probably be adopted in the average practice, but a 1000-gal tank with a heating capacity of 1000 gal per hour should suffice.

In apartment house work it is customary to allow a heating capacity of 10 gal per hour for each apartment with but one bath, and 15 gal per hour for those with two bath rooms. In the case of Fig. 3 with 36 apartments this calls for a heating capacity of 360 gal per hour although the storage might be made greater. Some designers prefer a greater storage but this is a matter of choice. Using the fixture method for Fig. 3 the heating capacity would be:

$$7.4 \times 36 \text{ apts} \times 5 \text{ gal} \times \left(\frac{224}{36+2} + 10\right) \text{ per cent} \times 2 = 426 \text{ gal}$$

In the case of one and two family houses where the demand may sometimes approach 100 per cent, the old rule of allowing a hot water storage of 30 gal and a heating capacity of 10 gal per hour per family is still a good practical one.

HOT WATER TEMPERATURE

There is usually no necessity of maintaining the domestic hot water temperature above 140 F when used only for bath or manual cleansing operations. A water temperature of 105 F makes a hot bath and while the hands may be plunged into water with a temperature of 120 F, a sustained immersion would be impossible. Mechanical dish washers and laundry machines, however, need a temperature higher than 140 F, and when such equipment is to be supplied in conjunction with hot water for personal use it is advisable to employ two separate tanks. Thermostatic regulating control should be used wherever possible.

ADDITIONAL BOILER CAPACITY

If the burden of the hot water requirement is added to the house heating boiler care must be taken to make certain that the capacity of the boiler is sufficient to meet the increased demand. To heat one gallon of water 120 deg requires about 1000 Btu which is approximately equal to 4 sq ft of equivalent heating surface (240 Btu per square foot). If the maximum hourly demand is heated in one hour, the capacity of the boiler or heater should be increased by 4 sq ft (+) for each gallon heated. If sufficient storage capacity is provided, the additional boiler capacity required is correspondingly reduced.

In houses with chimney heights of approximately 40 ft it is unsafe to expect that more than 5 lb of coal can be burned per hour on one square foot of grate. Allowing 8000 Btu available per pound of coal gives 40,000 Btu per square foot of grate. One square foot of grate surface may therefore be allowed for each 40 gal of water to be heated. This does not mean for each 40 gal of storage but for each 40 gal of hourly demand. In the higher type of buildings where the hourly coal consumption in the heating boiler may be much greater than 5 lb of coal per hour the grate area may be correspondingly reduced.

Chapter 14

HEATING BOILERS

Classification; Furnace Design; Heating Surface; Boiler Output; Equivalent Evaporation; Efficiency; Testing; Rating; Selection of Boilers; Pipe Connections; Smoke Breeching and Chimney Connections; Preparing Boilers for Service; Water Line in Steam Boilers; Water Gage Glass Fittings and Cocks; Correcting Unsatisfactory Operation; Protection of Boilers; Cleaning Boilers.

OF the various types and grades of boilers available, experience shows that most of them are capable of practically the same evaporation per pound of fuel, provided they are designed with the same proportions of heating and grate surface and are operated under similar conditions. They differ, however, with respect to space occupied, weight, capacity, first cost, and adaptability to particular conditions of operation and location.

As affecting fuel economy the boiler equipment is one of the most important parts of the heating system. It matters little how elaborate, modern, or well designed the boiler may be, skill, good judgment, and continued vigilance are required on the part of the operator to secure the best efficiency.

CLASSIFICATION

Boilers for steam and hot water heating systems are of two general types, namely (1) cast-iron sectional boilers, and (2) steel boilers of the fire-tube or water-tube type.

Cast-Iron Boilers

Cast-iron boilers may be of round pattern with circular grate and horizontal *pancake* sections joined by push nipples and tie rods, or of rectangular pattern with vertical sections. The latter type may be either of outside header construction where each section is independent of the other and water and steam connections are made through these headers, or assembled with push nipples and tie rods.

Cast-iron boilers usually are shipped knocked down to facilitate handling at place of installation where assembly is made. Generally they fit into small spaces, have a low water line and are low in first cost. In most cases they are limited to working pressures of 15 lb for steam and 30 lb for hot water. Special types are built for hot water supply which will withstand higher local water pressures.