can be figured using Fig. 3 and Tables 1 and 3. For copper tubing Tables 2 and 3 are to be used. In systems designed with reversed returns, it will generally be found that very little adjustment is necessary to secure even distribution to all radiators. However, orifices may be used to control the flow and the capacities are given in Table 4. In large buildings provision should be made for quickly draining radiators in case of breakage, and it is often advisable to install a lock shield valve on one end of each radiator and a hand controlled valve on the other. In case of

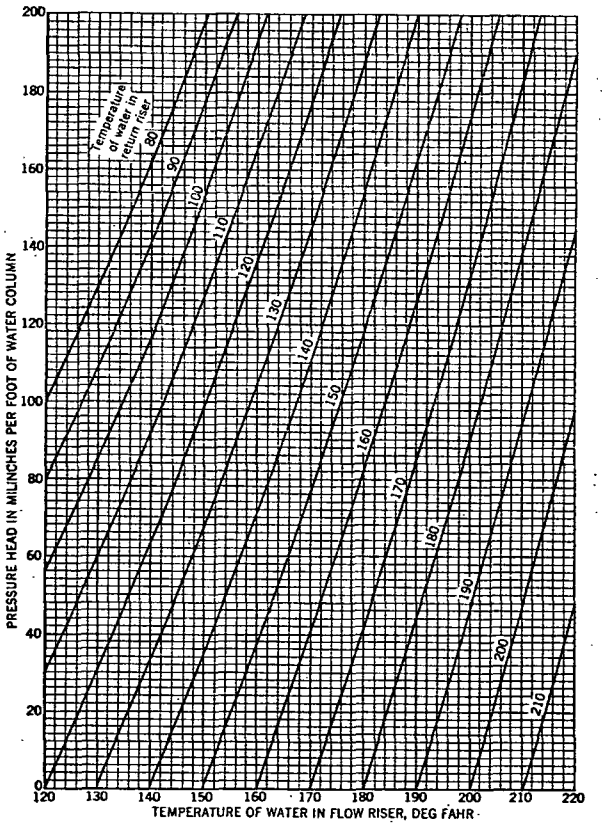

FIG. 4. GRAVITY PRESSURE HEADS FOR VARIOUS TEMPERATURE DIFFERENCES

breakage the two valves can be closed and the radiator removed without affecting the rest of the system. The lock shield valve can also be used for balancing the water circulation.

GRAVITY CIRCULATION PIPE SIZES

In gravity hot water heating systems the difference in temperature (density) between the flow and return water produces the required 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 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.

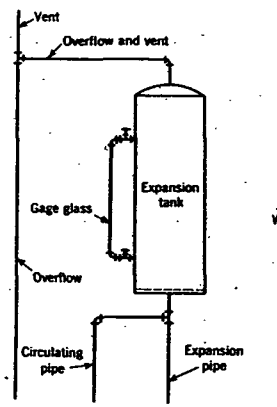

FIG. 5. AN OPEN EXPANSION TANK

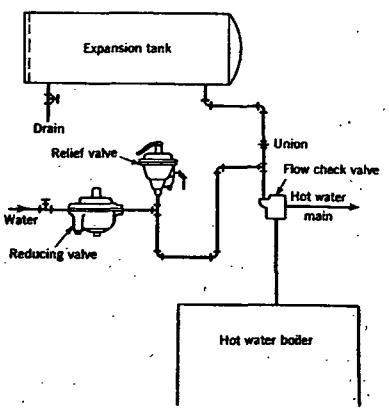

FIG. 6. A CLOSED EXPANSION TANK

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 atmosphere. The minimum contents of an open tank should be 0.06 of the volume of the water in the system including that in the boiler, heat transmitters, pipes, etc. This capacity is 50 per cent in excess of the actual increase in volume of water due to increase in temperature from 40 F to 200 F. The tank should be located at least 3 ft above the highest radiator. Provision must be made to prevent freezing of the water in the tank as well as in the pipe leading to the tank.

In a thermally circulating hot water heating system, the pipe to the open expansion tank should be connected to the supply riser from the