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. 15, or closed as shown in Fig. 16. 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

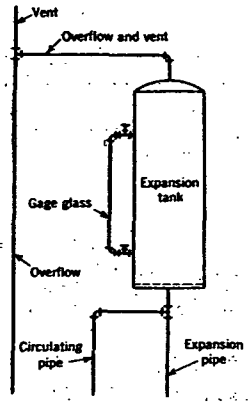

FIG. 15. AN OPEN EXPANSION TANK

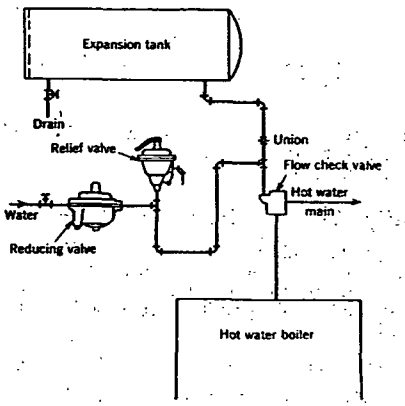

FIG. 16. A CLOSED EXPANSION TANK

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.

When the vent from an open expansion tank is extended through the roof, it should be not less than 4 in. in diameter from a point below the roof, through and beyond the roof line. This will prevent vapor, which sometimes rises from an expansion tank, from closing the vent during outside freezing temperatures.

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 an open expansion tank should be connected on the suction side of the circulating pump.

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 an expansion tank for installation in a closed system may be determined by the following formula:

$$V = \frac{E}{\frac{P_1}{P_1 + 0.434\,H} - \frac{P_1}{P_2}} \qquad (3)$$

where

V = required tank capacity, gallons.
E = expansion of water from cold system to flow riser temperature, gallons.
P_1 = atmospheric pressure, psia.
P_2 = maximum tank pressure specified for heated system, psia.
H = height of top of filled system above tank, feet. (NOTE: Top of system open to atmosphere when system is filled.)

Example 7. Select a closed expansion tank for basement installation on a system containing 5000 gal and operating at 200 F flow temperature. The static head due to the height of the system is 70 ft. The maximum pressure should not exceed 100 psig.

Solution. Assume that the system is filled at 40 F. Then

$$E = 0.04 \times 5000 = 200 \text{ gal}$$
$$P_1 = 14.7 \text{ psia}$$
$$P_2 = 100 + 14.7 = 114.7 \text{ psia.}$$

Substituting these values in Equation 3:

$$V = \frac{200}{\frac{14.7}{14.7 + 0.434\,(70)} - \frac{14.7}{114.7}} = \frac{200}{0.327 - 0.128} = 1000 \text{ gal.}$$

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: $x = 0.13\,V$ Four story buildings: $x = 0.23\,V$

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

This condition favors, especially in tall buildings, the placing of the closed expansion tank above the highest heat transmitter.

It is common practice to make multiple tank installations on large systems in lieu of having a tank made where the capacity required is beyond commercially manufactured sizes.

Any closed expansion tank located above the heat transmitters of a hot water heating system should be connected by a direct pipe with the flow main leaving the boiler, in order to enable the air to pass easily to the expansion tank. In a closed hot water heating system the water under pressure tends to absorb air at a rate increasing with pressure increase and decreasing with temperature increase.

Means must be provided to adjust and to observe the proportion of air within any closed expansion tank. This involves the provision of an air