Design of Lincoln Park Heating Plant Permits Future Power Generation

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The Rochester Gas & Electric Corporation has under construction at Rochester a new high-pressure central heating plant that will ultimately deliver both steam and electric energy

For a considerable time the Rochester Gas & Electric Corporation, of Rochester, N. Y., has been selling steam for heating and process work from its main generating station to surrounding factories and office buildings. In the summer of 1924 a survey was made of the business district of the city, and it was decided to build a station in this district to supply low-pressure steam for heating and steam at 100 lb. gage for industrial use. Steam was to be generated at 380 lb., passed through a turbine and exhausted at 5 to 20 lb. for the low-pressure heating. The power to be generated by the turbine would be purely a byproduct depending upon the available low-pressure load. The industrial load anticipated did not warrant the installation of a bleeder turbine, so reducing valves were used to lower the boiler pressure to a little above the 100 lb. desired at the customer's valve.

This station, described in the article, "Combined High-Pressure Power and Heating Plant," by R. D. DeWolf, *Power,* Dec. 1, 1925, was put into commercial operation in the latter part of October, 1925. The first season's results at this station were so favorable that a survey of the city for a location of a second similar plant was made. As a result it was decided to build a plant in the center of a promising industrial locality where the company already had an electrical substation and considerable available land.

The new building, approximately 109 ft. long by 70 ft. wide and 85 ft. high, will house two boilers. Land is available for increasing the size of the building to an ultimate capacity of eight boilers when the load demands. The present building has a turbine room large enough for one 3,000-kw. machine, but owing to the uncertainty as to type of load none will be installed at present.

Boilers and Furnaces

The boilers contain 9,580 sq.ft. of heating surface with 1,639 sq.ft. of integral economizer. They are straight-tube, vertical single-pass type designed for 384 lb. pressure. Provision has been made for the addition in the future of water-cooled side and rear walls and a water screen across the bottom of the furnace. The superheaters are designed to give 98 deg. F. of superheat at a flow of approximately 70,000 lb. of steam per hour.

Contrary to general practice the entire boiler setting, except for the ashpit and soot hopper under the rear sections of the boiler, is of hollow wall construction. On the vertical walls the hanger brick is clamped to 6-in. vertical I-beams on 18½-in. centers. The inner brick is held to the hanger brick by grooves in its side, as may be seen by the shape of the brick in Fig. 2. Every fourth hanger brick is supported on a clip to the 6-in. I's and is slightly longer than the others with a correspondingly short inner brick. This enables a section of the wall to be removed without disturbing the bricks above it. The lower 16 ft. of the side walls of the combustion chamber slope out approximately one foot, thus giving a greater width at the bottom of the furnace where the flame turns upward, and where width is needed. This undercut wall also keeps freer from clinkers than a vertical wall.

The brick of the horizontal suspended arch is held by 4-in. I's on 18½-in. centers, while the inclined arch is held by 4-in. I's on 14½-in. centers with smaller inner brick to match the 29-in. spacing of the boiler drums. A transite covering is placed outside of the I-beams, thereby providing air passages for preheating air for combustion. The space between I's around the boiler and on the rear wall of the furnace is to be packed with a Rock Wool packing. A careful study of the cost of this construction as against plain brick lined with firebrick was made, and it was found that, although the cost per square foot for material was higher, the cost of setting up the wall was considerably lower and the total cost was slightly in favor of the arch construction type. It was also felt that this construction makes a superior wall.

The ashpits are of reinforced concrete, brick-lined and supported on structural steel hung from above. The sides are vertical; the front and rear slope in at a very steep angle. Four hand-operated ash gates are provided per boiler.

A sluicing system is provided that carries the ash to a settling tank from which it will be removed and dumped into gondola cars on the railroad siding by the clamshell bucket of a gasoline-operated caterpillar hoist. The separating tank has sufficient storage capacity to fill one car.

One mill of 2,600 lb. per hour capacity and one of 8,500 lb. are being installed per boiler. Space is allowed for adding a second 8,500-lb. mill when the load demands. Each mill is equipped with a separately driven feeder. On the small mill both the coal and the air are admitted radially, while on the large mill the coal is fed radially and the air axially. The exhauster for the small mill is mounted on the mill shaft, while that for the large mill is on the floor above and is driven separately. Both the large and the small mills have a classifier between the mill and exhauster. Each large mill feeds two burners, the small mill, one. Allowance is made for admitting air to the exhauster fans without passing it through the mill. This is considered desirable as it maintains a high air velocity through the burner with a low velocity through the mills. This materially aids operation under light loads.

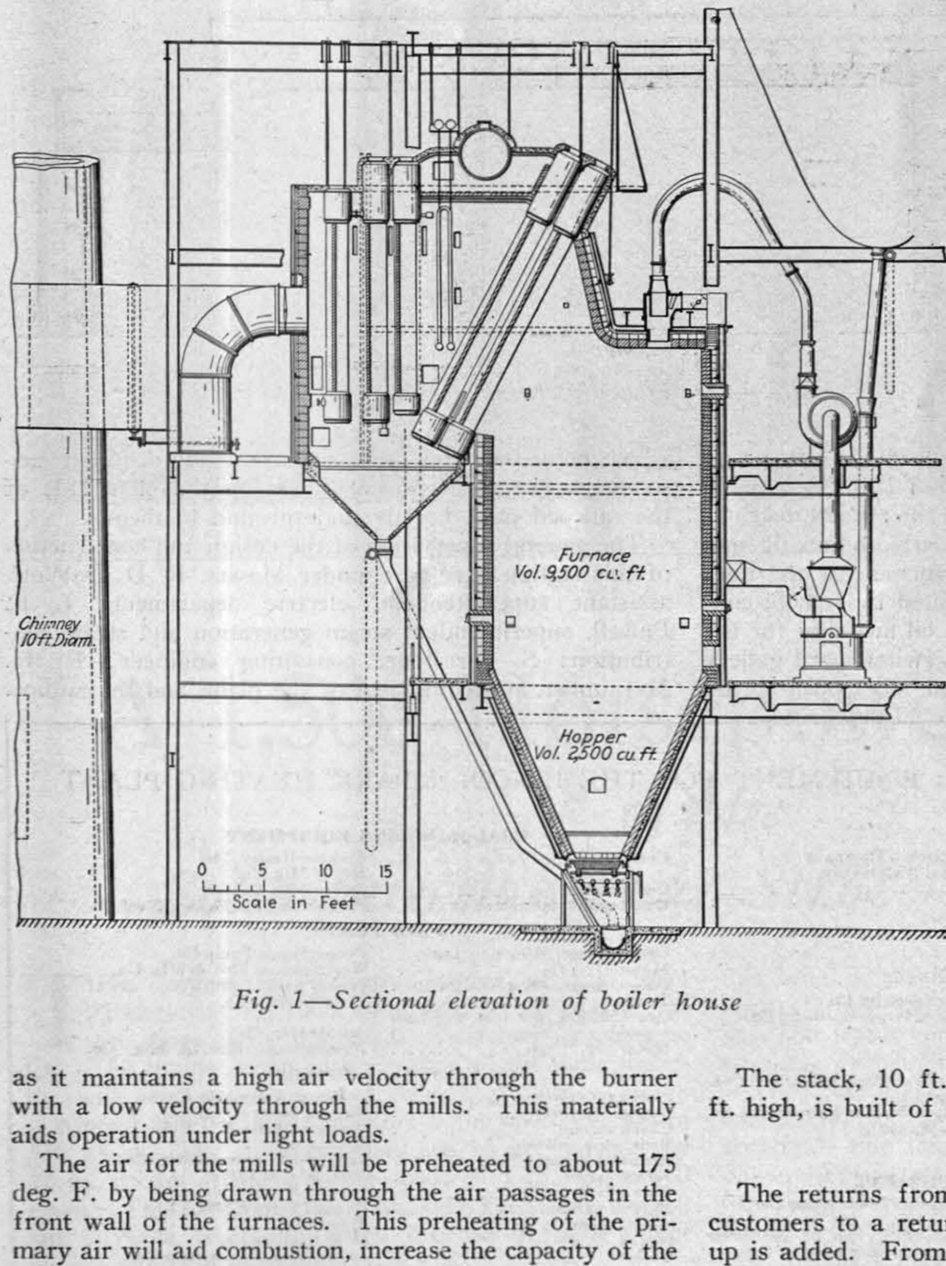

Fig. 1—Sectional elevation of boiler house

The air for the mills will be preheated to about 175 deg. F. by being drawn through the air passages in the front wall of the furnaces. This preheating of the primary air will aid combustion, increase the capacity of the mill when handling wet coal, and will materially reduce the power consumption. It is expected this amount of preheat will reduce the moisture in the coal while passing through the mill from approximately 5 per cent in the raw slack to 1.25 in the powdered coal.

Most of the secondary air for combustion will be drawn from the side walls by natural draft and admitted around the burners. However, when the load increases a blower will be installed to draw the air from the side walls and blow it into the furnace. Auxiliary air openings are provided near the bottom of the front wall to allow additional secondary air to enter during peak loads.

Future secondary air ports will be installed between the burners to allow more air to enter around the coal stream without carrying the excess pressure that would be required if all were forced through the burners.

Coal Handling

Coal dumped from gondola cars into a track hopper is fed to an inclined belt conveyor by a plate feeder, and dumped over a magnetic pulley into a hopper above a single-roll coal crusher. A two-way chute enables the coal crusher to be bypassed. From there it is carried by a vertical bucket belt conveyor to a horizontal belt conveyor running through a monitor above a 725-ton coal bunker.

The control of the coal-conveying equipment is such that a failure in any section will automatically stop preceding, but not succeeding, equipment. To safeguard against the danger of leaving the magnetic pulley on when the belt conveyor is not running, the power for the magnetic pulley is obtained from a motor-generator set that receives its power from the line to the first belt-conveyor motor beyond its oil switch. All coal-equipment conveyor motors are totally inclosed, squirrel cage.

The flue gas passes directly from the boiler into the stack through a separate opening for each boiler. Provision is made for the future installation of separate economizers. The gas will then leave the boiler and pass down through the economizer to an induced-draft fan on the ground floor and enter a second pair of openings just above the base of the stack. The present stack connection will then be used as a bypass for the economizer and fan.

The stack, 10 ft. inside diameter at the top by 230 ft. high, is built of reinforced concrete.

Feed Water

The returns from the system are pumped from the customers to a return tank, where the city water make-up is added. From this tank the feed water is pumped by a low-head pump through a deaërator which also acts as a second storage tank into which city water may be admitted through a float control valve if the water level falls below the desired limit. From the deaërator the water passes by gravity to the boiler feed pumps, of which there are two, a 500-g.p.m. turbine-driven pump and a 300-g.p.m. motor-driven pump. The speed of the 500-gal. pump is controlled by a differential pressure regulator set to maintain a constant pressure difference between the feed and the steam of 50 lb. The

300-gal. pump, as installed, has a 200-gal. impeller which greatly reduces the power required to drive it under light loads and is ample for present loads. The normal speed of this pump is 1,750 r.p.m., requiring a 150-hp. motor.

During the summer, when there is practically no demand for low-pressure steam, the motor pump will be used. During this season the future turbine will be shut down and it will be unnecessary to operate the boilers at full pressure. The pressure may therefore be carried at 150 to 200 lb., which is more than ample for the industrial lines. Under normal speed and practically no load this pump would require approximately 95 hp.; by dropping its speed to 1,150 r.p.m. the head is reduced to about 210 lb. and the power required to 40 hp. The pump is therefore being installed with the 150-hp. 1,750-r.p.m. motor on one end and a 50-hp. 1,150-r.p.m. motor on the other. The only work required in changing from one motor to the other will be to remove the pins in the coupling on one motor and insert those on the other.

Power for operating the station will be brought direct from the adjoining electric substation through a bank of 4,150- to 440-volt transformers to the station distribution bus. As the substation is strictly automatic and has no operator on duty, the oil switches for the lines to the generating plant will be operated by remote control from the plant. The individual oil switches for the different motors are all located on a switchboard gallery in the turbine room with start and stop push-button control beside the individual motors. A stop button is also installed for each motor on the panel board of the operating floor. The question of start buttons on this board was also considered, but the danger of a motor's being started when someone was working on it was considered too great, so they were omitted. All essential motors are designed to start under full line voltage, and no-voltage release coils are being omitted.

The steam mains leave the plant from the turbine room. Those crossing the railroad are carried overhead to the farther side of the tracks on a special bridge, from which point they pass underground to the different customers. The mains to customers on the plant side of the railroad pass directly underground to them.

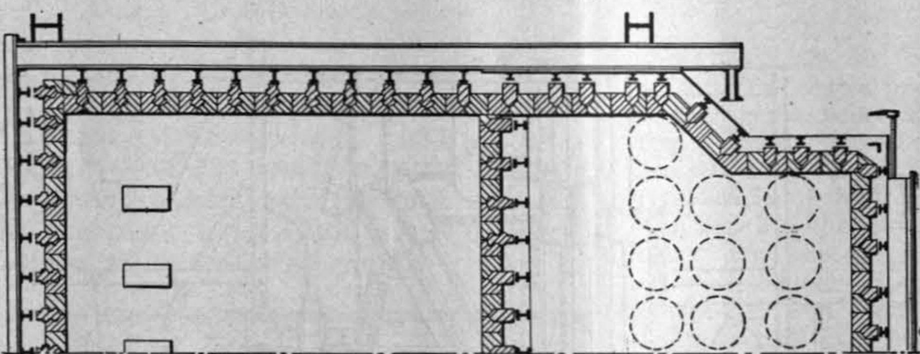

Fig. 2—Plan of boiler setting showing wall construction

The general supervision of the design and construction of this station have been under Messrs. R. D. DeWolf, assistant superintendent, electric department; I. E. Powell, superintendent steam generation and steam distribution; S. Firestone, consulting engineer; R. H. McCumber, superintendent of the plant, and the author.

PRINCIPAL MECHANICAL EQUIPMENT FOR THE LINCOLN PARK HEATING PLANT

BOILERS

Make	The Bigelow Company
Type	Vertical Water-Tube
Number installed	2
Boiler pressure, lb. gage	384
Steam temperature, deg. F	540
Water-heating surface, boiler sq.ft.	9,580
Integral economizers	1,639
Total	11,219
Superheater	Power Specialty Co.
Soot blowers	Diamond Power Specialty Co.

FURNACE

Boiler setting	The DeWolf Arch Brick Steel Construction.
Arch brick	Harbison-Walker Refractories Co.
Furnace casing	Johns-Manville
Furnace volume, cu.ft	9,500

COAL-BURNING EQUIPMENT

Pulverized coal system	Combustion Engineering Corp.
Mills, unit type	One—2,600 lb. per hr. per boiler One—8,500 lb. per hr. per boiler
Burners	Combustion Engineering Corp.
Pulverized coal piping	Combustion Engineering Corp.
Air ducts	Flesch & Schmidt.

ASH HANDLING

Hydro jet system	Allen-Sherman-Hoff Co.

STACK

Type	Concrete, lower part brick lined.
Make	Rust Engineering Co.
Height above ground level, ft.	230
Diameter of stack, ft.	10
Smoke flues	Connery Co.

COAL-HANDLING EQUIPMENT

Conveyors	Erskine-Healey, Inc. Jeffrey Mfg. Co.
Coal crusher	Jeffrey Mfg. Co.
Coal bunker, fabricated by	Pittsburgh Des Moines Steel Co

FEED PUMPS

One—6-stage, 300-g.p.m. pump	Pennsylvania Pump Co.
Motor	Westinghouse Elec. & Mfg. Co.
One—5-stage, 500-g.p.m. pump	Pennsylvania Pump Co.
Turbine	Terry Turbine Co.
One—500-gal. per min. low-head pump	Goulds Mfg. Co.
Motor	Westinghouse Elec. & Mfg. Co.

VALVES and PIPINGS

Steel gate valves	Chapman Valve Mfg. Co.
Steel globe valves	Edward Valve & Mfg. Co.
Check valves	Chapman Valve Mfg. Co.
Boiler stop valves	Elliott Co.
Reducing valves	Ruggles-Klingemann Mfg. Co.
Safety valves	Consolidated Valve
Blowoff valves	Yarnall-Waring Co.
Blowoff valves	Edward Valve & Mfg. Co.
Steam traps	Armstrong
Piping	M. W. Kellogg Co.
Gaskets	Goetze Gasket & Packing Co. Metallo Gasket Co.
Feed-water regulator (Copes)	Northern Equipment Co.
Excess,pressure regulator	Ruggles-Klingemann Mfg. Co.
Gate valves, low-pressure	Lunkenheimer
Float valves	Cochrane Corporation
Atmospheric relief	Cochrane Corporation

MISCELLANEOUS

Deaerator	Cochrane Corporation
Return tank	Leach Steel Co.
Flow meters	Bailey Meter Co.
Pressure recorders	The Foxboro Co., Inc.
Air compressor	Ingersoll Rand