenience. Then there is sufficient space between the walls to allow a three-ring circus to exhibit.

Early next month the dock will be floated and towed to a point in the Chesapeake Bay where the Navy Department will have in waiting the largest available battleship to make a test of the new dock.

The "Cavite" in service will have its own complement of officers and crew and these will be quartered as comfortably as if they were on any other vessel of the navy. There are staterooms and mess halls for nine officers and twelve men within the big side walls and there is a finely equipped library and a well appointed kitchen. A complete machine shop is one of the most important accessories and the equipment of this will be sufficient to permit the replacement of any part of a ship's machinery. Indeed, there will be material and apparatus enough in the shop to build a moderate sized vessel outright. All apartments of the dock are provided with electric lights, and there is a distilling plant for securing fresh water for cooking and drinking purposes. The dock has its own compressed air outfit for the manipulation of pneumatic tools used in repairing ships.

This marine giant will cost $1,147,000 and this government rates itself fortunate in getting the dock at such a favorable figure.

In building it there has been used 11,000 tons of steel, held together by more than 2,000,000 rivets. One hundred and thirty tons of red lead and linseed are being used to paint it. Its construction gave work to 300 men.

The length over all is 500 feet, with a width of 100 feet between benders, and a width over all of 134 feet.

The side walls stand 42 feet high clear of the pontoons and are 46 feet high from the bottom. The thickness of the side walls is 14 feet.

The pontoons, which form the base or hull of the dock, are 18½ feet deep.

The dock when floating light draft will draw but 6½ feet of water, but must be in 63 feet of water to give a draft of 30 feet above blocks for any vessel which it may be desired to block.

It has an extension feature by which arrangement sections may be built at any time and attached to it, thereby increasing its length as much as may be necessary. It is also self-docking, for the side pontoons can be sunk separately, each in turn raising the opposite side free from the water so the bottom may be cleaned, scraped, and painted.

The next largest floating drydock in the world is the Algiers dock, which was also built by the Maryland Steel Company and is stationed at New Orleans. It has a lifting capacity of 17,500 tons.

The Bermuda dock, which was built in England, has a lifting capacity of 16,500 tons. The Pola dock, owned by Austria, has a capacity of 15,000 tons. The Stettin dock, owned by Germany, has a capacity of 11,000 tons. The Pensacola dock of the United States government, and formerly located at Havana, is 450 feet long, with a lifting capacity of 10,000 tons.

The Current Supplement.

The current Supplement, No. 1530, opens with an interesting description of the first Philippine electric railway. Excellent illustrations give one an idea of the difficulties encountered. A *résumé* of Sir Oliver Lodge's paper on what he quaintly terms "A Pertinacious Current," is published. For the benefit of our readers, it may be stated that a pertinacious current is a continuous unidirectional discharge of electricity, obtained without cells, and under an E. M. F. so high that ordinary big resistances are easily overridden. We hope shortly to publish Sir Oliver Lodge's paper in full. Mr. Howard B. Dailey tells how to make an oscillating static electric motor, than which there is no adjunct of the influence machine that affords a prettier or more striking experimental demonstration of electrostatic attractions. Dr. Oskar Nagel writes on suction gas producers. A new hot-air engine is described by G. Emil Hesse. Charles F. Scott tells how to remember the wire table for the B. & S. gage. A *résumé* is presented of Prof. E. B. Poulton's lecture on Huxley and Natural Selection. Some new apparatus for recording the vibration of railway cars is described by Emile Guarini. The second installment of Mr. Alfred J. Hipkins's paper on "Musical Instruments: Their Construction and Capabilities," is published. "Flower Mimics and Alluring Resemblances" is the subject chosen by Percy Collins for an interesting illustrated article.

Tests of Animal Strength.

Two of the Barnum & Bailey show elephants broke the pushing record on April 16. Last year the same elephants pushed a big circus wagon containing twenty men until the rope, fastened to its axle and connected with a steel spring, sent the indicator on the test gage up to 6,500 pounds.

This year the same animals pushed until the gage showed 8,200 pounds. The wagon weighed 4,500 pounds, and it was estimated that it required a force of 1,200 pounds to move it. One elephant alone scored 7,200 pounds, and in pushing and pulling 6,000 pounds. Seventy-five men pulled 8,000 pounds and four horses pulling sent the gage up to 6,000 pounds on both the long and the short pull. Two camels were able to pull only 2,000 pounds.

The following interesting table shows the results of last year's tests compared with those of this year:

	1904. Pounds.	1905. Pounds.
One hundred men pulling	6,700	——
Seventy-five men pulling	——	8,000
One elephant pulling	8,750	6,000
One elephant pushing	4,500	7,200
Two elephants pushing	6,500	8,200
Two horses, short pull	3,750	3,000
Two horses, long pull	2,750	2,500
Four horses, long pull	5,125	6,000
Four horses, short pull	5,760	6,000
Two camels pulling	2,750	2,000

A prominent French automobile engineer recently stated that it would not be possible for a modern racing automobile to exceed the speed of 130 miles an hour while it is maintained at the present weight. M. Serpollet, the designer of the well-known steam car of that name, has therefore decided to approach this maximum as near as possible during this year. He is now constructing a steam car which he is confident will accomplish the kilometer in 18 seconds, or at an average speed of 125 miles an hour. The motor will develop over 200 horse-power, and the weight of the engine without the steam generator or boiler will be only 150 kilogrammes (330 pounds).

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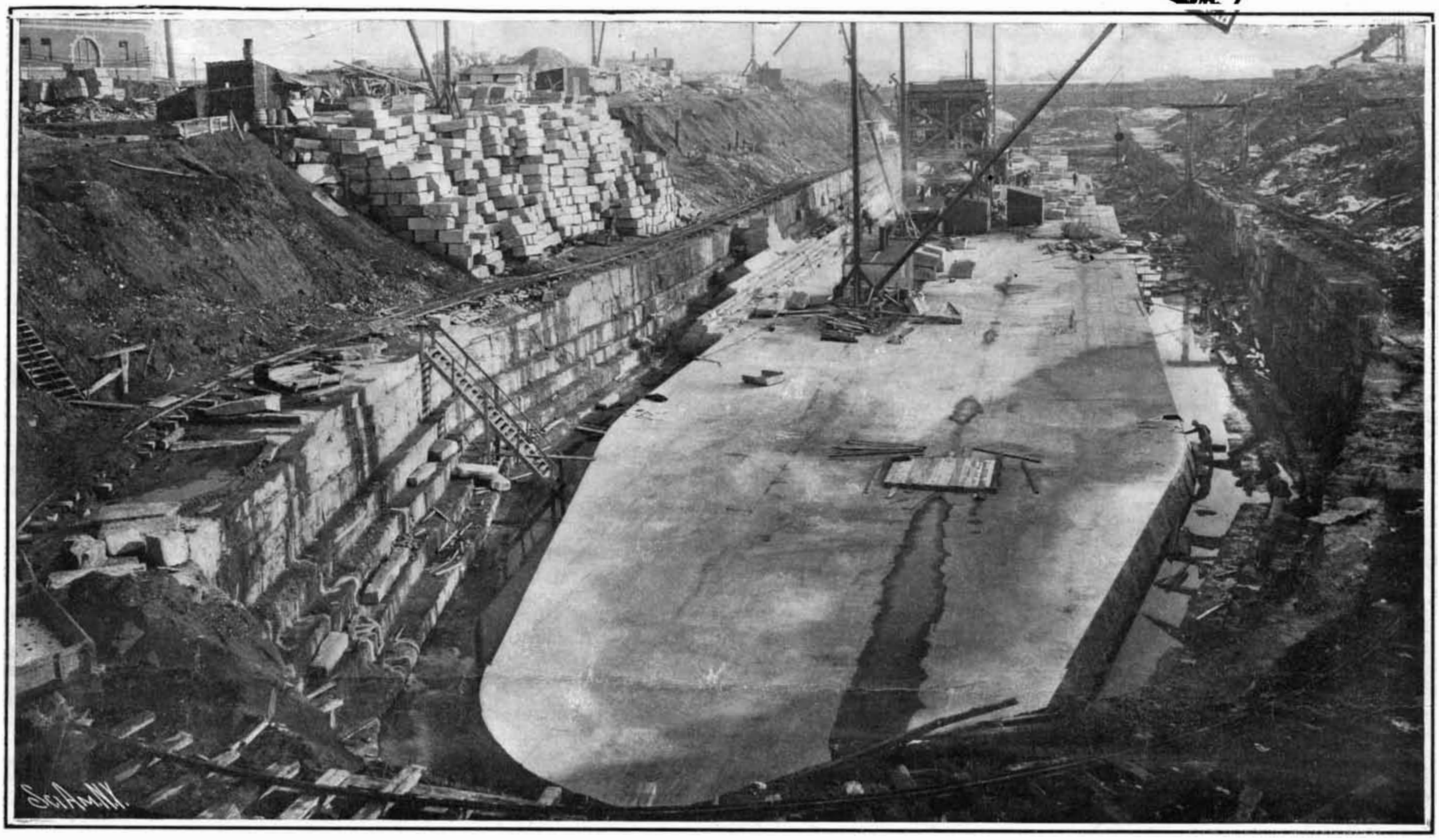
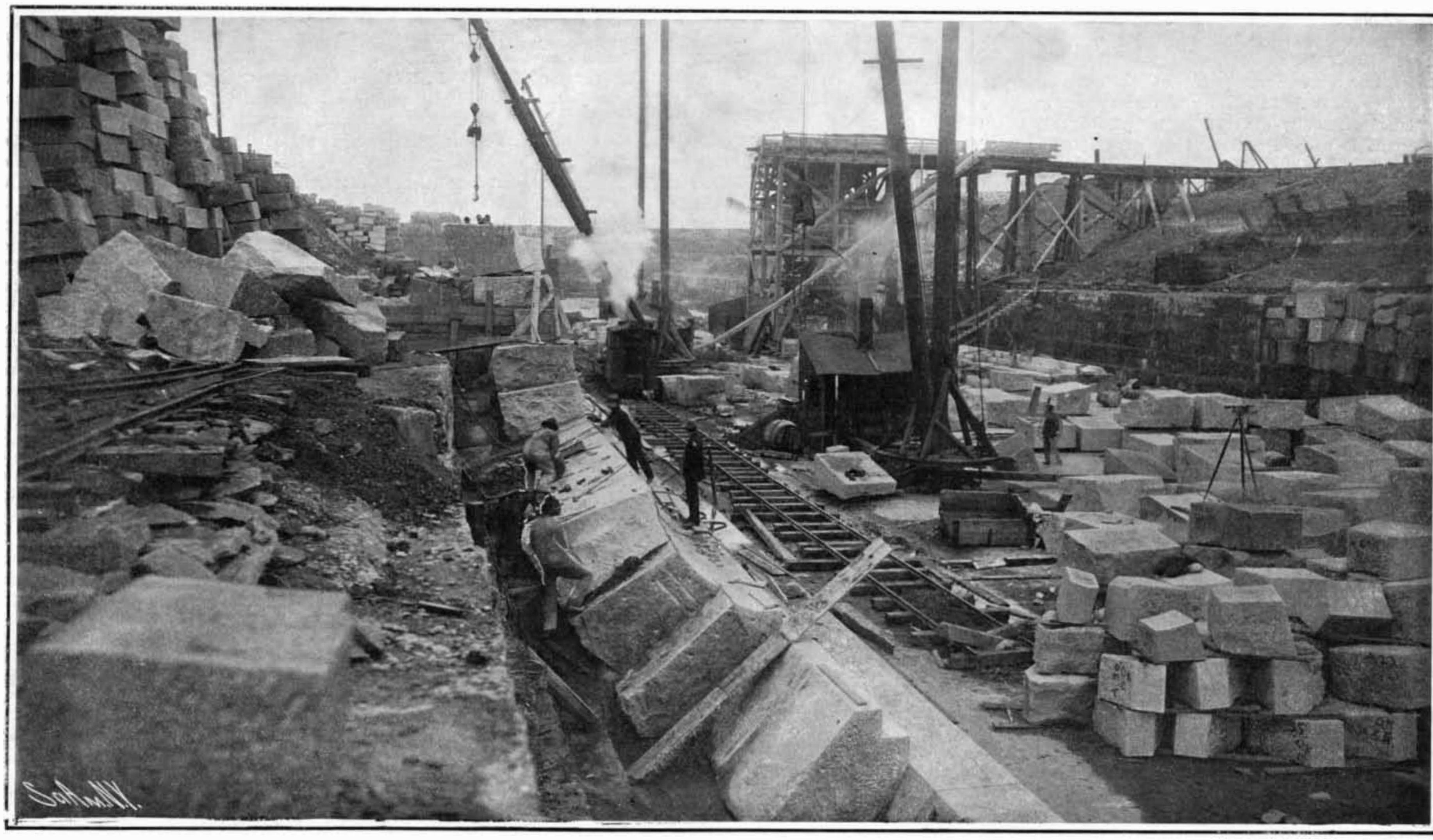


View Showing the Finished Granite Floor and the Concrete Backing, 18 Feet Thick, for the Side Walls.



View Showing the Massive Granite Masonry at the Turn from Floor to Side Wall.

Length on coping, 750 feet. **Length on floor,** 729 feet. **Width on coping,** 114 feet. **Width on floor,** 72 feet. **Draft on sill,** 30 feet.

THE NEW GRANITE DRYDOCK, BOSTON NAVY YARD.—[See page 341.]