

The two following important factors in tank sizing have not been illustrated in the *Examples 4 to 6*:

1. *Use of compressed air to increase the amount of air in the tank.* This factor affects the value of P_a by increasing it above atmospheric pressure. The use of compressed air to charge the expansion tank reduces the required tank volume.

2. *Effect of a design maximum temperature higher than 212 F.* The effect of design temperatures above 212 as used by some designers is given in the discussion of A, Fig. 17. It is possible to obtain proper operation of the expansion tank without adding the pressure required to maintain liquid water at temperatures in excess of 212 F. Two things are necessary on this basis of design: (a) the pressure increase in the system as the temperature increases from 40 F to 212 F and to the final design temperature must be sufficient to keep the pressure above that corresponding to the temperature of the water in order to prevent boiling and (b) the operating personnel for the system must be instructed regarding the proper pressure for various system temperatures in order that proper pressure control of the system may be maintained. An automatic fill valve cannot be used to maintain the minimum pressure for such a system.

In small systems where the volume of the water is small and where the

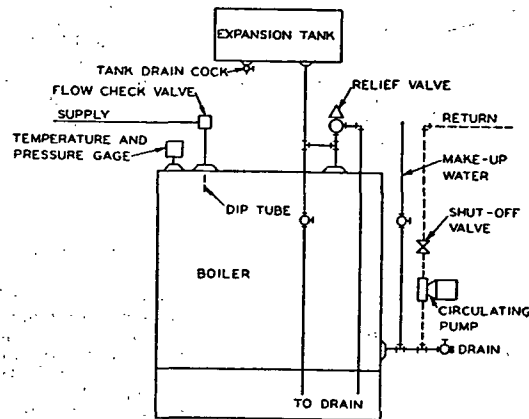


FIG. 18. BASIC BOILER CONNECTIONS FOR A HOT WATER SYSTEM

pressures due to pump and static heads are low, expansion tanks are small and no critical problems are encountered. However, for large systems the size of the expansion tank and the problems of pressure control can become critical. The following means of reducing expansion tank size and establishing satisfactory pressure control may be investigated in addition to the methods discussed under A to D, Fig. 17:

1. Compressed air, if available, can be admitted to the expansion tank to obtain the desired pressure.
2. The head of the pump may be reduced by the use of larger pipe sizes, or greater design temperature drop.
3. The boiler may be constructed for pressures higher than 30 psig.
4. The steam boiler may be used with a steam to water converter to heat the water circulated.

The point of connection of the expansion tank to the system should be studied carefully to guard against the possibility of isolating the tank from a hot boiler by normal operation of automatic, check, or manual valves.

Boiler Room Piping

The arrangement of equipment, its capacity, and the piping arrangement for its connection will vary, depending upon the size and characteristics of the systems which it serves. Most of the principles involved in these arrangements have been discussed. Fig. 18 shows the piping and specialties considered necessary for the most basic system. Fig. 19 shows a more elaborate multizone system. Most systems will fall between these extremes as the engineer fits the design to the requirements of the installation.

One device in boiler piping which facilitates elimination of air before it can enter the mains is the dip tube. Air will separate from the water in a heating system at a point where the velocity and pressure are the lowest and where the temperature is the highest. Although the pressure at the

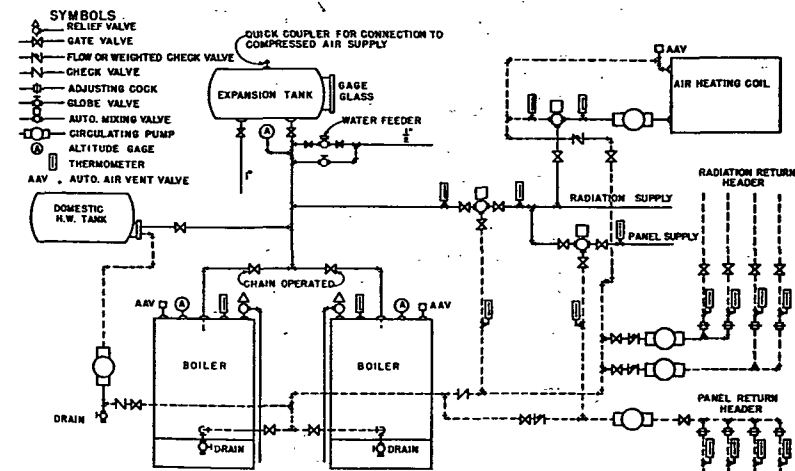


FIG. 19. BOILER PIPING FOR MULTIPLE-ZONE MULTIPLE-PURPOSE HEATING SYSTEM

boiler is generally high, it is a logical place to perform the separation. Fig. 18 shows the use of a dip tube. This extension of the outlet pipe forms a dead space at the highest and hottest part of the boiler. The air will tend to separate from the water in this space. The air can be conducted to the expansion tank by a connection from the tank to the highest point of the boiler, see Fig. 18. The connecting pipe should be as direct as possible and be pitched upward continuously to the tank. If the expansion tank is not connected directly to the boiler, an automatic air vent valve should be installed at the high point of the boiler, instead.

In general, the manufacturer's recommendation on the number of outlets to be used for a particular boiler for a given application should be followed. This applies also to return connections.

The prevention of thermal shock through proper use of return connections should be considered in piping arrangement. Where more than one pump is used for circulation, the discharge of the pumps should be connected together before being discharged into the boiler. A check valve should be installed in the discharge of each pump, unless another method of pre-