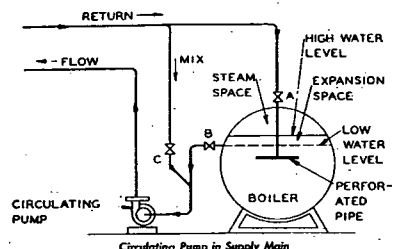


Circulating Pump in Return Main

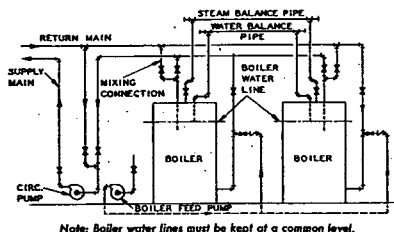


Circulating Pump in Supply Main

Fig. 5... Arrangement of Boiler Piping

volume. The problem of change in water expansion and contraction is minimized by rarely closing down a large system after it is in operation.

When pressurizing with a boiler feed pump automatically operated by pressure control, a relief valve for the maximum system pressure is provided. The pressure control is set to operate the boiler feed pump and feed water from the make-up tank to the boiler whenever the pressure falls to the regulator cut-in point setting, and stop when the cut-out point is reached. If the pressure increases beyond the safe limit of relief valve setting, excess water will flow through the relief valve to the make-up water tank. Pressurizing



Note: Boiler water lines must be kept at a common level.

Fig. 6... Piping Connections for Two or More Boilers in High-Temperature Water Systems Pressurized by Steam

may also be done by a continuously operating boiler feed pump.

Boiler Piping

When the circulation pumps discharge to the system supply piping, the flow main should not rise above the boiler water line high enough to reduce the total pressure sufficiently to permit flashing in the piping. Whether the pump is connected so as to deliver water to the system supply piping or to the boiler inlet line, the arrangement is a complete circuit and the water is returned to the boiler for reheating. The returned water is brought into the boiler below the water line as shown in Fig. 5.

When two or more boilers are used to supply a common load, means must be provided to equalize the flow of water to each boiler (see Fig. 6). Automatic water control is desirable. Balance pipes to maintain equal pressures must be liberal in size as shown in the following table.

Boiler Rating Millions Btu/h	Balance Pipe Dia, inches
2.5	3
5	3 1/2
10	4
15	5
20	6
30	8

Valves should be used in connections to individual boilers when more than one boiler is required as in power plant practice.

Natural or forced circulation may be used to produce internal boiler flow. Internal baffles or distribution pipes are arranged to prevent stratification and promote circulation in the boilers. Arrangements for this purpose vary with the

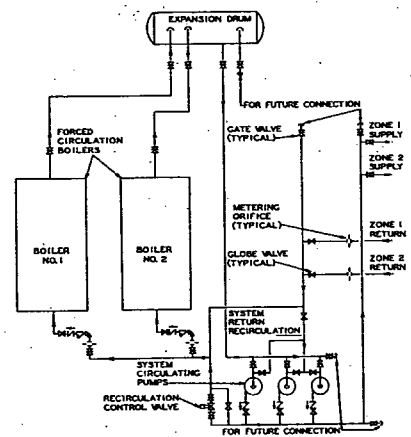


Fig. 7... High-Temperature Water Piping for Combined Pump System

High-Temperature Water Systems

various designs. In natural circulation, convection currents and the system circulating pump circulate the water through the boiler. Fig. 7 shows the piping arrangement for the system which is also known as the combined pump system. This method should be used only with boilers having a comparatively low pumping head loss.

In forced circulation boilers a circulating pump takes the water from the steam drum and discharges it back into the boiler, the proper water path being obtained by suitable boiler design. This is referred to as the separate pump system because the boiler circulating pump is separate from the distribution system pumps. One pump is normally used for each boiler to draw water from the expansion drum, circulate it through the boiler and return it to the expansion drum (Fig. 8). The system circulating pumps draw water from the expansion drum and circulate it through the distribution system only. The system return is connected to the suction side of boiler circulating pumps or to the expansion drum. This method permits the use of boilers with either high or low head loss.

With steam pressurizing, the water line must be held within proper limits to always provide a water seal at the entrance to the supply flow pipe. Otherwise, flashing or steam bubbling could occur in the supply pipe as the water level rises and falls.

Boiler Controls

Some of the automatic controls indicated in Fig. 4 and extensively used for operating boiler plants are:

1. Automatic combustion and safety control: control of fuel and combustion with flow changes.
2. Water level control: control of make-up and shutdown on low water.
3. Safety valve (steam), automatic relief valve (hot water):

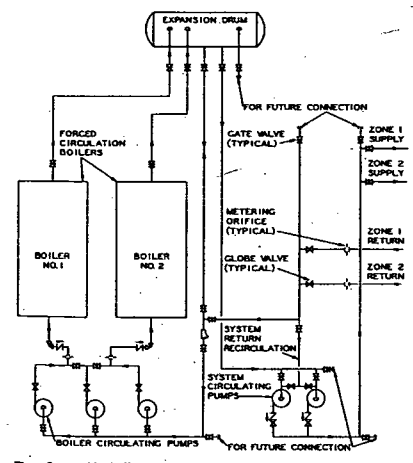
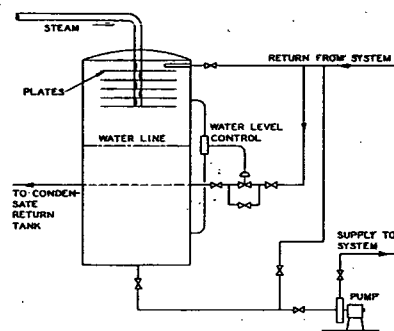


Fig. 8... High-Temperature Water Piping for Separate Pump System



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Fig. 9... Direct Contact Heater for Generating High-Temperature Water

on large water systems small additional relief valves should be provided to relieve minor excess pressures.

On installations large enough for high-temperature water heating to be economic, automatic control is usually a worthwhile investment. When package type boilers are used, automatic combustion control and water level control are usually components of the boiler package.

Direct-Contact Heaters and Auxiliary Heat Exchangers

High-temperature water may be obtained from direct-contact heaters in which steam from turbine exhaust, extractors, or steam boilers is mixed with return water from the system (see Fig. 9). The mixture takes place in the upper part of the heater where the water cascading from horizontal baffles comes in direct contact with steam.

The steam in the upper part of the heater serves as the steam cushion for pressurizing the system. The lower part of the heater serves as the expansion tank for the system.

Where the water heater and the boiler operate under the same pressure, the surplus water is usually returned to the boiler through a pipeline connecting the outlet of the high-temperature water circulating pump to the boiler. This

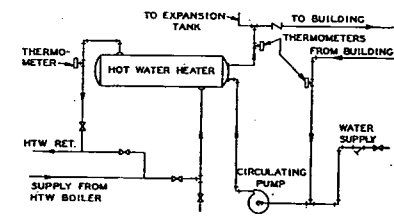


Fig. 10... High-Temperature Heat Exchanger Heating Water for Low-Temperature Heating System