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The meeting reconvened at 2:00 P.M., First Vice-President Donald H. Brandt presiding.

DISTRIBUTION COMMITTEE REPORT

ELWOOD A. CLYMER, Chairman
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MODERN GAS SETS THE CLIMATE AT ALLEGHENY CENTER

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Back in the 1800's the area now known as metropolitan Pittsburgh consisted of a group of separate communities clustered around the confluence of the Monongahela and Allegheny Rivers. On the north shore of the Allegheny River, the town of Allegheny prospered throughout the 1800's, fed by payrolls of steel fabricators, glass plants and food processors. It was not until 1907 that Allegheny City was incorporated into metropolitan Pittsburgh. Today, many old timers still refer to Pittsburgh's North Side as Old Allegheny. An important segment of Pittsburgh's lauded redevelopment effort is the rehabilitation of the area comprising the sector once known as Old Allegheny. Supplanting a sprawl of rooming houses and marginal retail stores will be a 79-acre area occupied by department stores, tasteful specialty shops, office buildings, high-rise apartments and townhouses. Equitable Gas-Energy Company, a newly formed subsidiary of Equitable Gas Company, will serve this $60 million dollar redevelopment project with Pittsburgh's first centralized heating and cooling systems.

This new metropolitan complex is appropriately named Allegheny Center. Four and one-half miles of pipeline will provide year-round climate control for 1,350 apartment units, 220 townhouses, plus 750,000 sq ft of commercial space and an eight-story office building (Fig. 1).

The townhouses make Allegheny Center unique among urban redevelopment projects to date. They will be heated and air-conditioned from central plant service and domestic hot water will be generated from energy from the central plant. These townhouses will be sold to individual owners.

The system, designed by Ford, Bacon and Davis, a New York Engineering Firm, provides an initial capacity of 150,000 lb of steam per hr, plus 6,000 tons of refrigeration capacity with a water flow sufficient to serve the water requirements of a city the size of Savannah, Georgia. The gas lights flanking the plant's entrance nostalgically recall the days of Old Allegheny. Deeter, Ritchey, Sippel, Pittsburgh-based project architects, designed the plant structure to blend tastefully into the Allegheny Center scene.

Gas centralized heating and air conditioning offers many advantages to contractors, building owners and occupants. Residents can dial their own climate. Building owners are saved the expense of engineers and maintenance men needed to tend conventional heating and cooling facilities. Space normally occupied by heating and cooling facilities can be used in a more beneficial manner. Domestic hot-water service is also supplied. This modern concept of supplying year-round climate control is ideally suited for enclosed shopping malls, educational centers, apartment complexes and major redevelopment areas.

The central plant has three centrifugal compressors (Fig. 2) rated at 2,060 tons of refrigeration each. They are driven by condensing steam turbines of 2,166 hp or 4,950 rpm with steam at 235 psig and exhaust at a vacuum of 26 in. Hg. Each chiller will cool 3,300 gpm of water from 54 to 39 F. Each unit will require 6,300

FIG. 1—Allegheny Center's facilities—stores, offices and living quarters—have a pleasant climate in common through central heating-cooling plant (arrow).

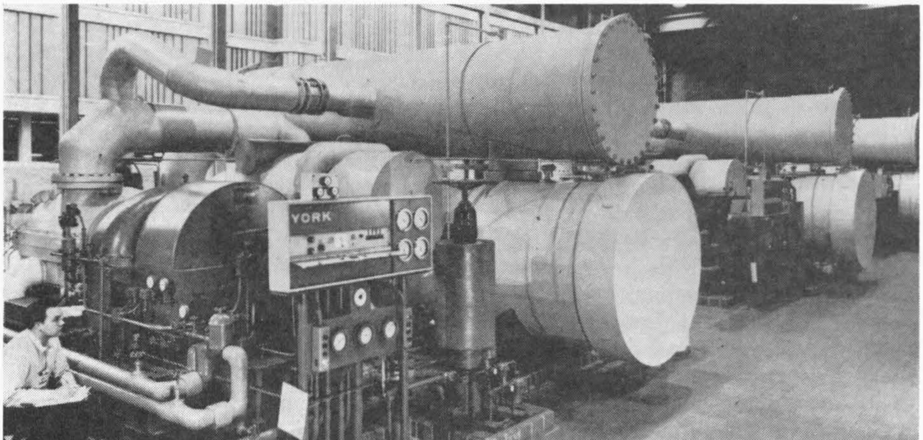

FIG. 2—Located on operating floor are three steam-driven centrifugal compressors.

gpm of condenser water, with a temperature rise from 85 to 95 F in the refrigeration condenser and a rise from 95 to 105 F in the steam condenser. The 54 gpm of condensate from each steam condenser will be handled by a duplicate set of motor-driven pumps discharging back to the deaerator against a head of 5 psig.

For generating steam at the expected maximum demand of 125,000 lb per hr (which includes domestic water heating and line losses), two boilers were installed, each to generate 75,000 lb of steam per hr at 235 psig.

The two steam generators were built by The Babcock and Wilcox Company at Wilmington, North Carolina. Weighing 36 tons each, they measure 14 ft 1¼ in. high, 24 ft 9 in. long, and 11 ft 8¾ in. wide. When the first of the two reached Pittsburgh by rail, it was moved by chain block from the flat car to wooden blocks until the second unit and special rig arrived. Then, the two generators were securely mounted on trucks and hauled to the site of the energy plant, with trolley wires and traffic control cables raised along the way to allow the trucks to proceed safely.

The boilers are of the two-drum type, gas-fired, with sidewalls, floor, and roof water-cooled. Each boiler has a forced-draft fan driven by a 50-hp steam turbine exhausting at 5 psig to the deaerator. One smaller motor-driven fan is provided for start-up service.

Each of the three boiler feed pumps will handle 150 gpm at 227 F at a discharge pressure of 300 psig. Two of the three will be turbine driven, exhausting to the deaerator, the third motor driven, all at 3,500 rpm.

Condensate from the heating systems will be pumped back to a 9,000-gal storage tank. Under maximum conditions, the return flow will be 250 gpm at a temperature range of 150 to 180 F. Two motor-driven pumps, each rated at 200 gpm, will discharge the water to the deaerator against a head of 80 ft.

The deaerator will have sufficient capacity to take care of the four boilers that may ultimately be installed. It is therefore sized to handle 280,000 lb of water per hr. It is of the direct-contact type, with two-shell design consisting of a vertical section welded to a horizontal storage section. The capacity is based on a feedwater temperature of 130 F with steam at 5 psig and a storage capacity equivalent to approximately 10 minutes of maximum boiler operation.

After evaluation of all cost factors, a cooling tower located adjacent to the central plant was selected as the most economical approach. A three-cell tower (with space allowed for three more cells) has been constructed. Each cell will handle 6,600 gpm with an inlet temperature of 105 F and an outlet temperature of 85 F at ambient air conditions of 95 F dry bulb and 75 F wet bulb. The six fans will be driven by two-speed motors through bevel gears with a reduction of 8 to 1. Special attention was given in the design to minimize the noise level. City water will be used for makeup.

Water from the cooling tower will return in a concrete flume beneath the ground floor of the central plant. Here, four vertical pumps have been mounted on the floor. Two will handle 3,300 gpm each, driven by 150 hp motors, two will handle 6,600 gpm each, driven by 250 hp motors. All will operate at 1,800 rpm against a head of 105 ft.

Careful consideration was given in making the plant attractive so as to blend into the surrounding area. The equipment has been color coded so that it is easy to follow the path of the various elements within the plant. The boilers are painted orange and the steam lines painted red, and the condensate lines painted redish brown—in other words, all of the steam facilities are in the red variety. All of the water facilities are in the green-blue variety. The condenser water system is painted green and the chilled water system is painted blue. Refrigerant storage tank is painted yellow. City water lines are painted white; the vent lines are painted black.

Last, and most important are the lines which make the plant operate—they are painted gold and carry natural gas which is the energy source. The gold lines carrying gas supply the fuel which generates the steam which is distributed throughout the distribution system supplying all of the space heating and domestic water heating requirements for all buildings to be built at Allegheny Center.

The steam is also used in the plant to drive many auxiliary pieces of equipment and also powers the turbines which drive the compressors to compress the refrigerant gas, which in turn cools the water which is distributed throughout the distribution piping system to supply the chilled water for air-conditioning for all of the buildings to be built in Allegheny Center. The heat balance is ideal and a very favorable fuel load factor results. No other energy will be used in any buildings for space heating, domestic hot water heating or air conditioning except as provided from this central heating and cooling plant.

The layout of equipment permits the addition of future units as demand increases. It is expected that from this central heating and cooling plant, not only will the demands of Allegheny Center be served but with later additions, also several adjoining areas. Expansion has been provided for in the design of the plant building, to serve loads equal to twice the capacity of the present equipment.

The main plant building includes dramatically high panels of plate glass—clear for the north front and solar gray for the south. There are 9-ft bays—14 of them for a building about 128 ft long and 80 ft deep (Fig. 3).

The framing of the building consists of 80 ft span, long-span, steel joists 5 ft deep supported by the columns of the front and rear glass column systems. The columns are aluminum H sections, especially formed for the job. The mill finish on these aluminum columns is left natural. The plate glass sheets are held in by stops mounted on the columns. They are unusually large sheets of ½-in. thick plate glass about 96 in. wide and 20 ft high with opaque duranodic aluminum panels above. The masonry at the ends are non-loadbearing and removable for future expansion. Columns rest on piles, as does the slab.

Note the clean lines of the operating floor with all of the service piping being contained in the lower level area (Fig. 4). The entire operating floor is also clear of partitions, giving a complete view of the boilers and chillers.

The control room and office space is separated from the equipment room, with the control console visible from the outside on the north elevation. It has been designed so that operations of the equipment can be completely controlled and recorded at the console. Windows between the control room and mechanical equipment room provide visual contact for the operators (Fig. 5).

Because Equitable wanted some distinction in the cooling tower visual design,

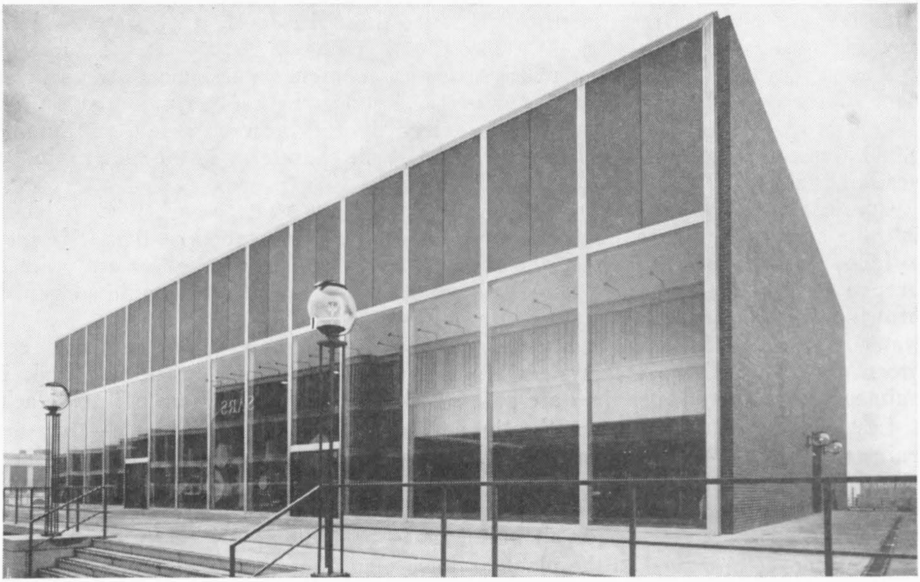

FIG. 3—Equitable Gas-Energy Company's central heating-cooling plant with custom-made gas lights at entrance.

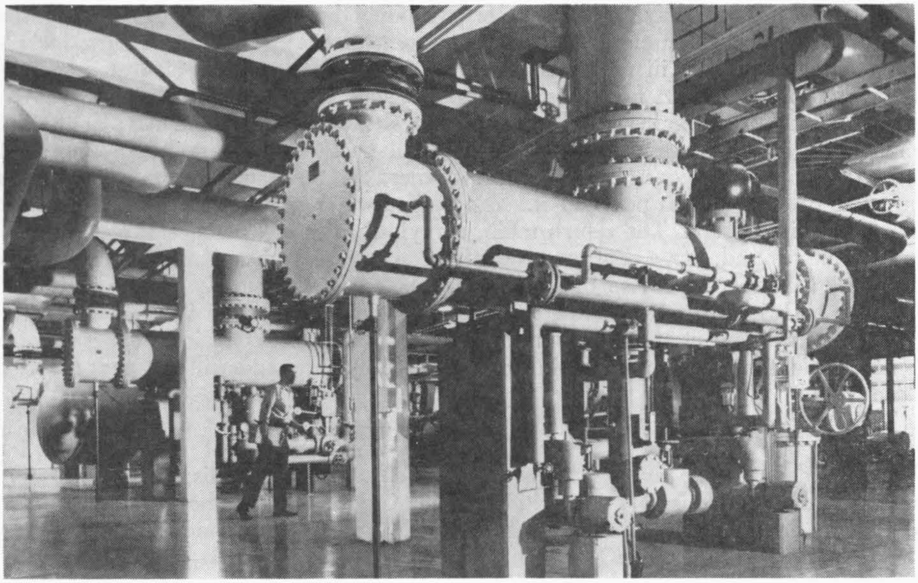

FIG. 4—Lower level, showing the three steam condensers and hot-well pumps.

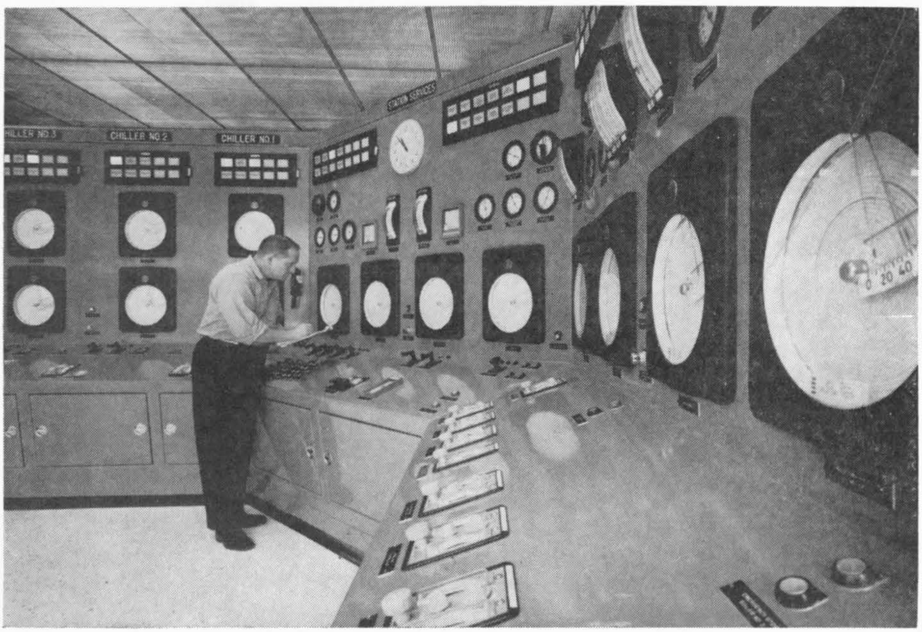

FIG. 5—Control room for plant operations and recordings. Panel at left for chiller operations; in center for station services; and at right for steam operations.

the sloping slats are constructed of 3/8 in. thick flat (glassweld) cement asbestos panels as produced by U. S. Plywood Corporation, finished in a Coast Bronze color, vitreous enamel for the exterior face. This paneling was manufactured in Belgium. We have one of the best appearing cooling towers, and the only one with this type of siding in the country.

It was decided to have chilled water available the year round because of the requirements of the commercial area and the office building. All customers, including the townhouses, will therefore have heating and cooling service at any time every day in the year. A four-pipe system was selected for the entire project.

The chilled-water mains will leave the central plant at 30 in. in dia; at the far end of the initial distribution system they will be 24 in. in dia, to take care of future customers beyond initial limits. Generally, these mains are sized for a pressure drop of 1.2 lb per 100 ft. The chilled-water supply main has 2-in.-thick glass foam insulation. The return main, carrying water at a temperature very near that of the ground, has a coal tar protective coating. At times of maximum cooling demand, a temperature rise of 0.5 F is expected in the supply main. This will increase to 1.5 F at times of low demand. No temperature rise is expected in the return main except at very low summer loads. Since the expansion of these mains is negligible, they will be buried in trenches, side by side, and will not pass through street vaults (Fig. 6).

The steam main will leave the central plant at 12 in. in dia and will be 8 in. in dia at the extreme end of the initial system—a size that again allows for future loads. On the average, this main is sized on the basis of a 9,000 fpm velocity. The condensate main will be 8 in. in dia leaving the plant and 4 in. at the far end. Both mains will pass through street vaults containing the necessary expansion joints, drip traps, and anchors. Between vaults, these mains will

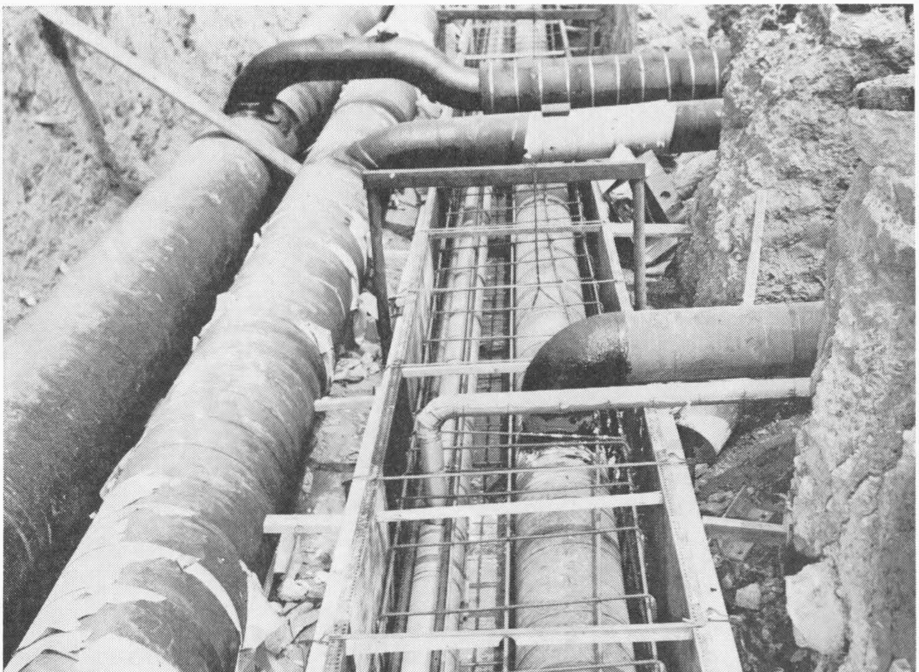

FIG. 6—Underground piping system: left to right; 30-in. chilled-water supply, 30-in. chilled-water return, 8-in. condensate return, and 12-in. steam supply. Take-off lines on right are service connections for Sears Department Store and Shopping Mall. Also shown are forms for encasing steam and condensate lines in concrete envelope.

be encased in a concrete envelope resting on the bottom of a trench. The uninsulated condensate return main is wrapped in corrugated paper; the steam main is insulated with 2 in. of calcium silicate.

Special precautions were necessary to support the pipe and to provide an air space between the pipe and insulation to allow for free movement of the pipe. A support cradle was formed from a bent piece of steel with lugs welded to each end to keep the supporting wires from slipping off. At intervals, parafin blocks ½ in. thick were wired around the periphery of the pipe. These melted when the steam was turned on and allowed a ½ in. air space all around the pipe.

Each vault is vented near the top through a 4-in. pipe under the street surface to the top of a small pit beneath the sidewalk, just inside the curb, and each pit is vented through a grilled cover. A similar 4-in. pipe from near the bottom of the sidewalk pit to the bottom of the manhole provides for the entrance of outside air.

Cathodic protection will be provided for all underground piping, and special precautions were taken in regard to the condensate return lines. Schedule 80 carbon steel pipe was selected, not because of the pressure, which is less than 20 psig, but to provide the extra wall thickness for longer life. As an additional safeguard, a filming amine is added to the steam to form a protective film on the inside of the pipe.

Three services: steam, chilled water, and hot water (townhouses only), will be furnished to customers. Steam will be delivered to a shut-off valve inside the curb line, and the customer will return the condensate to an adjacent valve. The steam pressure will be 235 psig maximum, and the customer is required to install a double-reduction pressure-reducing valve station. With a few exceptions, steam is not to be used directly in a customer's building but only in heat exchangers, from which all condensate is to be pumped back to the street main at 20 psig by the customer's condensate pump. The Equitable Gas-Energy Company will install and own condensate meters.

Chilled water is supplied to and returned by the customer to shut-off valves located inside the curb line. The supply temperature is not to exceed 40.5 F, and the return temperature is to be no lower than 55 F at peak load when the water is used directly in a customer's system and no lower than 52.5 F when used in heat exchangers. The chilled water will be delivered at a pressure sufficient to overcome a 25 psig pressure drop through a customer's system. The customer is to provide modulating controls to reduce the flow at part load to maintain the foregoing temperatures. He is to provide booster pumps if his system needs more than 25 psig pressure drop. Equitable will install a Btu meter in the supply pipe, actuated by the flow and the temperature difference between supply and return water.

The commercial area, which is the first part of the project, is noteworthy for its size and the air conditioning of the enclosed mall. Overall, the building will be 1,024 ft long by 476 ft wide, with three floors below ground level and two floors above. The underground levels will be devoted mainly to garage and parking space and tenant service and storage areas. The parking areas will not be heated but will be ventilated at a rate of ¾ cfm per sq ft. The other spaces will be heated to maintain 50 to 60 F with unit heaters and air-handling units. On the ground level, the covered mall will be two stories high, flanked by air-conditioned stores and display areas. These open onto the mall, with heating and cooling provided by air-handling units. Design temperatures are 70 F in winter with 0 F outside, and 78 F DB with 50 per cent RH in summer with 95 F DB and 75 F WB outside.

For the townhouses, Allegheny Center will provide an equipment and meter room for each of the four separate areas. Equitable will install a steam to hot water converter with circulating pumps and auxiliary equipment. The hot water at approximately 200 F will be conveyed through secondary mains in trenches to shut-off valves located in the rear of each house. Hot water will be supplied at sufficient pressure to overcome a 16 psi pressure drop through the system in each house. Allegheny Center, Inc. will install control devices to modulate the water flow to maintain a 20 F drop in the circulated water in each house. Domestic hot water will be supplied from a heat exchanger in each house, with suitable controls.

Chilled water will be brought to these equipment rooms from the street mains. From there a secondary system of piping will run through the same trenches as the hot-water piping. Equitable will install a Btu meter in each equipment room. The houses will be conditioned through a duct system supplied by an air-handling unit arranged so that both cool and warm air will be available at all times.

INSTALLATION OF A BUTTERFLY VALVE

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Introduction

In 1964 a 20-in. butterfly valve was installed and put into operation in a 24-in. steam main in Consolidated Edison Company's steam distribution system.

The use of a butterfly valve as a throttling device in a steam line is not unique. This paper is presented in the belief that an exposition of the background, installation details and results obtained will be of interest and value to the membership.

Background

Let us first briefly consider the development of the steam distribution system. At it's inception in 1882, it consisted of a single boiler plant and two to three miles of steam mains in the extreme south end of the present system. This was and is still known as the Downtown District. In 1886, a boiler plant and distribution system were put into operation in the northerly or Uptown District.

The Uptown and Downtown Districts continued to grow but were not interconnected until 1932 when the final section of main along the westerly side of the steam territory was completed. Higher pressures are generally carried in the Uptown than in the Downtown steam territory. The linking of the Uptown and Downtown steam territories, however, presented no control problems due to the length of the steam tie, approximately two miles, and its attendant pressure drop.

A 400 psig main was installed from the East River Plant to the Downtown area in 1956. Terminal pressure is controlled by varying the send-out pressure. This main augmented the steam supply to the Downtown area and was a step toward the eventual retirement of the outmoded Station A (Burling Slip).

In 1964, two 24-in. 400 psig mains were installed in a tunnel under the East River from the Hudson Avenue Station in Brooklyn. (See Distribution Committee Report 1966 "Serving Steam Under the East River from Brooklyn to Manhattan" by James A. Sheppard, Jr., Consolidated Edison Company of New York, Inc.) These two mains tie in at points A and B in Fig. 1. The combined capacities of these two steam mains is 2,000,000 lb/hr. On test, separately, they have been up to 20 and 15 per cent respectively above that figure.

A study of the system quickly established the need of a throttling device south of point B to control the flow southward, prevent overpressuring the Downtown District and to divert the balance of the steam to the Uptown District.

Equipment

The throttling device selected was a steel butterfly valve manufactured by the Continental Equipment Company, together with a Limitorque motor operator