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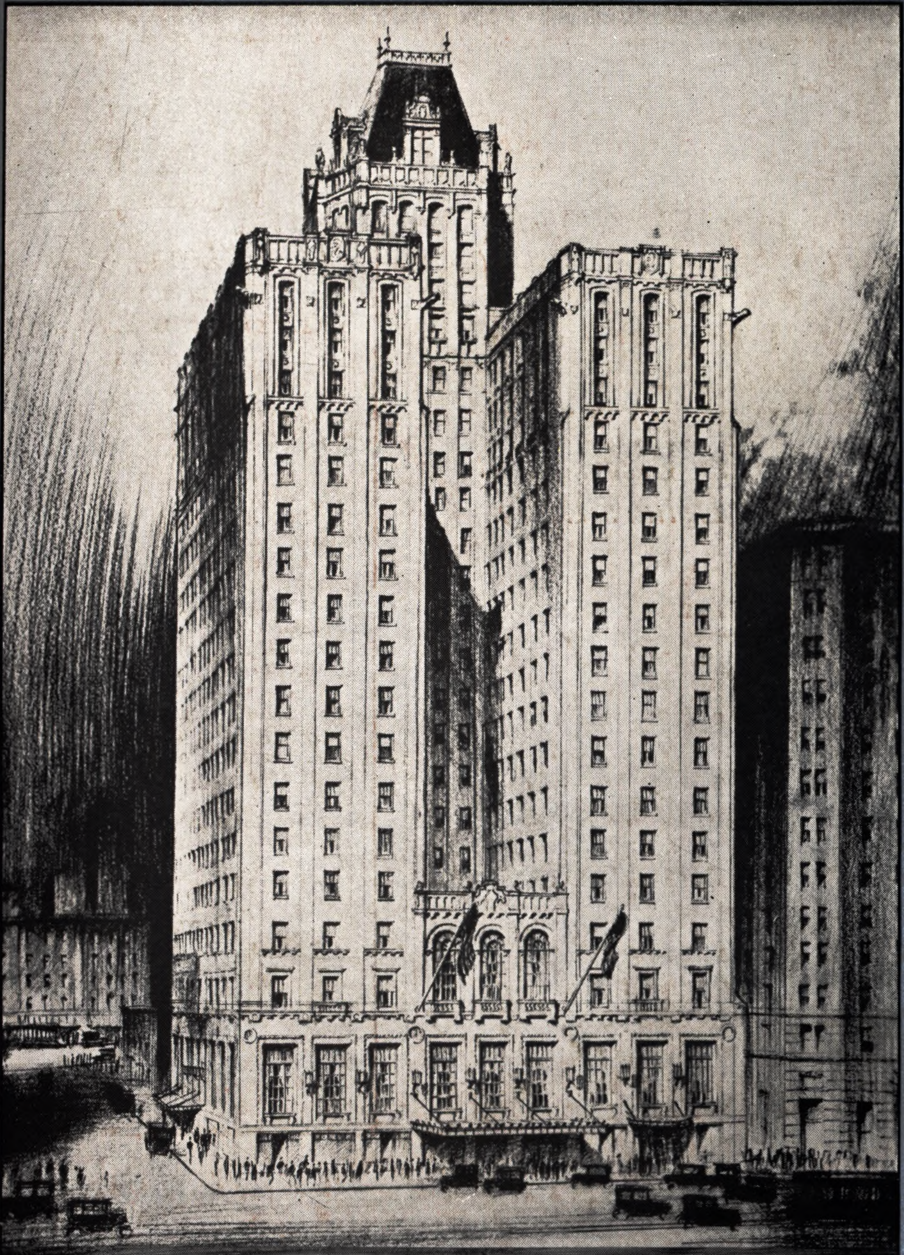


LORD BALTIMORE HOTEL
BALTIMORE MARYLAND.

First Section of New Terminal Plant—Baltimore

Description of Production Stations and Their Operation

STEAM HEATING SYSTEM

Consolidated Gas Electric Light & Power Company of Baltimore, Maryland

By R. C. HINE
Assistant to Superintendent, Power Production Stations

WYOMING STREET PLANT

PRIOR to August 1, 1928, the Consolidated Gas Electric Light & Power Co. of Baltimore had furnished steam for heating and processing to a group of customers located principally within the city block east of and adjacent to the Company's main office building at Lexington and Liberty Streets. This service was supplied from a plant located at the rear of the office building, between Wyoming St. and Goodwyn Alley, and erected by the Company primarily for the purpose of heating their offices. In this Wyoming St. plant there are two Edge Moor, straight tube, two longitudinal drum, water tube boilers, each having 3,990 sq. ft. of heating surface, and each boiler is equipped with a type AA4, five retort, Taylor underfeed stoker having 76.2 sq. ft. of projected grate area with intermittent ash discharge. Each furnace has a volume of 640 cu. ft. and the flue gasses are discharged into a common steel stack by natural draft.

Coal is unloaded from trucks into a pit from which it is hoisted either to a storage bunker or to the service bunkers supplying the stokers. A Sprague mono-rail hoist is used for all transfer of coal within the plant. Ashes are hoisted to street level and disposed of by trucks. Auxiliaries are steam driven and raw city water is used for make-up. Steam output is delivered to a 6 in. high pressure transmission main in Liberty St. at a pressure of about 150 lb. per sq. in. gage.

Normally this equipment is not operated for present system requirements but is held as reserve capacity.

TERMINAL PLANT

On August 1, 1928 the Company expanded its steam heating business by purchasing the properties of The Terminal Freezing and Heating Company located on South Eutaw St., between Barre and Houser Sts., about 0.6 mile southwest of the Wyoming St. plant. The steam raising equipment purchased included three Edge Moor, straight tube, four longitudinal drum, water tube boilers, each having 10,084 sq. ft. of heating surface and fired by a type AA6, ten retort, Taylor, engine (later changed to motor) driven underfeed stoker having 161.6 sq. ft. of projected grate area with intermittent ash discharge. The volume of each furnace is 1,785 cu. ft. Gases are discharged into two brick stacks by natural draft. Air for combustion is obtained from a common duct that can be supplied by two motor driven and one steam driven fan. During the fall of the year 1928, a new plant, containing a single boiler, was erected on the property to the west of the original plant and placed in operation on December 22, 1928. This section of Terminal Plant can be expanded to an ultimate of four boilers similar to the present design.

This boiler is the largest single unit supplying the steam system. It is an Edge Moor, straight tube, four longitudinal drum, water tube boiler having 12,610 sq. ft. of heating surface, excluding water walls, and is fired by a type 45JC7, eleven retort, Taylor, underfeed stoker, having 368.6 sq. ft. of projected grate area. Continuous ash discharge is obtained by two 18 in. crusher rolls. The volume of the furnace is 6,550 cu. ft. The front wall is of refractory construction. The side walls are refractory and water cooled. The water cooling surface is the design of the American Engineering Company and consists of seven rows of 3¼ in. O. D. tubes, spaced on 6 in. centers, and protected by cast iron blocks. The tubes parallel the slope of the stoker grate and extend from the front wall to the rear wall for a height of 4′-6″ above the grate line. Each wall has 150 sq. ft. of heating surface. The rear wall is completely water cooled and has a heating surface of 409 sq. ft. It consists of 38, 3¼ in. O. D. vertical tubes, 21′-8″ high, spaced on 6 in. centers, and extends the full width of the furnace with the lower six feet protected by cast iron blocks. Seven recirculating tubes are a part of the rear wall construction. The stoker is motor driven and the forced draft fan is steam driven.

Flue gases are exhausted by a steam driven Prat-Daniel, Thermix, dust collecting fan fitted with a skimmer damper which shunts a portion of the gases through a cyclone collector for the purpose of reducing the flue dust content. The cleansed gas is then discharged to an unlined steel stack. The following table gives a sieving test of the flue dust removed from the gas:

Sieve No.	Per Cent Passing Through
8	99.86
20	91.45
40	71.36
70	52.78
100	38.80
200	18.98
325	10.98

Coal is delivered to this plant in standard railroad cars with capacities of 50 to 75 tons. There is a pit below the street level at each boiler house to which the coal is unloaded from the railroad siding above it. From the pit at the eastern end of the siding, coal is unloaded by a bucket elevator to a storage yard having a capacity of about 700 tons. From the storage yard, coal is carried to the overhead bunkers, serving the three small boilers, by a Beaumont skip hoist with a bucket capacity of 40 cu. ft. Coal for the single large boiler is unloaded from the pit at the western end of the siding by a flight conveyor, through a single roll crusher, to a Bartlett & Snow vertical skip hoist, having a bucket capacity of 2½ tons. This hoist delivers the coal to a hopper from which it is discharged to an overhead suspended steel bunker by a traveling belt. A 10 ton larry distributes the coal to the stoker hopper. Ashes are sold and removed by trucks. Ash disposal from the single boiler has been simplified by a design which permits spotting the trucks directly beneath the power operated ash gates.

The feedwater system has been designed to supply both boiler plants. The make-up requirement amounts to 100 per cent. of the plant sendout and is city water treated by the Zeolite softening process and then pumped through a heat exchanger, which is a part of the continuous blowdown system, to a storage tank above the Elliott deaerating heater. From the heater, the water is pumped to the boilers by steam driven boiler feed pumps, the rate of feed being controlled by Copes level regulators and assisted by Copes excess pressure control valves. Each of the two Zeolite softening beds is regenerated after passage of 200,000 gallons of raw city water having a hardness content of about 45 ppm. Boiler water concentration is maintained between 700 ppm and 1,000 ppm of total solids by continuous blowdown. The addition of sodium sulphate serves to maintain the sulphate carbonate ratio at the minimum of 2.2. To expel dissolved gases in the feed water, an operating pressure of 2.5 lb. per sq. in. gage is maintained within the shell of the Elliott deaerating heater. The performance of the heater as a deaerator has been improved by the addition of two boiling coils in the water storage space. Live steam is supplied to these coils in sufficient quantity to maintain the heater shell pressure at 2.5 lb. per sq. in. gage until a coil inlet pressure of 50 lb. per sq. in. gage is reached. Should the shell pressure then be below the requirement, an automatically controlled unloading valve admits steam from the 50 lb. header to the exhaust header. The tests for oxygen content of the feed water normally show a value between zero and 0.016 ppm, depending upon the load. The single large boiler operates for a great part of the time at a high rate of evaporation per square foot of steam liberating surface and with water having relatively high concentration of total solids. To insure relatively low moisture content of the steam sendout of this boiler, a Wright Austin, horizontal type, steam purifier has been installed. At a steam output rate of 150,000 lb. per hr., purifier efficiencies within the range of 73.8 per cent. to 82.3 per cent. have been obtained.

The output from the Terminal Plant is fed directly to a 12 in. high pressure transmission main at a pressure of about 145 lb. per sq. in. gage and to a 16 in. low pressure transmission main by means of a motor operated valve. This valve is controlled, through Selsyn sender and receiving units, by the pressure in the low pressure system at a point near the Wyoming Street plant.

PRATT STREET

The Pratt Street plant, which was originally an electric generating station, is located about 0.6 mile southeast of the Wyoming Street plant and contains 16 boilers that are now used to supply the steam heating system.

In November, 1929, a 16 in. high pressure transmission main was installed from the Pratt Street plant to a distribution station at Baltimore and South Streets. This main supplies steam to the high pressure system at the distribution station through a valve actuated by an Atwood & Morrill regulator set to open at 120 lb. per sq. in. gage. Steam is also supplied to the low pressure system from the 16 in. high pressure main at the distribution station through a Schutte & Koerting motor operated throttle valve which is regulated manually by remote control from the Pratt Street plant.

Each boiler is a Babcock & Wilcox two drum, straight tube, sectional header water tube boiler having 4,434 sq. ft. of heating surface. The boilers are fired by Westinghouse type DDM-17, five retort, underfeed stokers each having a projected grate area of 89.1 sq. ft. with intermittent ash discharge. The furnace volume is 715 cu. ft. Flue gases are discharged into brick lined steel stacks by means of natural draft, four boilers discharging into each stack. Raw city water is used as make-up, and blowdown is intermittent. Coal is delivered on scows of about 500 tons capacity and is unloaded by two towers to the overhead bunkers. Ashes are removed by bucket elevators to a storage hopper from which point they are removed by truck and sold.

The sustained net sendout rate of each of the three plants stated herewith is the average rating that can be maintained for ten hours, making due allowance, where necessary, for the cleaning of fires.

Terminal Plant

3 boilers, 138,000 lb. per hour
1 boiler, 125,000 lb. per hour
Total . 263,000 lb. per hour

Pratt Street Plant

16 boilers . . 330,000 lb. per hour

Wyoming Street Plant

2 boilers . . 38,000 lb. per hour

Total sustained net sendout rate
of all plants 631,000 lb. per hour

Terminal Plant supplies the entire demand from about May 1 to about November 1. From the latter part of May to the middle of September, the low pressure system is out of service, and the high pressure demand is supplied by the large boiler, except for the time of the planned outage for annual inspection. This is by reason of the relatively low incremental heat rate of the input-output characteristic for this boiler. Growth of the high pressure service is hastening the time, however, when boiler operating pressure must be increased if the distribution pressure at the southern end of this system is to be maintained without an additional source of supply.

During winter months, all boilers at Terminal Plant are operated with a sufficient number of the boilers at Pratt Street to provide the necessary operating spare.

The policy regarding operating spare has been described in the panel discussion presented by the Steam Station Engineering Committee. The total system load is divided between the two plants in accordance with their relative incremental production cost rates. Terminal Plant's portion of the total system load is then further divided between the three small boilers and the single large boiler in accordance with the relative incremental production cost rates of these boilers.

The operators at the Terminal Plant regulate the division of total system load between the stations by use of cost tabulations prepared for this purpose. For any value of total system demand, with a definite combination of boiler equipment in service, the economical allocation between stations is determined. The operator at Pratt Street is then instructed to adjust the remote controlled valve at the distribution station to obtain the desired Pratt Street output. Boiler pressure of sufficient value is maintained at the Terminal Plant to insure all high pressure demand being supplied normally from this point. This high pressure demand, together with that part of the low pressure demand not carried by Pratt St., automatically determine the Terminal Plant output. The single large boiler is then set for its portion of total Terminal Plant sendout by the use of the cost tabulations and the remainder is divided equally among the three small boilers.

The Steam Distribution System

Consolidated Gas, Electric Light and Power Company of Baltimore, Md.

By HENRY F. DAVIS

Assistant Superintendent of Engineering and Construction,
Consolidated Gas Electric Light & Power Company of Baltimore

WE entered the district steam business, in 1928, through the acquisition of the Terminal Freezing and Heating Company which operated a low pressure heating system that had about 13,600 feet of mains, from 7″ to 16″ in diameter, laid generally in wood casing. Almost immediately we were faced with the necessity of supplying some customers with high pressure steam. As these high pressure mains were laid, we renewed the old Terminal low pressure mains and put both sets of mains in the same conduit. Replacement of the old mains continued for several years, but most of it was done in 1928, 1929, 1930 and 1932. One short section was replaced in 1934, and all that is left of the old main is about 2,800 feet which was laid in 1924-27.

We now have 28,512 feet of low pressure main and 17,346 feet of high pressure main —a total of 45,858 feet. All of the main laid by us, except 1,130 feet, is in concrete conduit and the remaining Terminal main is in hollow tile duct. We used a cast iron conduit for 1,130 feet of main because it was subject to flooding by high tides.

Our high pressure system was first supplied by a small plant known as the Block Plant which is located back of our main office building (The Lexington Building) and very close to the shopping district. Growth of the steam business soon made additional boiler capacity necessary for both the high and low pressure systems, and it was decided to utilize an old plant acquired some years before and located on Pratt St. and Dugans Wharf. This plant is located at the extreme Southeastern section of our steam district, and, since the street surface at the plant is only about 6 feet above mean low tide, a serious problem was presented in the installation of a 16″ high pressure main. Tidewater actually covers the street at times, but experience has shown that our problem was satisfactorily solved by the use of a specially designed cast iron casing pipe made in two sections with machined joints, which, after the installation of the pipe, insulation, etc., were bolted together with a gasket between them and then caulked with lead ribbon. An attempt was made to weld these joints instead of caulking but, although various rods were used, it was impossible to make the joints water-tight. Figure 1 shows the special casing. One end of each section of the casing is flanged and the other is plain.

A mass of concrete is poured around the flanged ends securely anchoring them. The plain ends terminate in sleeves which are themselves anchored in concrete, but lead joints at these plain ends permit the conduit to move. The steam main itself is anchored where necessary by special anchors which are located at flanged ends, which are in turn firmly anchored in concrete. The conduit and pipe can thus move independently. All manholes are steel-lined, have water-tight manhole frames and covers, and special water-tight joints are used where the conduit enters these manholes. The length of main installed in this manner is 1,130 feet and is at several points below tide. At one particularly low point, drainage is discharged by duplex-automatic sump pumps, the floats of which are set at different levels so that, if one pump is insufficient, the other starts operating. (Note: We have a similar arrangement at another point in our distribution system). Several times during construction of this line it

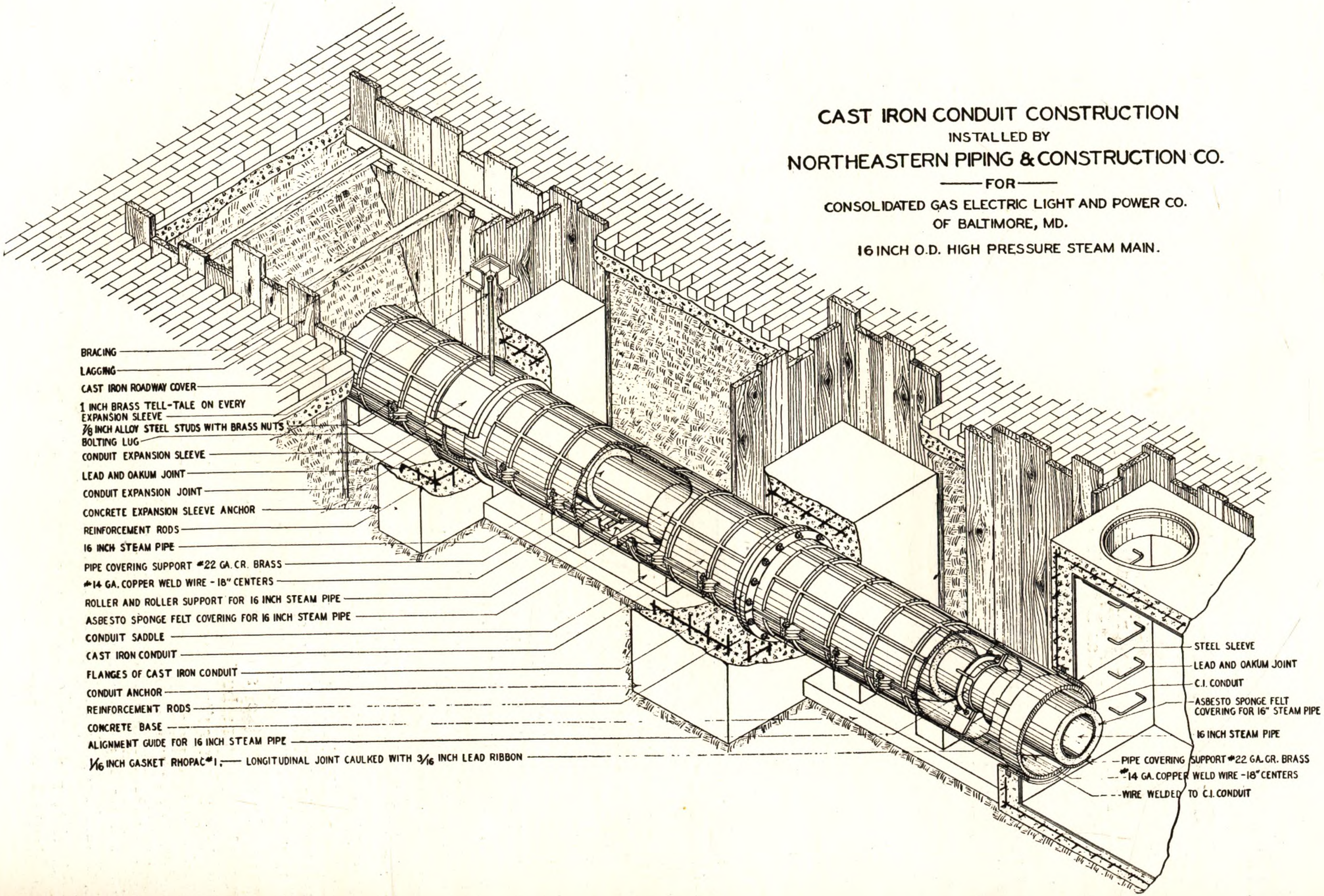


Figure 1
Cast Iron Conduit Construction

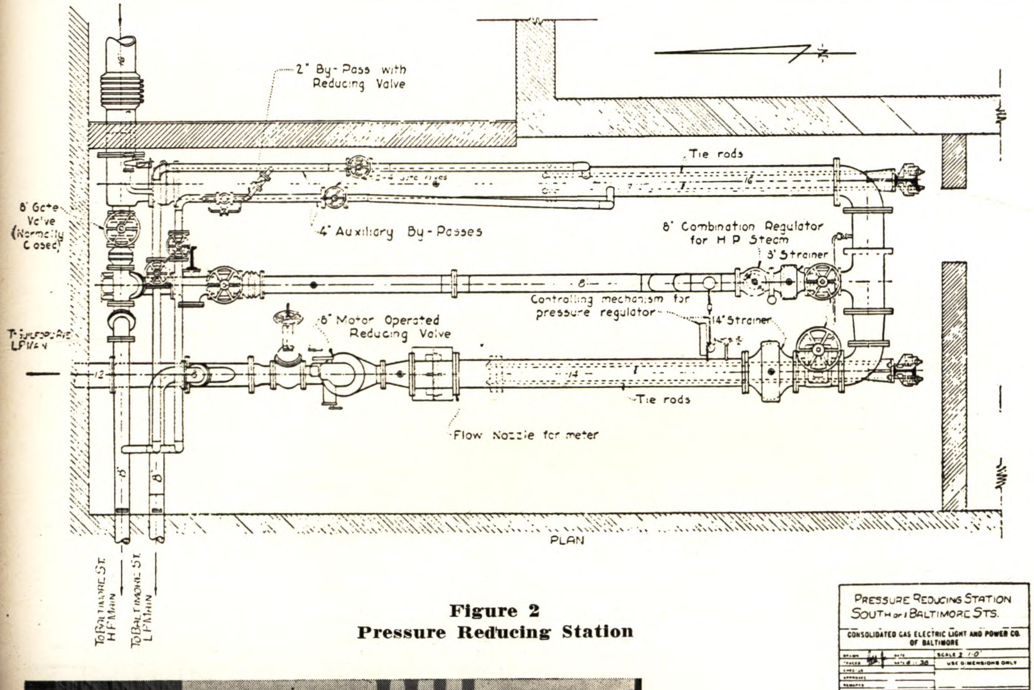


Figure 2
Pressure Reducing Station

Cast Iron Conduit under Construction

was submerged by high tides. Each sleeve throughout the length of the conduit is drilled and tapped and a brass pipe inserted which leads to the street surface where it is capped and covered with a small roadway frame. The purpose of this arrangement is to permit a more accurate location of a steam leak than would otherwise be possible. Thus far we have not had an occasion to try this. It will be necessary to break away one concrete anchor and remove one top section of casing to gain access to the pipe at any point. The photograph shows a portion of the main under construction with the plant in the background.

The 16" main from the Pratt St. Plant is about 2,300 feet long, including the part in cast iron, and terminates at a pressure reducing station in an underground vault at Baltimore and South Streets. From this

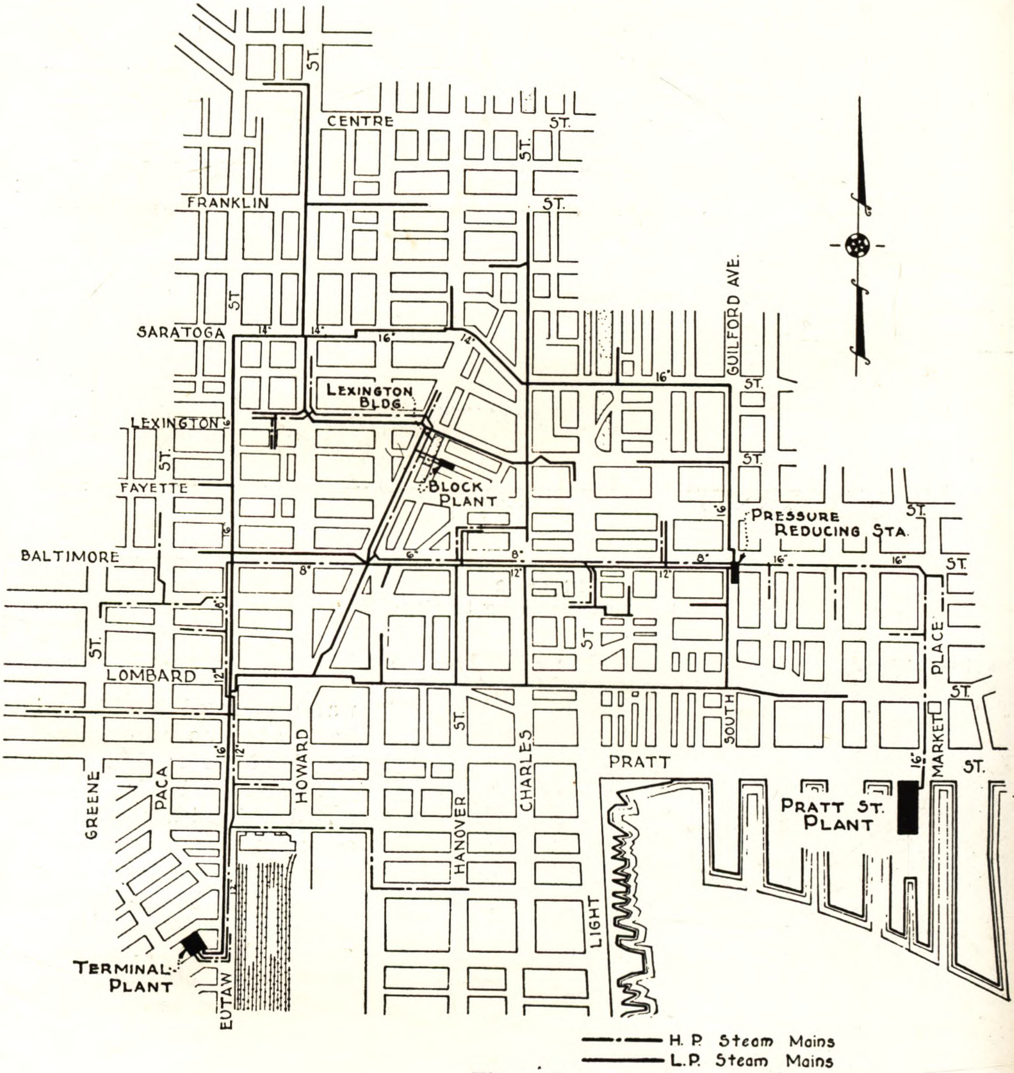


Figure 3

High and Low Pressure Steam Distribution System in Baltimore

reducing station, the plan of which is shown in Figure 2, steam enters both the high and low pressure systems. The mains in Baltimore St. from the reducing station to Hanover St., the reducing station itself, and the 16″ main from Pratt St., were all installed during the same year and soon after these installations, the Block Plant was discontinued. Acquisition of high pressure loads in the Western section made necessary the conversion of the 12″ line from the Terminal Plant to a high pressure line and the installation of a new 16″ low pressure main. The high pressure line from Terminal Plant was, about a year later, connected to the main from the East, and it was then possible for Pratt St. to be "shut-down" during the Summer and the entire high pressure load supplied from Terminal Plant (the low pressure system is "off" during the Summer). At present, practically all the

(Continued on Page 140)

W. H. Colburn
Boston Edison Company
Boston, Massachusetts

H. L. Martin
J. B. Ellsworth

Mr. Colburn, in his capacity as steam sales engineer for the Boston Edison Company, has done much to advance the cause of district heating. He has been instrumental in signing up some of our larger steam customers.

He graduated from Worcester Polytechnic Institute in 1916 with a B. S. in Electrical Engineering. He has worked for the Bethlehem Shipbuilding Corporation, Quincy, Massachusetts, and the Thompson Electric Welding Company of Lynn, Massachusetts. Since coming to the Boston Edison Company, he has worked for the Station Engineering Department as head of the Electrical Engineering Division, and is now one of the Company's Commercial Engineers.

He is a member of the A. S. E. E., the Engineering Societies of New England, and now—the N. D. H. A.

We are pleased to welcome Mr. Colburn and expect that both he and district heating will gain by this new association.

CLASS D

R. Y. Sigworth
Pennsylvania State College
State College, Pennsylvania

G. K. Saurwein
R. M. Nee

Mr. Sigworth is doing a very fine job as Superintendent of Utilities for Penn State.

He is responsible for the College's extensive group of buildings and grounds.

Mr. Sigworth, known to his fellow engineers as "Bob", received his B. S. from The Pennsylvania State College in 1919, and in 1921 he received his Mechanical Engineering degree from the same school in company with C. H. B. Hotchkiss. It is significant that this thesis dealt with superheated steam in the heating system.

After graduating, Mr. Sigworth was associated with the National Transite Pump and Machinery Company in Oil City, Pa., and later returned to the Department of Grounds and Buildings at The Pennsylvania State College, where he has been ever since. He is now in charge of all power plant operation, and has been an ardent supporter of the National District Heating Association for the past five years.

Steam Distribution System

(Continued from Page 134)

high pressure load is supplied from the Terminal Plant the year round, Pratt St. augmenting the high pressure supply when the pressure at South St. drops below 125 lbs., which is seldom. Pratt St. Station augments the supply of steam to the low pressure system West of the reducing station when Terminal Plant has reached its generation capacity. Pressure on the low pressure system is regulated by a control located in the Lexington Building which operates a valve in the Terminal Plant. The flow of steam into the low pressure system from the Pratt St. Plant is controlled at that plant by a motor operated reducing valve in the pressure reducing station at Baltimore and South Sts. Long distance pressure recorders enable the plant operator to maintain proper pressures in the low pressure system by operation of the motorized reducing valve. Figure 3 shows, diagramatically, the two distribution systems. It also shows the relative location of the two generating plants, the South St. reducing station, the Lexington Building and the Block Plant.

TRANSPORTATION INFORMATION

Train Schedules for Delegates attending the National District Heating Association Convention, Lord Baltimore Hotel, Baltimore, Md., June 28--July 1, 1938

Time Shown is Eastern Standard—Subject to Change—Consult Local Agent

Schedule from Boston, New York, Elizabeth and Philadelphia	Road	Time	Road	Time	Railroad—Round Trip Coach	Railroad—Round Trip First Class	Pullman—One Way Lower	Pullman—One Way Upper	Pullman—One Way Compt	Pullman—One Way Dr rm	Pullman—One Way Seat
Lv. Boston	NYNH&H	10:00 am		6:00 pm	18.40	26.70	3.50	2.80	10.00	13.00	2.00
Ar. New York, Grand Central Sta.		3:00 pm		11:15 pm							
Lv. New York, 42nd St. Sta.	B&O	*4:00 pm		12:25 am	7.40	11.10	2.50	2.00	7.00	9.00	1.00
Lv. Elizabeth, B&O Sta.	B&O	5:05 pm			6.90	10.30	2.50	2.00	7.00	9.00	1.00
Lv. Philadelphia, B&O Sta.	B&O	6:31 pm		3:46 am	3.80	5.70					.50
Ar. Baltimore, Mt. Royal Sta.	B&O	8:05 pm		6:14 am†							

*The "COLUMBIAN"—streamlined train. †Sleeper may be occupied until 7:30 a. m.

Schedules from Kansas City, St. Louis.	Road	Time	Road	Time	Coach	First Class	Lower	Upper	Compt	Dr rm	Seat
Lv. Kansas City	Alton	11:59 pm			50.30	67.00	8.50	6.80	24.30	30.00	
Ar. St. Louis		7:40 am									
Lv. St. Louis	B&ORR	9:30 am			36.20	54.30	6.00	4.80	17.00	21.00	
Lv. Louisville	B&ORR	1:30 pm			27.40	41.10	5.50	4.40	15.50	20.00	
Lv. Cincinnati	B&ORR	6:05 pm			22.60	33.90	3.75	3.00	10.50	14.00	
Lv. Washington	B&ORR	8:45 am			1.60	2.30					.50
Ar. Baltimore, Mt. Royal Sta.		9:35 am									

Schedules from Denver	Road	Time	Road	Time	Coach	First Class	Lower	Upper	Compt	Dr rm	Seat
Lv. Denver	UP	4:45 pm	CB&Q	4:00 pm	72.15	80.40	12.75	10.20	36.00	45.00	
Ar. Chicago		9:23 am		8:30 am							

Schedules from Duluth	Road	Time	Road	Time	Coach	First Class	Lower	Upper	Compt	Dr rm	Seat
Lv. Duluth			C&NW	8:00 pm	48.25	66.85	8.50	6.80	24.00	30.00	
Ar. Chicago				8:00 am							

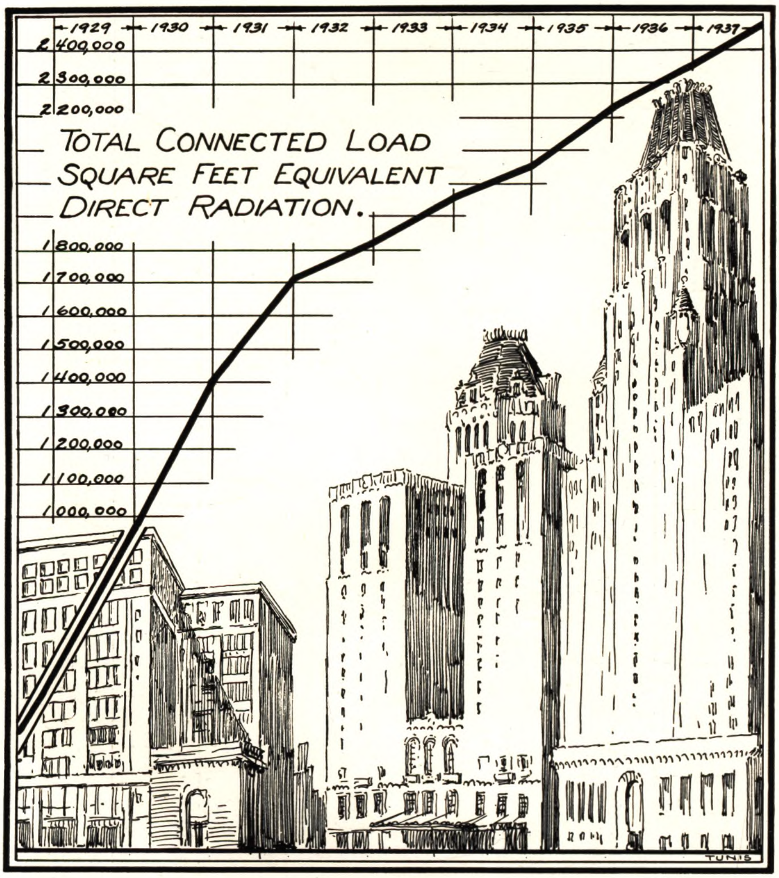
Schedules from Minneapolis	Road	Time	Road	Time	Coach	First Class	Lower	Upper	Compt	Dr rm	Seat
Lv. Minneapolis			CB&Q	8:00 am	46.40	64.65	8.00	6.40	22.50	28.00	
Ar. Chicago				3:00 pm							

Schedules from Chicago, Detroit, Cleveland and Pittsburgh	Road	Time	Road	Time	Coach	First Class	Lower	Upper	Compt	Dr rm	Seat
Lv. Chicago			B&ORR	3:30 pm	30.90	46.30	5.50	4.40	15.50	20.00	
Lv. Detroit			B&ORR	5:15 pm	24.00	36.00	4.25	3.40	12.00	15.00	
Lv. Cleveland			B&ORR	9:00 pm	17.40	26.10	3.00	2.40	8.50	11.00	
Lv. Pittsburgh			B&ORR	11:59 pm	12.10	18.10	2.50	2.00	7.00	9.00	1.50
Ar. Baltimore, Mt. Royal Sta.				9:35 am							

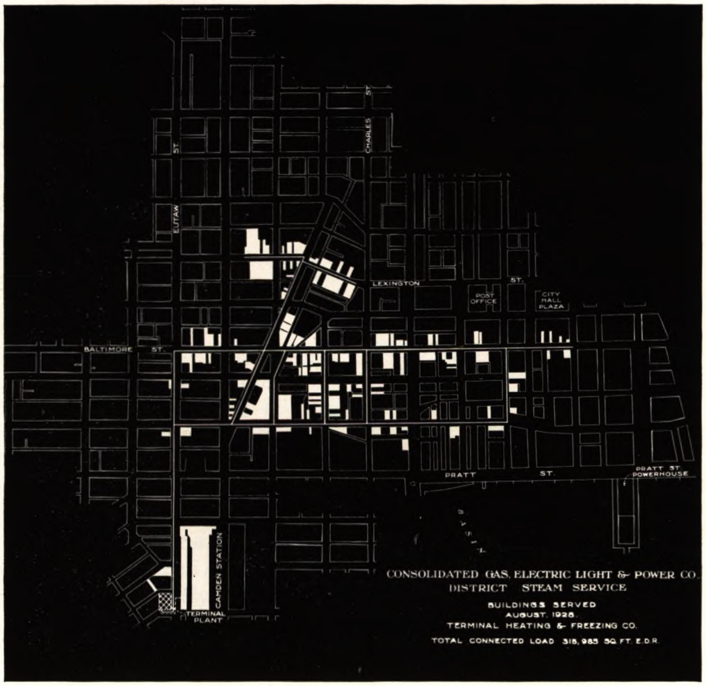
NOTE: All service shown above is completely air-conditioned.

Growth of District Steam Heating in Baltimore

By J. EARL SEITER
Assistant Manager in Charge of District Steam Sales
Consolidated Gas Electric Light & Power Co. of Baltimore



DISTRICT steam heating in Baltimore dates back to 1901, when the Terminal Freezing and Heating Company was organized to supply district steam and refrigeration. In 1914 the Consolidated Gas Electric Light & Power Company of Baltimore erected their office building near the retail district of the city. At the same time one of the leading department stores in the same block was contemplating an expansion and contracts were made whereby the plant for the new office building would supply steam to this store and other buildings in the block.



Baltimore District Steam Service 1928

Baltimore District Steam Service 1937

In August 1928, the Consolidated Gas Electric Light & Power Company purchased the franchise and property of the Terminal Freezing and Heating Company and the two district heating systems were combined into the nucleus for a much more comprehensive system.

Since this merger, the Company has enjoyed a consistent increase in the steam business. The year 1937 was the ninth full year that the Consolidated system has been in operation. Its growth has been continuous during this period, and the connected load served is now nearly 2,500,000 square feet of radiation and 7.4 times that taken over from the former two systems. Eighty-two percent of the new business obtained during the above 9-1/3 year period (September 1928 to December 31, 1937) was through the displacement of 477 private heating plants. This growth is especially gratifying when it is considered that most of it took place during the depression period when few new buildings were erected.

During this same period, building operators appreciated more and more the necessity of reducing their operating expenses. Simple equipment, easy to operate and maintain, was important to them. Satisfied tenants and customers were necessary. Reducing to a minimum the cost of building cleaning, painting and maintenance, helped their slim budget. Building management could release the money spent on these items and the usual worry connected with operating their own plant. Item by item active costs were broken down. They realized that temperature control would give them more comfortable and healthful working conditions. Their former pride in operating their own plant was replaced with peace of mind in knowing the attendant plant worries were ended and an automatically operated steam supply substituted. The work of cleaning became easier and less expensive and the use of basement space in many instances brought in additional income. Further, through rejuvination of the system and the flexibility of supply, much less steam was required than formerly.

The sales policy of the Company greatly contributed to the growth. The salesman assigned to a prospective customer does the preliminary educational work, obtains contracts, designs and supervises the installation and continues to observe the customer's operation and is active in seeing that the steam is used most efficiently. In fact, he is salesman, designer, draftsman, and utilization man, familiar with every detail of customer-company relations.

It has been found important to see that the initial installation is correctly designed. Customers expect comfortable heating when district steam service is purchased. This expectation can be obtained only by making many physical changes in the customers' premises. It is particularly true in the older buildings with antiquated heating systems. The growth of the load in a large measure is through the successful operation of this activity.

Further, in a business such as district steam heating, it is essential that steam should not be wasted in any way on the customers' premises. With a good installation, designed by experts in district steam utilization, properly followed up to see that maximum comfort is obtained, customers become salesmen.

To show the effectiveness of the correct installations and efficient utilization, outlined above, the steam consumption per square foot of connected radiation was reduced from 427 pounds per square foot per normal year in 1929, to 321 pounds per square foot per normal year in 1937. This drop naturally means some loss in sales to individual customers, on the other hand, it opens the door to many more customers. Further, waste means loss and high bills, discontented customers and, consequently, temporary customers, whereas with improvement, modernization, temperature control constantly being sponsored, the economical and efficient use of district steam is assured, which means enthusiastic and satisfied users of a permanent nature.