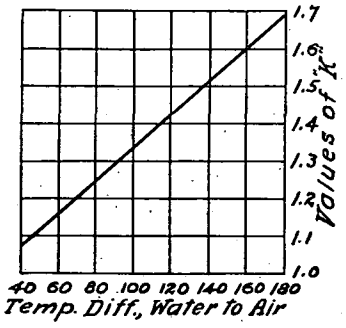

FIG. 1. HEAT DISSIPATION COEFFICIENT—*K*—OF A 38-IN., 3-COL. 20 SEC. HOT WATER RADIATOR AS DETERMINED AT THE UNIVERSITY OF ILLINOIS

water to air, is decreased. The writer conducted a series of tests in the laboratory of the Department of Mechanical Engineering, University of Illinois, to determine the values of *k* for a 38-in., 3-col., 20-sec. radiator, when the temperature difference, water to air, varied from about 55 deg. to about 145 deg., and when the water entered the radiator through the upper tapping and was discharged through the lower tapping. The results of this series of tests are shown in Fig. 1.

Using the values of Fig. 1 as a basis and assuming that the heat dissipation coefficient of a hot water radiator varies with the height of the radiator and with the number of columns of the radiator in substantially the same manner in which the heat dissipation coefficient of a steam radiator varies, as determined by Professor Allen and other investigators, Fig. 2 shows the values of *k* for the most common types of hot water radiators. It can be used to determine the size of the radiator when the type of the radiator to be used, the average temperature difference, water to air, and the quantity of heat to be dissipated per hour by the radiator are known.

An inspection of Figs. 1 and 2 shows that it is very important to maintain a high average water temperature in every radiator. For

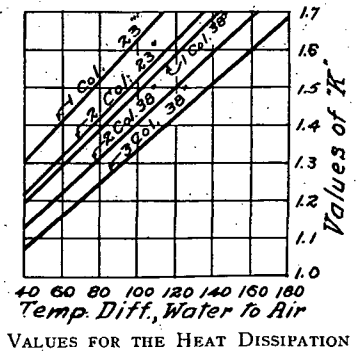

FIG. 2. SUGGESTED VALUES FOR THE HEAT DISSIPATION COEFFICIENTS—*K*—OF VARIOUS TYPES OF HOT WATER RADIATORS

example, if a 38-in., 3-col., radiator, located in a room having a temperature of 70 deg., is to dissipate 12,000 B.t.u. per hour, a 100-ft. radiator must be selected if the average water temperature in the radiator is 160 deg., whereas we may use a 70-ft. radiator if the average water temperature is 190 deg., or a 60-ft. radiator if the average water temperature is 205 deg.

It will be shown in the discussion of the design of the pipe system, that a decrease in pipe sizes results in an increase of friction, in an increase in the difference of the temperatures of the water in the flow and return risers, and consequently, in a decrease in the average temperature of the water in the radiator.

It is evident from the preceding discussion of radiator design that any economy which may have been effected by reducing pipe sizes will be offset in part, and may be totally offset, by the increased sizes of the radiators, particularly as the cost of a hot-water heating system is frequently based on the total radiation surface.

To illustrate the use of the diagrams of Fig. 2, let it be required to find the size of the radiator to be used if 8000 B.t.u. are to be dissipated by a 38-in., 3-col. radiator when the average temperature difference, water to air, is 170 − 70, or 100 deg. The value of *k* for this case, from Fig. 2, is about 1.34. The total surface required is 8000/1.34 or 60 sq. ft.

HEATER

To determine the heater it is necessary to know the quantity of heat which is to be transmitted to the water in the heater, and whether hard coal, soft coal, gas, steam, or electricity is to be used for heating the water.

The engineer designing a hot water heating system does not, as a rule, design the heater. He simply selects a heater suited to his needs from those available on the market. In selecting a heater for large installations, it is generally desirable to install at least two heaters, so that if one should fail the other will be available. When two heaters are installed, it may be advisable to select them of different sizes, the larger one having a capacity about 75 per cent greater than the smaller heater. If this is done, the heaters should be selected of such sizes that both may be used during extremely cold weather and the smaller or the larger during milder weather, depending on the outside temperature so that, at all times, the heating plant may be operated at a fairly high efficiency. There is frequently an advantage in having the two heaters of the same size so they may be interchangeable. This arrangement is very satisfactory, especially in the colder climates, if each heater is made of a size sufficient to carry about two thirds of the maximum load.

PIPING SYSTEM DESIGN

To design the piping for a hot water heating system many factors must be considered. For any given combination of heater and radiator, several different systems of piping may be designed so as to secure successful and satisfactory operation of the system.

There is only one general rule for the design of pipe systems that is applicable in all cases. It is this: *When the heating system is functioning*