natural circulation of the water. The design temperature difference is usually assumed from between 20 to 35 F. After having determined the temperature difference and the temperature of the flow water, data given in Fig. 4 can be used to obtain the pressure head. With information obtained concerning the required pressure head the same procedure is

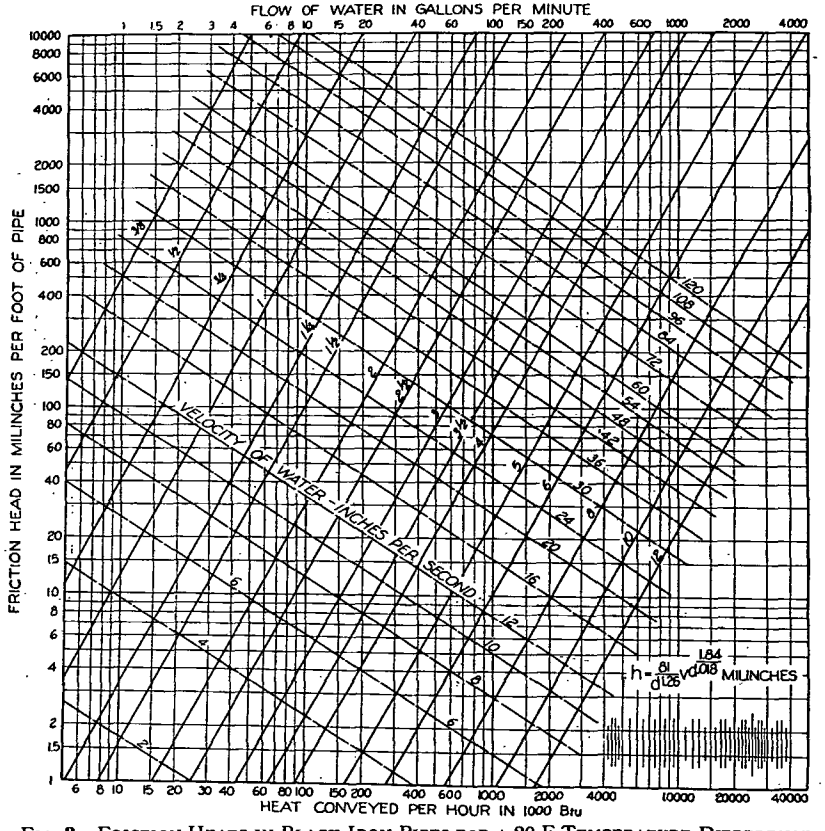

FIG. 3. FRICTION HEADS IN BLACK IRON PIPES FOR A 20 F TEMPERATURE DIFFERENCE OF THE WATER IN THE FLOW AND RETURN LINES

For other temperature drops the pipe capacities may be changed correspondingly. For example, with a temperature drop of 30 F, the capacities shown in this figure are to be multiplied by 1.5.

followed for computing the necessary data for a gravity circulation system as was previously outlined for a forced hot water system. Radiator heat emission rates from 150 to 200 Btu per square foot are commonly used so that flow temperatures generally range from 180 to 200 F or higher. Assuming a flow temperature of 200 F and a 35 F drop, and with the mains located 4 ft above the top of the boiler, a circulating pressure head of 600 milinches results. This is obtained by following the 200 F floor riser line in Fig. 4 to where it intersects the 165 F return riser line

and reading horizontally a pressure head of 150 milinches per foot or 600 milinches for 4 ft. Assuming first floor radiators are located 3 ft above the mains and second floor radiators 12 ft above the mains, third floor 21 ft and fourth floor 30 ft, the circulating pressure heads are 450, 1800, 3150 and 4500 milinches respectively.

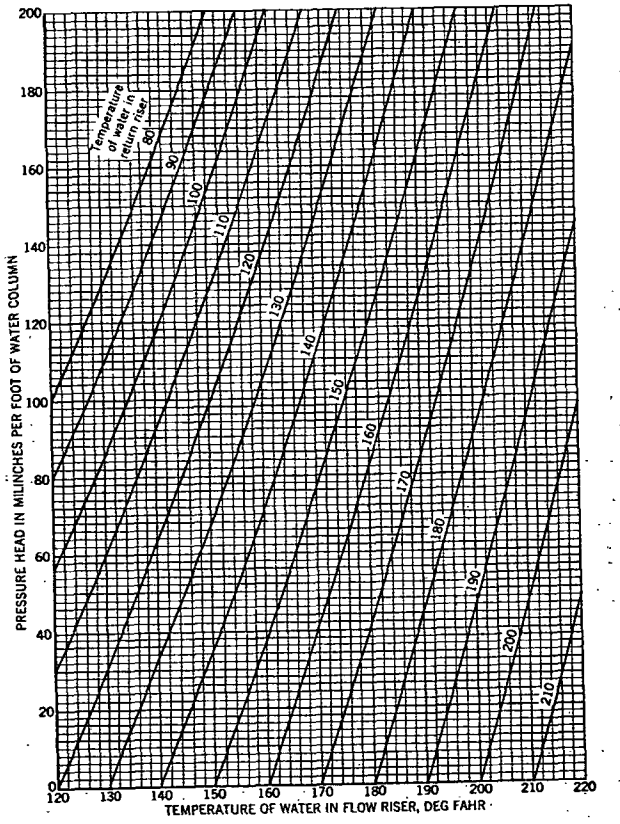

FIG. 4. GRAVITY PRESSURE HEADS FOR VARIOUS TEMPERATURE DIFFERENCES

EXPANSION TANKS

Water heated from 40 F to 200 F expands about 0.04 of the original volume. The expansion tank permits the change in volume of the water in the heating system to take place without producing undesirable stresses due to pressure in any part of the system.

Expansion tanks may be open, as illustrated in Fig. 5, or closed as shown in Fig. 6.

An open expansion tank has free vent to the atmosphere and consequently the pressure on the surface of the water is always that of one