ness than that determined by the use of Fig. 6. The data in Fig. 6 are based on conditions of insulation exposed to the air, whereas normal ground temperature is substituted for air temperature in determining the temperature difference for use with the chart when applying it for underground pipe line estimates.

## REFERENCES

[1] Heat Loss from Copper Piping, by R. H. Heilman (*Heating, Piping and Air Conditioning*, September, 1933, p. 458).

[2] Rapid Method of Determining the Economical Thickness of Pipe Insulation, by Utley W. Smith (A.S.H.V.E. JOURNAL SECTION, *Heating, Piping and Air Conditioning*, October 1947, p. 118).

[3] Handbook of the *National District Heating Association*, Second Edition, 1932.

[4] Theory of Heat Losses from Pipes Buried in the Ground, by J. R. Allen (A.S.H.V.E. TRANSACTIONS, Vol. 26, 1920, p. 335).

CHAPTER 29

# DISTRICT HEATING

Steam Distribution Piping, Pipe Sizes, Conduits for Piping, Pipe Tunnels, Overhead Distribution, Inside Piping, Metering, Steam Requirements, Rates

THE term *district heating* refers to the heating of several buildings from a central plant as in the heating of portions of cities, or to the heating of groups of buildings as in institutions and factories. It is usually preferable, in a group of industrial or institutional buildings, that they be heated from a central plant rather than by individual plants. Fuel can generally be burned more efficiently, less labor is required, and often a central plant is cheaper to install. Those phases of district heating which frequently fall within the province of the heating engineer are outlined here, with data and information for solving incidental problems in connection with institutions and factories. Some data are included to cover the piping peculiar to heating systems which are to be supplied with purchased steam. A complete district heating installation should not be attempted without a thorough study of the entire problem by men competent and experienced in that industry.

*Air Conditioning.* In many cases steam from district heating mains can be used for air conditioning. There are three types of refrigeration machines which use steam as a source of energy. They are: (1) steam-driven compression machines, mostly turbine-driven; (2) steam jet machines; and (3) absorption machines. The method of using the steam for the cooling unit and for closed absorption systems is described in Chapter 37.

## STEAM DISTRIBUTION PIPING

The methods used in district heating work for the distribution of steam are applicable to any problem involving the supply of steam to a group of buildings. The first step is to establish the route of the pipes, and in this matter, since the local conditions control the layout, little can be said regarding it.

Having established the route of the pipes, the next step is to calculate the pipe sizes. In district heating work it is common practice to design the piping system on the basis of pressure drop. The initial pressure and the minimum permissible terminal pressure are specified, and the pipe sizes are so chosen that the required amount of steam, with suitable allowances for future increases, will be transmitted without exceeding this pressure drop. The steam velocity is therefore almost disregarded and may reach a very high figure. Velocities of 35,000 fpm are not considered high. By the use of this method the pipe sizes are kept to a minimum with consequent savings in investment.

The steam flowing through any section of the piping can be computed from a study of the requirements of the several buildings served. In general, a condensation rate of 0.25 lb per (hr) (sq ft of equivalent direct radiation) is a safe figure. This allows for line condensation which, however, is a small part of the total at times of maximum load. Miscellaneous