1000 Btu per pound are required. There is a trend in present practice toward heating the water in addition to heating the air. Equipment for doing this may make use of sprays, or it may take the form of water circulating coils placed within the combustion chamber and connected by pipes to the humidifier pans where a constant water level is maintained by some separate float device.

Sprays are usually controlled by solenoid valves wired in parallel with the fan motor. The water supply may, in turn, be controlled by a humidity-controlling device located in one of the living rooms, so that the washer will operate at all times when the fan is in operation, unless the relative humidity should rise beyond a desirable percentage. Sprays used in connection with commercial or heavy duty plants should be a regulation type of commercial spray. In all cases provision must be made to flush out accumulation of lime and dirt.

REFERENCES

1—See A.S.H.V.E. TRANSACTIONS, Vol. 35, 1929, pp. 322 and 332.

2—See A.S.H.V.E. TRANSACTIONS, Vol. 36, 1930, p. 42.

3—See A.S.H.V.E. TRANSACTIONS, Vol. 37, 1931, p. 23.

4—See A.S.H.V.E. TRANSACTIONS, Vol. 44, 1938, p. 366.

5—*I = B = R* Testing and Rating Code for Low Pressure Heating Boilers (*Institute of Boiler and Radiator Manufacturers*).

6—*I = B = R* Ratings for Cast-Iron Boilers (*Institute of Boiler and Radiator Manufacturers*).

7—Engineering Standards, Part II, Net Square Feet Radiation Loads in 70 Deg Fahr., Recommended for Low Pressure Heating Boilers, 1943 (*Heating, Piping and Air Conditioning Contractors National Association*).

8—Comfort Heating, 1938, pp. 35 to 39 (*American Gas Association*).

9—For definition of Heating Surfaces and Ratings of Wood-Burning Furnaces see Gravity Code and Manual for the Design and Installation of Gravity Warm Air Heating Systems, (*National Warm Air Heating and Air Conditioning Association*).

10—Recommended forms for municipal installation and fire codes are included in Volume 7—Code and Manual for the Design and Installation of Warm Air Winter Air Conditioning Systems (*National Warm Air Heating and Air Conditioning Association*).

Chapter 19

CHIMNEYS AND DRAFT CALCULATIONS

Theoretical and Available Draft, Determining Chimney Sizes, Factors Affecting Required Draft, Domestic Chimneys, Observed Test Performance, Draft Requirements of Domestic Appliances, Chimneys for Gas Heating, Construction Details, General Considerations

A DRAFT, in the older sense, is a current of air and the draft of a furnace or boiler is that air current which flows through the fire-box and furnishes the oxygen for combustion. In engineering, however, the word *draft* has come to mean that pressure difference which causes this air current to flow and the word will be used in this sense in this chapter.

Draft is usually measured in inches of water and it is proper to speak of the draft in the fire-box or in the smoke breeching, etc., meaning the difference in pressure between the gases within and the air without those parts of a system. Draft is called positive when the pressure within such a part is less than that outside.

Draft is classified as natural and mechanical, depending on whether it is produced by a chimney or by a blower, and mechanical draft is further classified as induced or forced, depending on whether the air is drawn through or forced through the combustion chamber.

Chimneys can serve both to create a draft and to dispose of combustion products at a desirable height. For the latter purpose, chimneys, stacks, or, in the case of ships, funnels, are used in conjunction with mechanical-draft systems.

THEORETICAL DRAFT

If the air in one of two equal chimneys is heated while that in the other is not, the air in the heated chimney will be less heavy than that in the other chimney and a manometer or other pressure gage connecting the two at the bottom will indicate a pressure difference, called natural draft. The pressure of the air at the tops of the two chimneys will be equal, so that the pressure difference between them at the bottom will depend only on their height and the difference in density of the air they contain. The density of the air in either chimney is inversely proportional to its absolute temperature, so that the difference in pressure between them at the bottom will be proportional to their height and to the difference between the reciprocals of the absolute temperatures within them.

The pressure at the bottom of an unheated (and uncooled) chimney will be the same as that of the air outside, so that the unheated chimney can be dropped from the foregoing illustration. The manometer reading will be the same if its free connection is left open to the atmosphere.

These considerations in conjunction with those of barometric pressure and the difference in density of flue gases from that of air lead to the following formula:

$$D_t = 2.96\, HB_o \left(\frac{W_o}{T_o} - \frac{W_c}{T_c} \right) \qquad (1)$$

where

H = height of chimney, feet.
B_o = existing barometric pressure, inches of mercury.
W_o = density of air at 0 F and 1 atmosphere pressure, pounds per cubic foot.
W_c = density of flue gas at 0 F and 1 atmosphere pressure, pounds per cubic foot.