head available for circulation may be selected from the charts or tables in the same manner as for forced circulation systems.

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 deg drop, and with the mains located 4 ft above the top of the boiler, a head of 600 milinches results. This is obtained by following the 200 F floor riser line in Fig. 5 to where it intersects the 165 F return riser line and

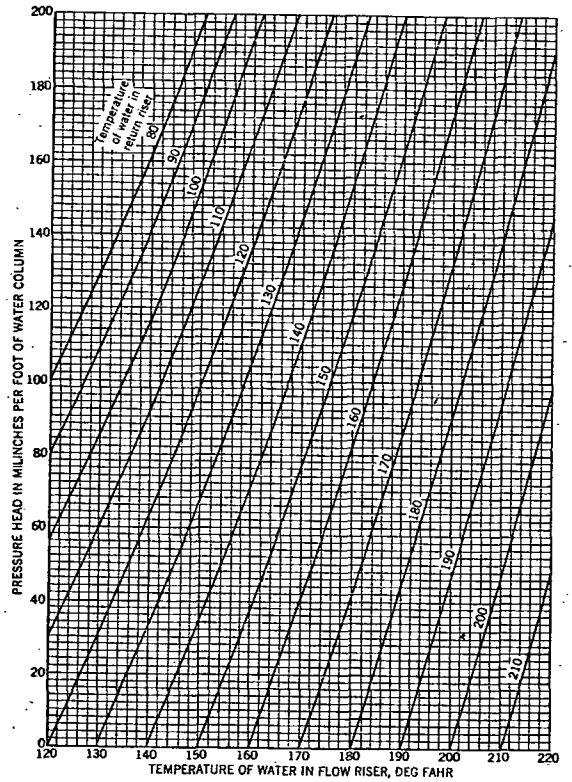

FIG. 5. [HEADS RESULTING FROM TEMPERATURE DIFFERENCE (GRAVITY SYSTEMS)

reading horizontally a 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 heads are 450, 1800, 3150 and 4500 milinches respectively.

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. 6, or closed as shown in Fig. 7. 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 gravity circulation system, the pipe to the open expansion tank should be connected to the supply riser from the boiler, so that the air liberated from the water in the boiler will enter the expansion tank.

In a forced circulation system, the pipe to the open expansion tank

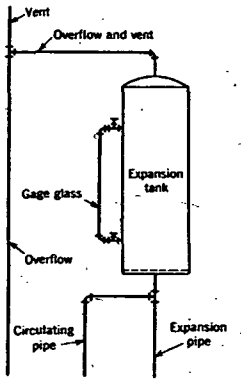

FIG. 6. AN OPEN EXPANSION TANK

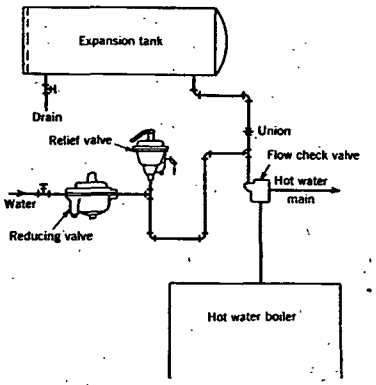

FIG. 7. A CLOSED EXPANSION TANK

should be connected on the suction side of the circulating pump, so that the head on the suction side of the pump will remain practically constant.

A closed expansion tank is sealed against free venting to the atmosphere. The tank may be above the highest radiator or heat transmitter, or may be below the lowest one. The minimum contents of a closed expansion tank must be such that the expansion of the water due to increase in temperature will be cushioned against a reservoir of compressed air above the water level in the expansion tank. The tank must provide space not only for the change in water volume, but also for variations in air volume within the tank due to changes in air pressure. If the closed expansion tank is below the heat transmitters, the tank should be larger than if it is above them, and the higher the building, under such circumstances, the larger should be the air capacity in excess of that required for increase in water volume due to temperature rise.

The size of a basement-located closed expansion tank should be at least equal to the following:

One story buildings: $x = 0.10\ V$ Three story buildings: $x = 0.17\ V$
Two story buildings: $x = 0.13\ V$ Six story buildings: $x = 0.28\ V$

where x = expansion tank size in gallons.
V = water volume in heating system in gallons.