The Blast Furnace and Steel Plant
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By-Product Plant at Sheet & Tube Works

New By-Product Coke Plant of the Youngstown Sheet & Tube Company, Recently Completed, Contains Many Means for Expediting Materials Handling, With Dual Units.

By CHARLES C. LYNDE.

Concentration and consolidation of all the units and departments contributing to the manufacture of finished steel products led the Youngstown Sheet & Tube Company to the installation of its own coking plant, for the furnishing of fuel for the six blast furnaces comprising its raw material department. This coke plant, specially designed to give economy of manufacture and reliability of operation, at present consists of four batteries of Koppers ovens, each battery being composed of fifty-one ovens, of 12½ tons nominal capacity. The coke plant is built as an extension of the former main plant of the Sheet & Tube Company down the river below Youngstown, and is close enough to the plant to give all haulage within the company's jurisdiction. The ovens are located across the river from the furnaces, but a special coke bridge gives uninterrupted handling of the fuel for the stacks. Complete provision for the arresting of all by-products is made in the Semet-Solvay benzol plant, which in itself recovers benzol, toluol and naphtha from the coke oven gas stream after it passes through the Koppers direct process tar and ammonia

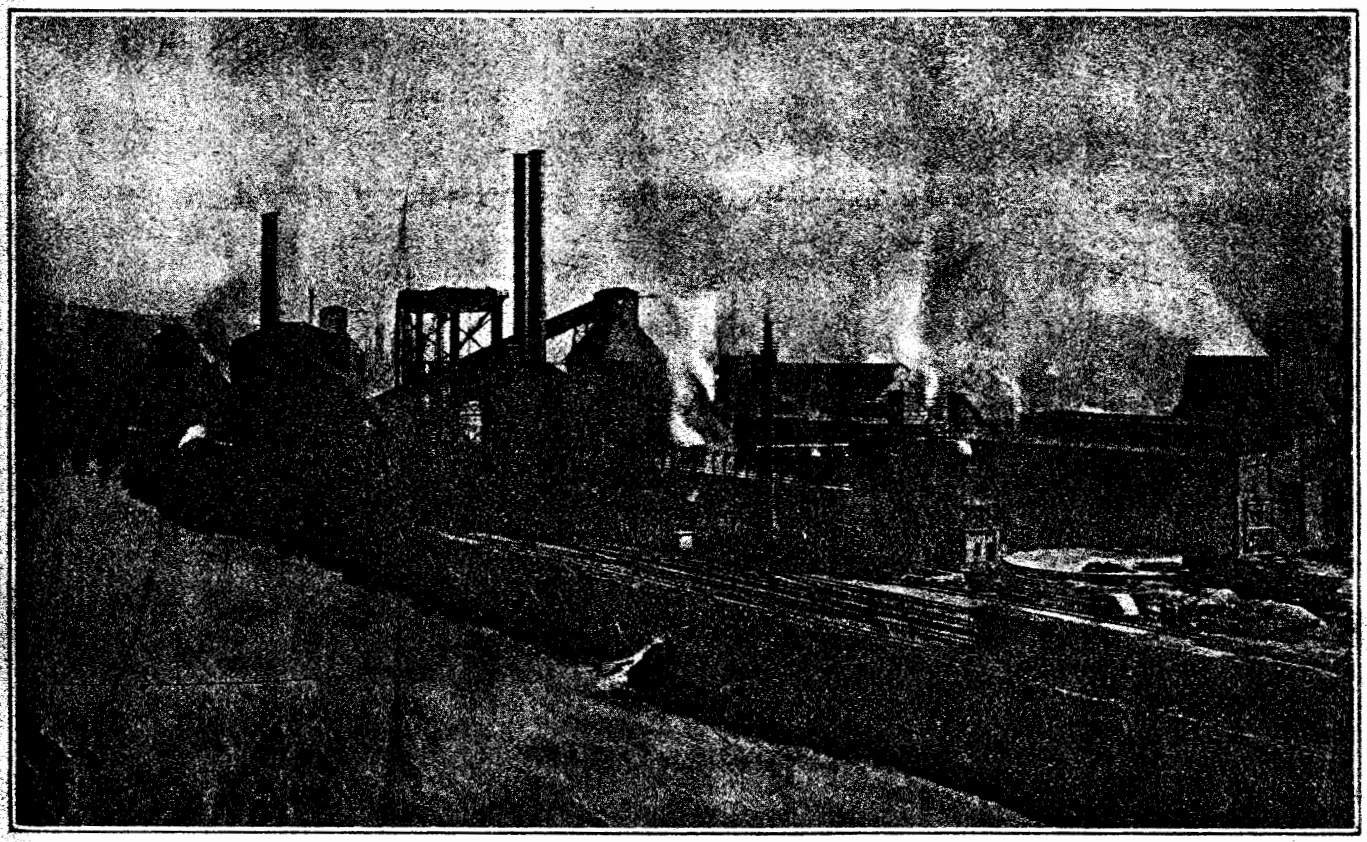

Figure 1.—The coke plant from across the river, one quenching station in the central foreground and the dumper and storage buildings toward the left.

recovery plant. The plant as now being operated is making slightly in excess of 2,300 tons of coke per twenty-four hour day, which leaves a small margin over normal furnace demands for the four stacks at the main plant.

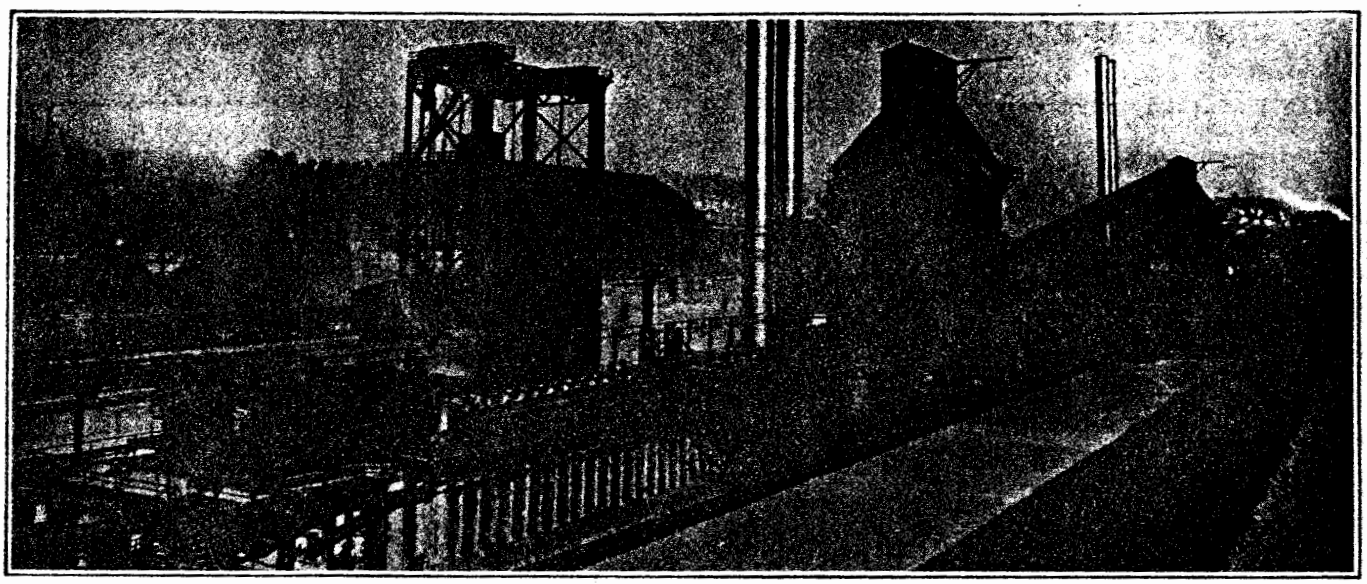

Figure 2.—Top of dumper and crusher building with storage bins in center, showing dual layout.

Rail haulage, formerly relied upon to provide a steady stream of coke for the furnaces, now is utilized to bring in the raw coals from the different mines. As the cars come in they are sorted on a coal analysis basis onto various storage tracks, and held there awaiting time for them to be unloaded by the high-lift car dumper which normally handles all incoming coal.

By giving the raw coal one high lift at unloading, much preliminary lifting by a conveyor is done away with, and the movement of the coal greatly expedited. A Westinghouse electric pusher locomotive, running on a special track between the standard gauge lines in the coal storage yard, moves the cars to and from the unloader track, and spots the cars for lifting. This locomotive is provided with pushers on each side, and in this way controls all the tracks within its yard. It is also provided with cable and drums so that it

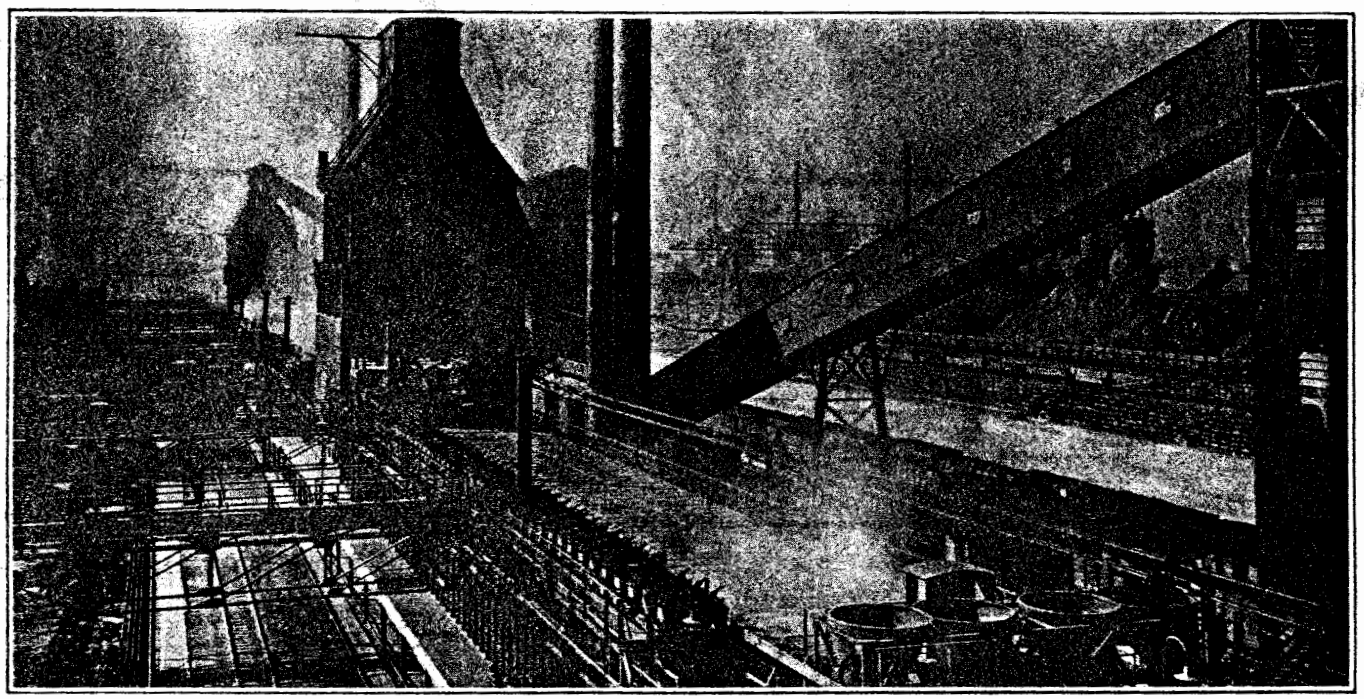

Figure 3.—Looking down on battery, with oven larry in foreground, showing shape of charging hoppers which prevents clogging.

n be used to bring cars in from outside of its current dius as limited by the covered third rail system.

The car dumper is provided with two dumping sta- ons, one for regular operation, and the second for orage purposes. Under normal routine, the car is isted to the high position, and there dumped at a ight sufficient to permit the coal to move through avity to the breaker and hammer mills, eliminating e need for belts usually found here. Frozen coal is rtially thawed on the ground before dumping, by es ranged along each side of the waiting track, and

time in a storage and receiving hopper. From the hopper the coal passes to the flight feeder serving the breakers. Feed from this bin is by gravity, and is controlled by the demand of the system farther along. The receiving hopper is fitted with a grating of beams, with eighteen-inch apertures, to prevent clogging of the outlet through the admission of large lumps of frozen coal.

Coal is first screened and divided, the fine passing to the hammer mills and the coarse to the breakers. In this latter equipment, provision is made for sort-

Figure 4.—One of the quenching stations in operation. The side walls serve as a stack, and carry most of the steam up and away from the quenching-car operator.

e smaller lumps of frozen coal treated as mine mps in the subsequent handling.

The lower position of the car dumper is for trans- rring the coal into a 110-ton electric side-dump trans- r car to store the coal within the radius of action a grab-bucket equipped bridge which will be in- alled to provide for fuel storage in excess of that w obtainable through loaded cars, standing in the rd. This storage coal will be rehandled into railroad rs by the bridge, as needed, and then taken by the r to the dumper, and elevated to the higher posi- on before dumping.

The coal breaker building is fed by the discharge om the dumper, the coal being stored in the mean-

ing refuse from the coal as discharged by the breakers. This refuse is fed onto a sorting conveyor belt, from which sorters pick the iron and slate, allowing the unsized coal to pass to the breakers.

Spare units are provided in the breaker equipment and hammer mills so that provision against shutdown through a breakdown is secured. Two hammer mills are kept as stand-by, and may be instantly put into service should they be needed. Hammer mill motors and other electrical equipment are housed in a special compartment which is sealed tightly against the mills themselves to eliminate the danger of dust explosions.

The oven batteries are operated as two sets of

two each, one set of equipment serving 102 ovens. The quenching cars are filled at their respective ovens, run to the end of their set and are quenched, and then return to a coke wharf at the middle of the oven installation, where both unload on the same wharf at one time.

Work on both sides of the oven at drawing time has been systematized and improved by the use of a complete electrical signalling system, so that signaling system, and the coke is drawn in safety.

On the pusher side of the ovens the doors are handled by the pusher itself, special equipment being provided for removing the door of the oven to be discharged. In practice on this set, it is customary to combine operations in many instances by removing one door of one oven while the leveler is smoothing down the coal just deposited in an adjacent oven.

Coal for charging is stored in bins straddling the

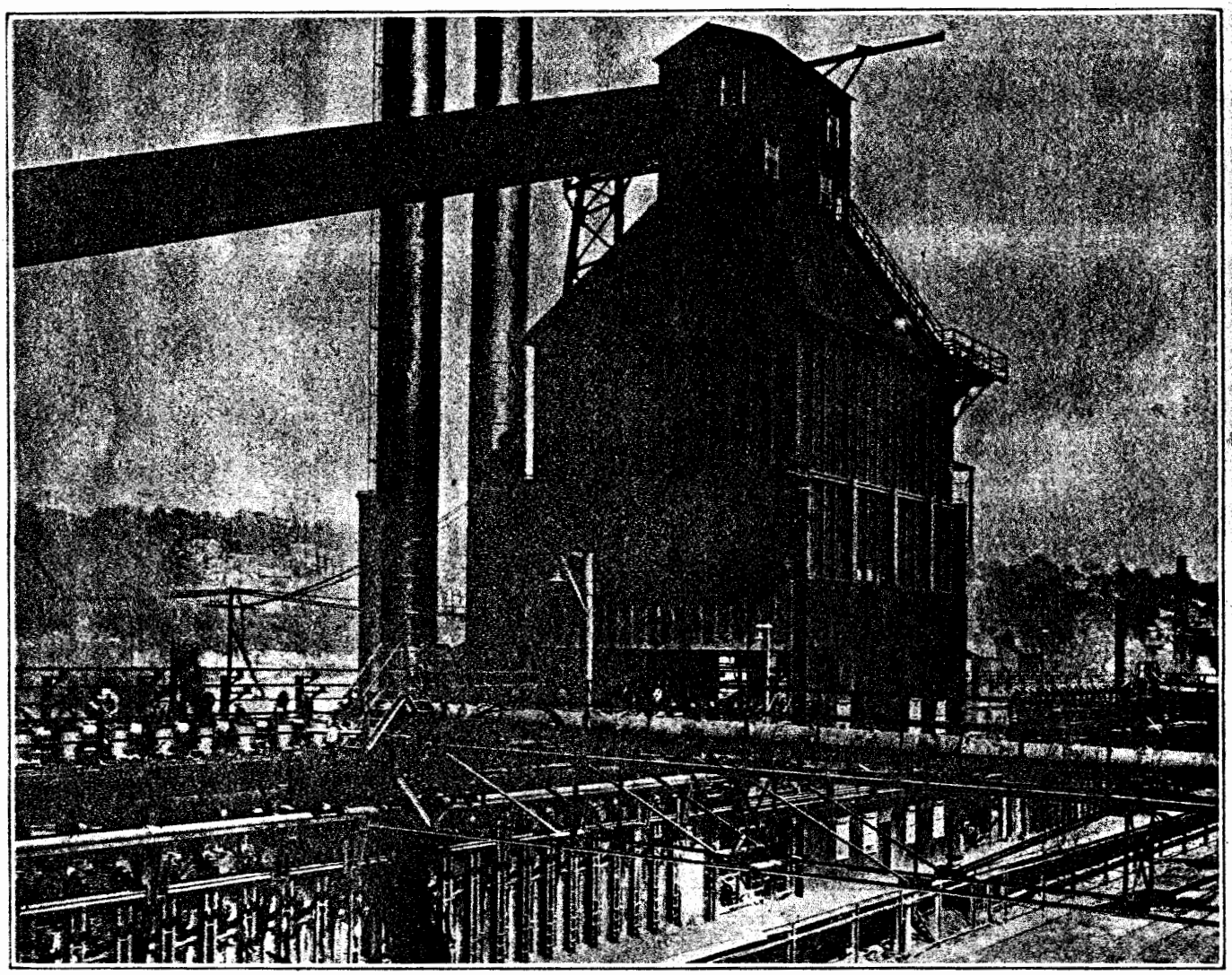

Figure 3.—One of the two coal bins straddling the ovens and serving the larry cars.

premature pushes are practically impossible. The coke side doors are extracted by a special design Koppers extractor, mounted on a truck which runs the entire length of the four batteries. Three of these machines are provided, one being kept in reserve for emergency use. The extractor and quenching car travel together, so that each has its round of work on an oven to complete within the five to six minute interval between ovens. When the door machine operator on the coke side of the ovens sees that the guide is placed and the coke ready to push, he merely signals the pusher operator by means of the electrical

batteries, it being properly proportioned to give the desired grade of coke before reaching this point. Mixing is done in the mixing house, which is provided with four 550-ton bins, over which the belt conveyor from the hammer mill screens discharges, a pivoted discharge enabling the operator to discharge the coal into the desired bin. These compartments are glass lined on the bottom, and discharge through a graduated gate, with screw adjustment, so that the flow of different kinds of coal to the mixing belt can be carefully regulated.

Larries are weighed with their load as they take

it on from the discharge chutes of the bins, so that the exact amount required for an oven is weighed out onto the car as it is filled. The hoppers on the larries are built cone-shaped, with one edge or side perpendicular, as it has been found that this plan will prevent the coal clogging or packing unduly. This form of hopper most nearly resembles the opening left in any coal bin with a bottom outlet.

Hot water for the quenching stations is taken from the efflux of the primary gas coolers, and stored in the tank shown at the right of the station illustrated. The water is released for quenching the coke by a valve convenient to the quenching car operator. After cooling the coke the water flows through a screen in the base of the station, where all coke that has been washed from the car is collected, and thence out into the river nearby. A locomotive crane and grab bucket are used to remove the coke from the dump under the station.

At the coke wharf the coke is controlled by a rank of finger gates, each about six feet wide. These gates are operated by extension levers, and are controlled from a platform running the length of the wharf.

Rotary feeders at the bottom of the wharf take the coke as it passes under the finger gates, and pass the charge to the conveyor. As each section of the wharf is cleared the finger gate is lowered and provision thus made for the next charge of coke, which will be, in normal times, on the wharf within six minutes from the time the last was deposited. By the sectional handling of the coke in this way it is possible for one man to quench the hot spots properly, and at the same time prevent over-quenching charges.

Coke from the wharf is discharged by the offtake conveyor into a grizzly screen in the coke crusher house. Oversize coke is automatically sorted out and fed to a crusher. The entire product then passes onto a second conveyor, and is then screened and the breeze removed.

Blast furnace coke from the second grizzly serving as final screen is received in a curved chute, so shaped as to give a minimum of coke breakage. These movable curved chutes discharge the coke into three bins, whence it is passed into the transfer car.

From the final screening the coke is carried by electrically-driven transfer cars directly to the coke storage points for the four blast furnaces across the river from the coke plant, so that there is normally no store of furnace coke on the by-product side of the river.

The small coke falling through the separating grizzly is further divided by an additional screening into domestic coke and breeze. This latter product is used for fuel under plant boilers and elsewhere that heating or power for steam drives is needed.

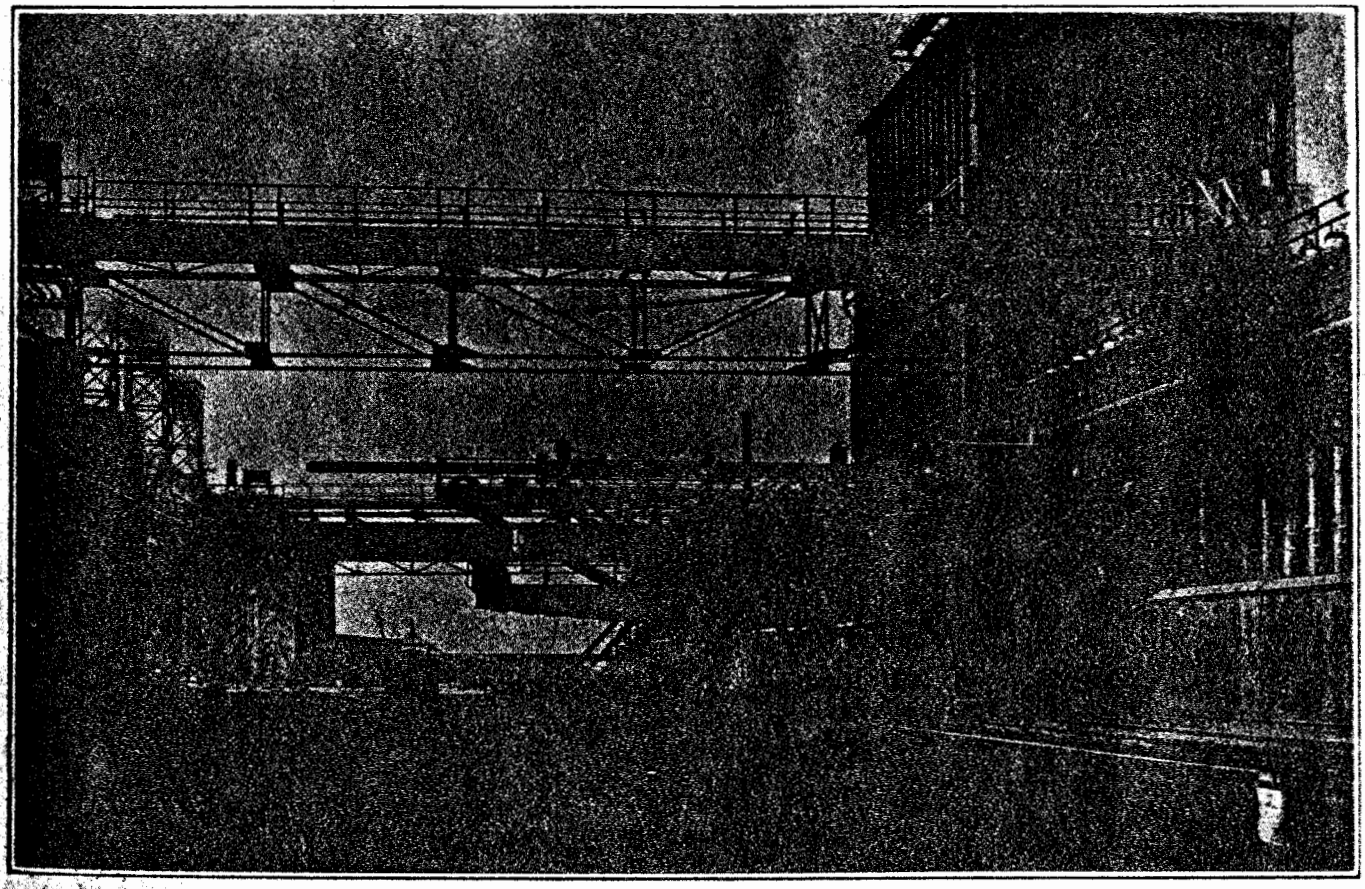

Figure 6.—Pusher at battery 3, showing thorough guarding of moving parts.

There is no point in the entire plant where the failure of some one unit will tie up production for more than the time required to retire the disabled unit and substitute one in perfect working order. If the coal dumper, for instance, should fail, track hoppers and a bucket elevator would enable the plant to continue taking in coal at the rate of 250 tons per hour, which would more than cover the running needs of the blast furnaces, even on full production. The same duplication of units is found through all motive units on the ovens. There are extra charging larries, extra pushers, an extra quenching unit, and other doubled equipment to provide against shutdown. In case of trouble to the trestle providing for coke haulage across the river to the blast furnaces, depressed tracks are built in at both quenching stations so that all the coke handling from quenching through wharf and screens can be eliminated and unsorted coke for pressing furnace needs handled by the regular railroad lines and steam locomotive haulage to the coke bins of the blast furnace plant.

Safety to the workmen is considered first at every turn in the plant. All elevated platforms and walkways are provided with guard rails and tee boards, and every precaution taken to safeguard not only those who work on these positions, but also those whose work takes them below these places, and who therefore are exposed to the danger of dropping tools and other articles.

At regular intervals along both sides of the oven batteries are conspicuous danger signals warning of the presence of electricity in the covered third rails, and all overhead transmission lines are blazoned with the company's danger signs.

One of the shafts of the drive gear on the pushers is equipped with two couplings carrying short lengths of chain, which fly out by centrifugal action as the shaft revolves and strike two steel disks rigidly supported within reach of the chain ends. These gongs have a distinctive note and give unmistakable evidence of the approach of the pusher, even above the other noises incident to the plant and the extraneous disturbances coming from passing switch engines and other rail traffic.

The structural work on batteries number one and four is left in such condition that extensions may be built on at any time and the coking capacity thus enlarged. This move would be more than covered by the present equipment for handling and preparing the coal, as the installed capacity is considerably more than the present coking capacity of the by-product ovens.

Room is afforded on the ends of both batteries to permit of the addition of extra ovens, with the moving of practically no equipment, and the laying of the necessary foundations. The location of the coke

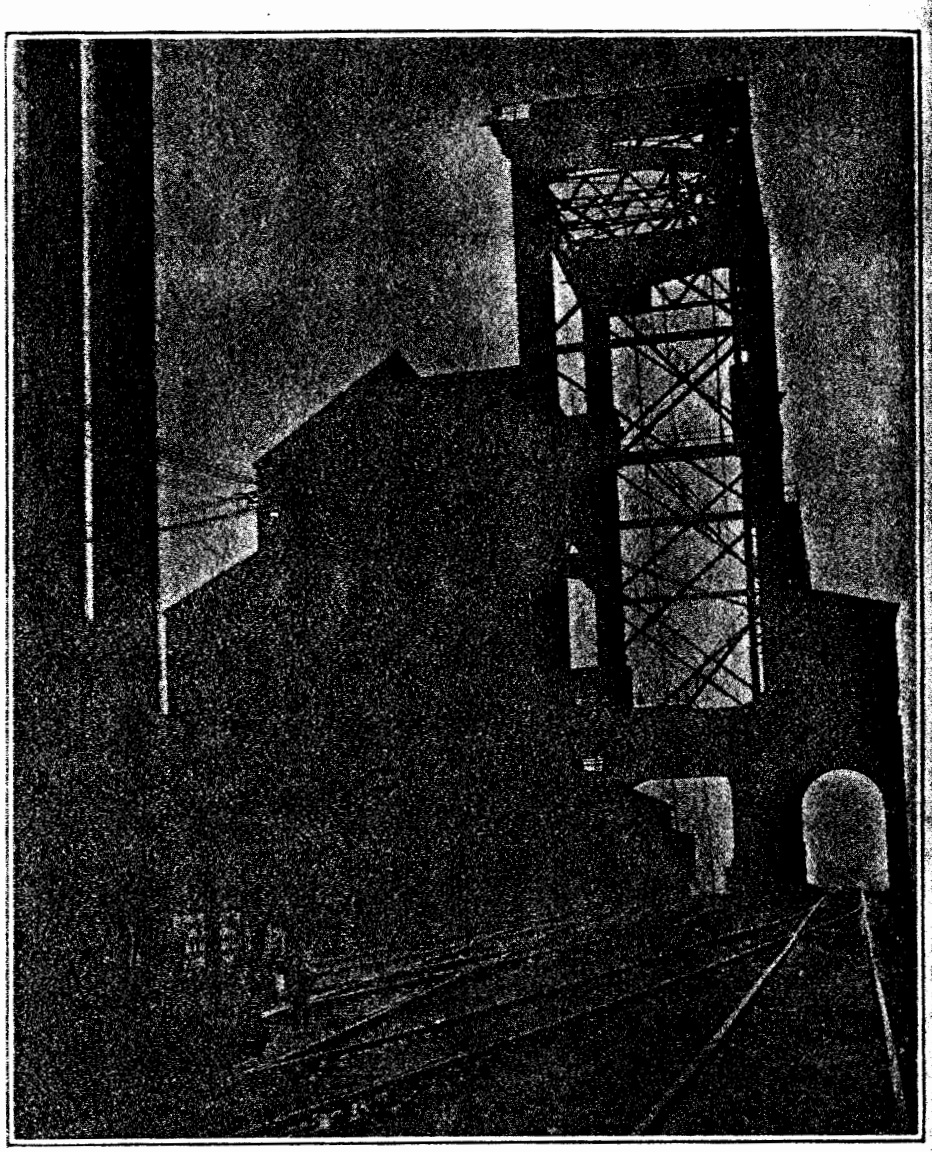

Figure 7.—High-lift dumper with car in position for hoisting.

wharf at the center of the battery lay-out insures the transportation of the coke at all times, even though it were found desirable to add to both ends of the existing string of ovens.

The addition of the projected coal storage space and equipment will further tend to insure the plant against the traffic tie-ups which are to-day cutting such a figure in production schedules, as there will then be available sufficient stocks of raw materials to enable the entire plant to run at regular schedule for some time without any incoming shipments.