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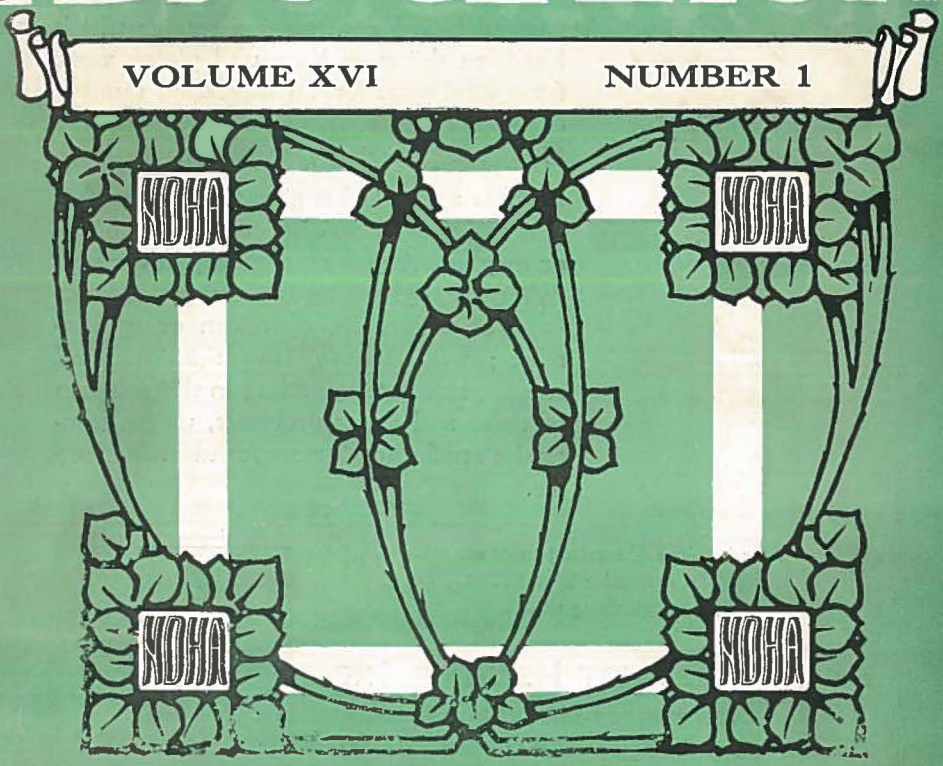

OCTOBER 15, 1930

District Heating In Paris

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FOREWORD

M Phillippe Schereschewsky, Director de la Cie Parisienne, de Chauffage Urbain, is one of our most distinguished members. His article and the accompanying illustrations are exceedingly interesting in showing how, after a careful survey of American methods, he attacked the problem of installing a district heating system in Paris. That his problem was no simple one will be appreciated as one reads the article, and the methods used are in some respects quite original. The underground conditions in Paris, particularly because of the very large and numerous sewers, are extremely difficult, and a great deal of effort has been required to find routes for the heating tunnels and conduits.

We will await with interest Mr. Schereschewsky's report of operating results.

The Cie Parisienne de Chauffage Urbain organized in the middle of 1928, has the exculsivé franchise in the City of Paris for the distribution of steam or hot water by means of pipe lines laid under the public streets. The life of the franchise is forty years. The Company is planning to start with a capital of about 80 million francs, ($3,140,000), which capital has been furnished for the most part by the electric companies in the Paris district. The City of Paris has taken no part in raising the capital, but in exchange for the franchise granted, the City must receive part of the gross receipts and profits which the Company may realize.

Since our Company has been in existence only two years, it is not yet possible for us to give to the members of the N.D.H.A. the results of the operation of this important system. We intend to give in this article, chiefly, information about the plans and the first steps in their execution, hoping later to be able to complete the account somewhat by details of the results obtained.

From the start of its organization, the Company has first of all sought the districts most favorable from all viewpoints for district heating. It has commenced by preparing statistics, house by house, of central heating installations,* also it has made a detailed study of the subsoil of the streets, a subsoil which is especially full of obstructions in an old city like Paris.

* The term central heating, as used here, refers of course to heating by means of a single heater rather than by fireplaces or stoves. (Ed.)

The statistics just mentioned have shown that the density of the central heat per square kilometer is much lower than the figures generally given in the U.S.A. This is explained by the mild climate, the mean winter temperature in Paris being between +3 degrees and +4 degrees Cent. (37.4 and 39.2 degrees Fahr.), by the fact that the installa-

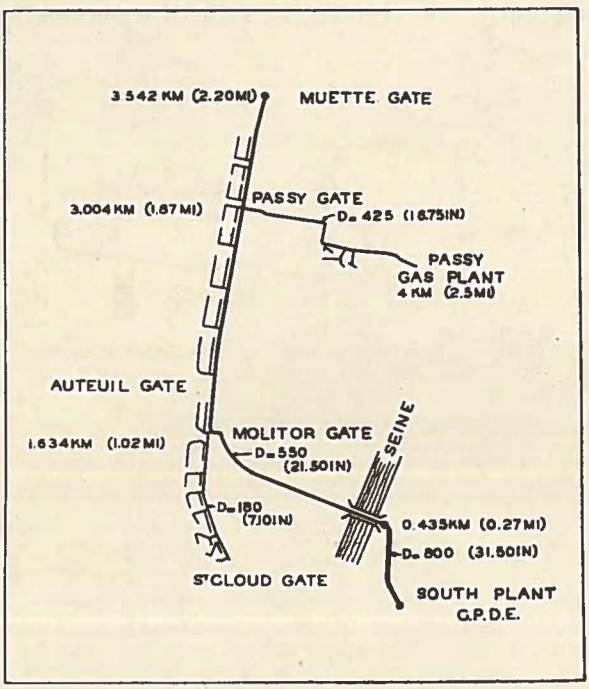

Fig. 1

General plan of the Auteuil District. Distances to various points from the power house and diameters of the mains are indicated.

tions of central heat are calculated to give an inside temperature of +18 degrees Cent. (64.4 degrees Fahr.) for an outside temperature of —5 degrees Cent. (23 degrees Fahr.), and also because buildings are generally not so high as in the large American cities. Also, even in those sections where central heat is actually most widely used, about half of the buildings are still heated by individual heaters or stoves.

The survey has shown that the density was highest in the west part of the City. In the district concerned, it varies between 25 and 100 million calories per sq. km (257,000 to 1,028,000 pounds of steam per square mile). The zone in question extends in length about 5 km (3.1 miles), in width between 1 and 2 km ($\frac{5}{8}$ and $1\frac{1}{4}$ miles); one point of advantage of this zone is the fact that construction of new buildings

is continually increasing along the Bois de Boulogne on the site of the old fortifications, where elaborate buildings are being erected for a distance of about 4 km (2½ miles).

The amount of heat consumed per km of street is also less than in the United States. It usually varies from 1 to 10 millions of calories (6,400 to 64,000 pounds per mile), with an average of between 2 and 3 millions (12,800 and 19,200 pounds per mile) for the sections under discussion.

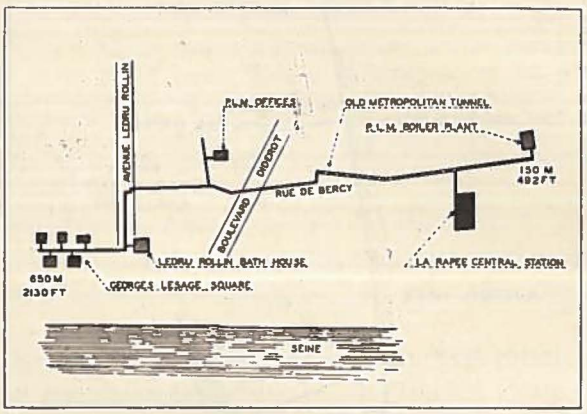

Fig. 2
General plan of the Gare de Lyon District

One of the considerations which must not be overlooked in a comprehensive study of district heating is the amount of heat used annually (counted in terms of the maximum load). Experiments made last winter on a series of typical buildings showed that this use generally extends from 1,000 to 1,200 hours; in the United States it is easily 50 per cent more than this.

Furthermore, a factor which also will contribute to the great difference between the district heating system of Paris and those of American cities lies in the fact that in our most favorable sections there are no old electric plants from which we could take steam. Besides, for aesthetic reasons, the City absolutely forbids the construction of plants in these districts as well as throughout the remaining part of the City. Paris district heating must therefore get steam outside of the City, which involves the construction of large pipe lines connecting the heating plants with the centers of consumption, and consequently, heavy expenditures which would not be necessary if heating plants might be located near the centers of consumption.

In American cities, on the contrary, the distance between the place of production and the sections served is short, and they do not

hesitate to build heating plants near office building districts with the result that the cost of construction of the network of pipe lines is not excessive and is, in general, less than the cost of the plants.

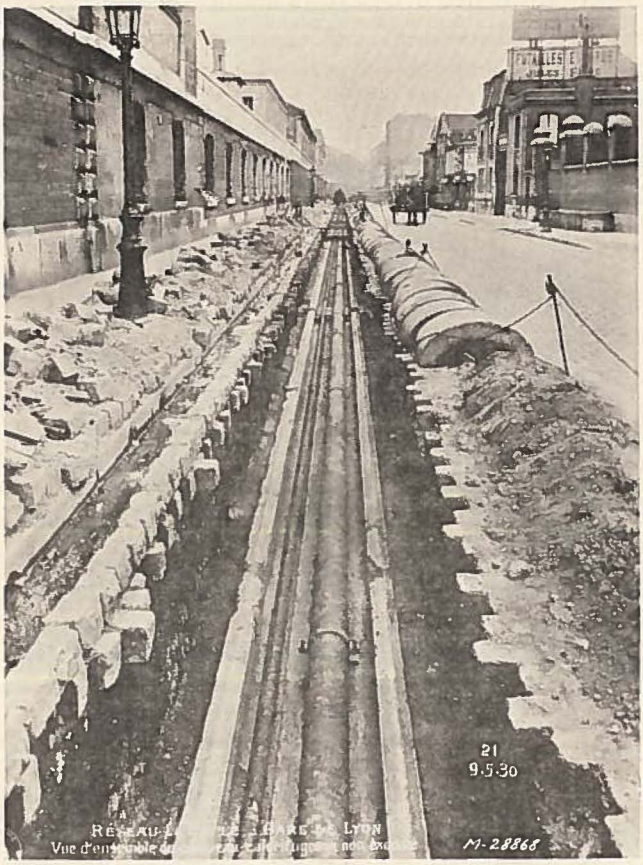

Fig. 3
View of La Rapee line in Rue de Bercy, Gare de Lyon District, showing pipes in place but not insulated.

All these considerations have influenced the Company to serve the west side of the City of Paris, taking steam from the nearest suburban plants. One will see further that the choice fell on the existing electric plants.

The electric plant nearest the district of greatest heat consumption is that of Issy-les-Moulineaux situated on the banks of the Seine about 500 m (550 yards) south of the Paris city limits, and 3 or 4 km (1¾ or 2½ miles) from the districts of greatest consumption. It is this electric plant which will feed the main network of Paris city heating. It is

equipped with boilers having an hourly output of about 1,000 tons (2,205,000 pounds) of steam, the great part of which is at 45 kg (640 pounds per square inch) pressure and 450 degrees Cent. (842 degrees Fahr.) temperature. The steam demand in the sections near the plant, which are mostly residence districts, is about 500 tons (1,102,500 pounds) per hour.

Fig. 4

View of La Rapee line in Rue de Bercy, Gare de Lyon District, showing the insulated pipes and the application of pre-cast covers to the duct.

The high pressure boilers must be supplied with distilled water, so the district heating system is obliged, in order to avoid too great expense to the central station in preparing make-up water, to return the condensate after filtering and degassing. For this reason the conduits of the Paris city heating system contain a return pipe for condensed water.

The total length of the main network (the Auteuil network) served by this plant will be about 15 km (9.3 miles); the diameter of the pipes, which will be about 800 mm (31½ inches) at the start, will decrease in proportion to the distance from the central station. The principal artery will be 4 km (2½ miles) long and its diameter will not become less than 750 mm (29½ inches). The total possible capacity of this line will be about 70 millions of calories (277,760 pounds) per hour, with an average of 4.5 millions of calories (28,600 pounds) per mile for the main artery; the hourly heating requirements of the buildings connected is on an average between 200,000 and 500,000 calories (800 and 2,000 pounds of steam).

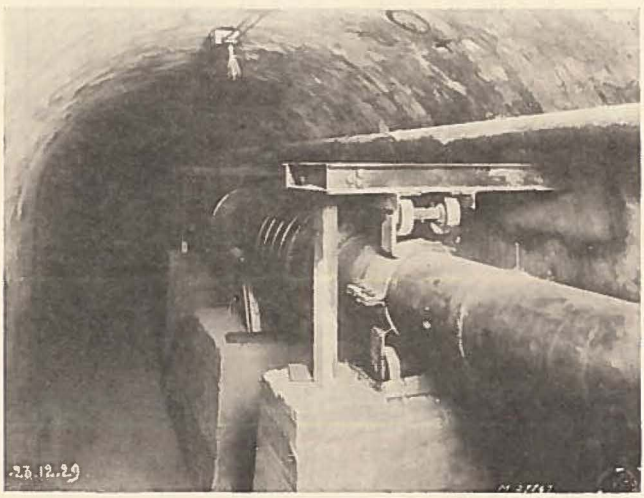

Fig. 5

View in the old Metropolitan cable tunnel, showing a bellows type expansion joint applied to a 253 mm. (10 inch) diameter main

The conduits will be constructed in general in trenches not open for inspection; however, from the start at the power house for a distance of about 500 to 600 meters (550 to 660 yards), they will be laid in a tunnel, of which the interior width is 3.5 meters (11 feet six inches), and which is designed to accommodate two steam pipes 800 mm (31½ inches) in diameter, two additional steam pipes 400 mm (15¾ inches) in diameter, and two return pipe lines 300 mm 11¾ inches in diameter.

This tunnel, located along the Seine in unstable ground, and the bottom of which is about 10 meters (33 feet) below the normal level of water in the river, will be of difficult construction, the more so since there are in the subsoil of this district numerous con-

duits, chiefly sewers, some of which are more than 3 meters (3 yards) inside diameter. Besides, generally speaking, the work of constructing

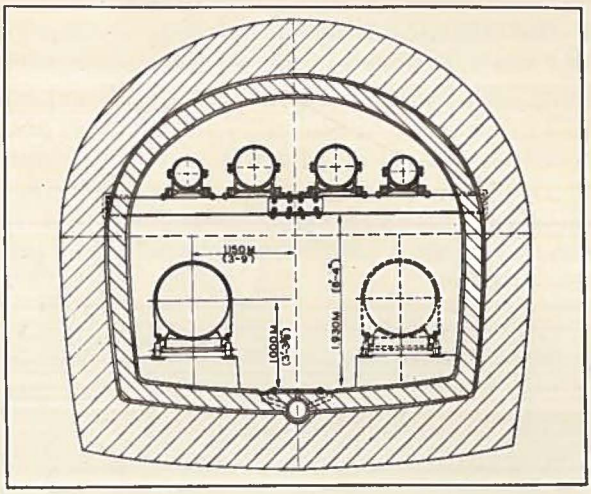

Fig. 6

Cross-section of the tunnel between the Issy-les-Moulineaux power plant and Auteuil bridge

the conduits of the district heating system will be more difficult and expensive in Paris than in the United States because the streets are not so wide and are already obstructed by various conduits, particularly the sewers, famous for their great size which is necessary because of the fact that they must be capable of being inspected throughout.

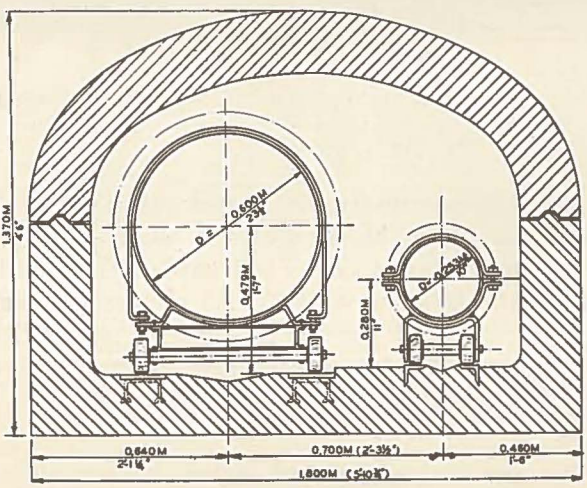

Fig. 7

Cross-section of duct for a 600 mm. (23½ inch) diameter main.

Independent of this principal network, the Company has at present almost completed an experimental system situated in the Gare de Lyon section, 1 km ($\frac{5}{8}$ mile) long. This system, constructed in co-operation with the firm of Rud. Otto Meyer, will be supplied with steam by the old central station of the Metropolitan Railroad which has boilers operated at 10 kg (142.2 pounds per square inch) pressure and producing

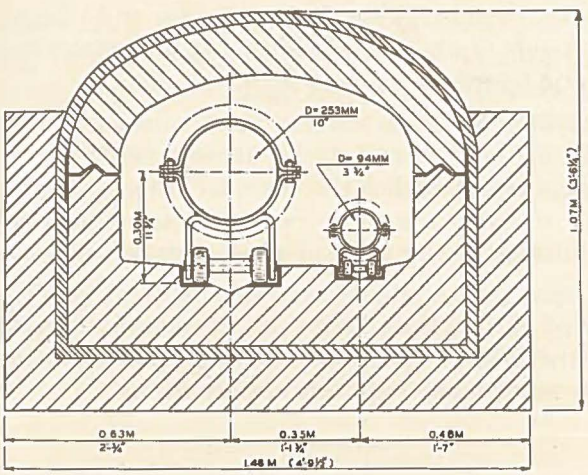

Fig. 8

Cross-section of duct for a 250 mm. (10 inch) diameter main in the Gare de Lyon district. This district is subject to floods, making a throughly waterproofed duct necessary.

steam at 300 degrees Cent. (572 degrees Fahr.). It will have, to begin with a calorific capacity of 15 millions of calories (600,000 pounds of steam) per hour; the diameter of the steam pipes ranges between 150 and 250 mm (6 to 10 inches); the pressure for distribution will be about 3 kg per sq. cm (42.7 pounds per square inch). This system will be in operation in October 1930. The results of the trial operation during the first winter of 1930-1931 will be of great value to the Company, for they will permit the exact determination of a number of points and the establishing of a rate for the sale of available steam, taking into account the interests of the public as well as of the Company.

We have said above that the Company was anticipating supplying the network of the west section with steam from the electric plants. Detailed study of the problem in Paris has indeed shown that returns from district heating would be satisfactory only if the steam could be purchased at a very low price, principally in order to meet the high charge on the capital resulting from the distance of the central stations from the center of consumption. All this can be done only by close

co-operation between the district heating system and the producers of electricity in the Paris area. This co-operation evidently exists judging from the fact that the producers have co-operated closely in the organization of the Compagnie Parisienne de Chauffage Urbain, but it must also be manifested in the course of its operation.

The steam intended for city heating can be actually relatively low in price only if it is supplied from back-pressure turbines (or better, extraction turbines, because these can meet in a suitable manner the independent demands of the City for heating and electric energy, whatever the outdoor temperature may be).

We have stated that the boilers at the Issy-les-Moulineaux were operated at 45 kg (640 pounds). That is a condition favorable for district heating, for the higher the pressure, the greater the amount of electric energy recovered; and consequently, as the figures show, the greater the reduction in the price of steam needed for heating.

We think that part of the network of Auteuil will be under steam for the winter of 1931-1932 and that the whole system will be ready for operation for the winter 1932-1933 and that the operating results will be good and in accordance with our anticipations.