

lowered. The property becomes more desirable on account of his heating service and, therefore, can command a higher price if one wishes to sell. It has also been found that in residences with such connection it is easier to secure and keep servants. These considerations are of considerable economic importance to every property owner and householder in a city where district heating is proposed and should therefore receive the careful consideration of the prospective customer.

That the central heating station is receiving considerable attention of late is evident from the following quotation from Bulletin No. 40 of the Bureau of Mines, which states: "The central heating plant is not a new thing; in fact, some of the plants have been in operation for twenty to twenty-five years. Development in this direction has been very slow, however, until within the last five or six years, when the idea has received renewed attention." A table in the same bulletin gives data on 57 plants throughout the United States in 1907, and from this table it is evident that the plants are most numerous in the States where coal is relatively cheap. It will be shown in a later part of this article that a very considerable portion of the cost of central station service is the overhead charges on the distribution system, and this proportion increases as the price of coal decreases. It is therefore apparent that in these cities where coal is cheap the citizens prefer central station service for other reasons than economy in fuel cost. If, under such conditions, this service has certain acknowledged merits to commend its use, it seems hard to understand why it has not been more widely adopted in localities where coal is expensive and where the distribution costs would form in consequence a smaller proportion of the charges for central station service. It seems evident that the value of this service will be recognized in the near future and that in consequence the number of central heating plants will increase quite rapidly.

Isolated plants in large office buildings, stores, hotels, factories, etc., are able to furnish the necessary heating, together with the power and light required, at a low combined cost. If a central heating company wishes to secure such business, it must be prepared not only to supply heat but also electricity under more favorable conditions than would the isolated plant. This may not necessarily mean at a lower cost, for many executives are willing to pay for the relief from the care and anxiety incident to the installation and maintenance of a steam-electric power plant.

**The Central Heating System as a Public Utility.**—A central heating system must be considered as a public utility, and it therefore comes under the control of the "Public Utility Commissions" in such states as these exist. In Wisconsin public utilities are controlled by the Railroad Commission.

The methods employed by the commission in making its valuations are of very great interest and deserve the careful study of all engineers engaged in public utility work. There have been no rulings up to the present time on any case involving district heating, so that there has been no fixed rate of return recognized. In the case of utilities supplying electricity, 8% profit on the entire valuation has been taken as a basis for ratio-making. The books of all public utilities must be kept according to methods and forms prescribed by the commission.

Public utility corporations in the State of Wisconsin are so regulated by the commission representing the state that they are true servants of the public. At the same time the guarantee of a fair return on capital honestly

invested has so enhanced the value of the stocks and bonds of these corporations that they are now considered "gilt-edge" on the stock markets.

These laws have been extracted at some length to make perfectly clear the conditions that would be imposed on a corporation that proposes to organize and do a central station heating business in the State of Wisconsin.

The property of a public utility corporation can be assessed at an appraised value by the commission and taxed for municipal and state purposes in the same manner as other real property.

The corporation is required to report at regular intervals to the commission on forms provided for such purposes. These reports cover service records and financial statements.

There are greater natural limitations to the extent of the service of a heating station than in the case of an electric plant. The distance over which heat can be transmitted cannot compare with the transmission of electricity owing to the higher first cost of the underground distribution system and the greater power lost in forcing the heating medium—either steam or hot water—to the outlying portions of a long system. There will be a certain radius around the central station over which heat can be supplied to customers at a reasonable cost after allowing a fair return on the investment.

The greatest distance over which heat can be transmitted from a central station is determined by the allowable friction losses in the mains and the amount of service at the end of the line. Mr. Chas. R. Bishop, in a paper before the New England Section of the National Electric Light Association, stated that in general this radius of distribution should be from one to one and three-quarter miles from the central plant. From data pertaining to the heating stations in the United States, it would appear that a reasonable radius of distribution is from 4,000 to 5,000 feet.

**Plant Location and Design.**—In considering plant location and design, it is of first importance to determine the probable extent of the heating service, for on this depends the entire design of plant equipment and underground pipe lines. The central business portions of cities and the more thickly populated well-to-do residential sections will provide the greatest heating loads for the least capital expenditure.

When a central heating plant is under consideration, a careful examination should be made of all territory, both business and residential, that it is proposed to serve, and a scaled map of this section should be prepared. The distance to the extreme portions should not exceed about two miles from the station. The type of each building (whether wood, brick, concrete, etc.) should be noted on this map, together with the classification of the use to which the building is put, as, for instance, stores, residences, theatres, hotels, etc. The next step is to secure weather records of the city or of a neighboring city. Then the maximum and minimum temperatures throughout the heating season should be plotted. From these curves it is possible to select other cities where similar conditions prevail, and data should be secured from those cities as to the maximum and average heat demands for each type of structure in such a town. This information should be applied to each block or section of the town in question and the results will form a fair estimate of the probable requirements that must be met by the proposed heating system. The design of mains from the station may now be commenced and the proportions of these should be such as to