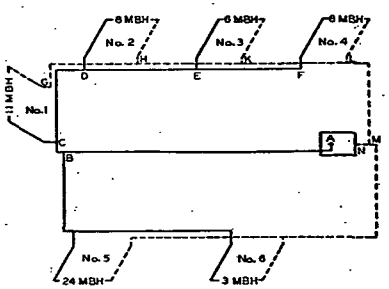

FIG. 13. TWO-PIPE REVERSED RETURN GRAVITY SYSTEM (EXAMPLE 5)

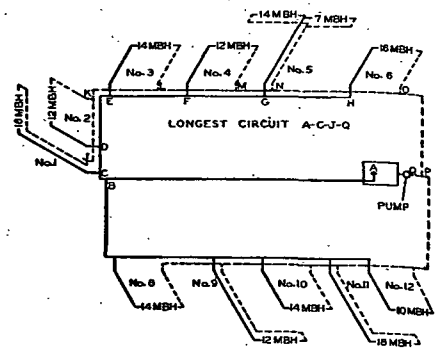

FIG. 14. FORCED CIRCULATION TWO-PIPE REVERSED RETURN SYSTEM

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 percent in excess of the actual increase in volume of water

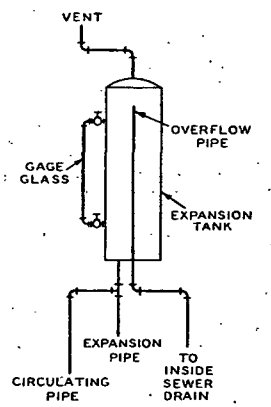

FIG. 15. AN OPEN EXPANSION TANK

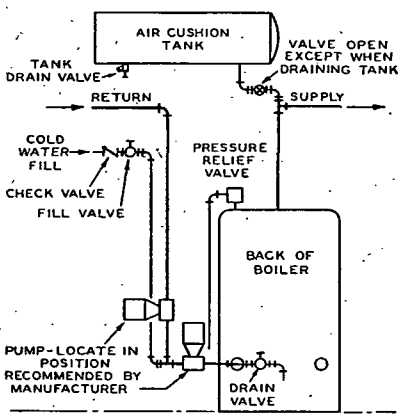

FIG. 16. A CLOSED EXPANSION TANK

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.

In accordance with Paragraph H-92 of the *A.S.M.E.* Low Pressure Heating Boiler Code 1946: "All hot water heating systems shall be so installed that there will be no opportunity for the fluid relief column to freeze or to be accidentally shut off. If the system is equipped with an *open expansion tank*, an *internal over-flow* from the upper portion of the expansion tank must be provided in addition to an open vent, the internal over-flow to be carried within the building to a suitable plumbing fixture or to the basement." (See Fig. 15.)

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:

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

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