Radiant heaters are required to have a radiant efficiency of not less than 28 per cent.

Design Considerations

Some factors important in the design of gas heaters are:

1. Proper design of the burner head, port sizes and locations so that the flame will not lift, float, or flash back, and be excessively noisy in operation.
2. Proper venting of combustion chamber for relief of forces resulting from ignition of an explosive mixture of gas and air.
3. Protection of valve handles to prevent excessive temperature rise during operation.
4. Insulation and baffling of heater to prevent over-heating of walls and floor.

INSTALLATION OF SPACE HEATERS

The two most important considerations involved in the installation of a space heater are safety and chimney draft. The items of chimney details and flue connections which should have special attention, are outlined in Chapter 16, Chimneys and Draft Calculations. In all cases, it is recommended that installation be made in accordance with the current National Building Code.

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] Gravity Code and Manual for the Design and Installation of Gravity Warm Air Heating Systems, Section No. 5, Second Edition, Jan. 1945, (*National Warm Air Heating and Air Conditioning Association*).

[10] Recommended forms for municipal installation and fire codes are included in Manual 7—Code and Manual for the Design and Installation of Warm Air Winter Air Conditioning Systems, Second Edition, 1947, (*National Warm Air Heating and Air Conditioning Association*).

[11] The Development of a Design of Smokeless Stove for Bituminous Coal, by B. A. Landry and R. A. Sherman, presented at the 1948 Annual Meeting of the *ASME*.

[12] American Standard Approval Requirements for Gas Space Heaters, ASA Z21.11, 1942 (*American Standards Association*).

[13] American Standard Listing Requirements for: Automatic Pilots, Z21.20, 1940, Gas Appliance Thermostats Z21.23, 1940, Domestic Gas Appliance Regulators, Z21.18, 1934, Automatic Main Gas-Control Valves, Z21.22, 1935, (*American Standards Association*).

CHAPTER 16

CHIMNEYS AND DRAFT CALCULATIONS

Theoretical Draft; Factors Affecting Required Draft; Industrial Chimneys, Available Draft, Determining Chimney Size; Domestic Chimneys, Available Draft, Determining Chimney Size; Performance of Various Types of Domestic Chimneys, Draft Requirements of Domestic Appliances, Chimneys for Gas Heating, Recommendations of the National Board of Fire Underwriters, General Considerations

A DRAFT to the layman, is a current of air, and the draft of a furnace or boiler is the current of air which flows through the firebox and furnishes the oxygen for combustion. To the engineer, however, the word *draft* has come to mean the pressure difference which causes this current of air to flow.

The engineering concept of draft will be used in this chapter; hence, *draft* will be defined as a negative differential pressure, constituting the absolute pressure at some point in the flue, less the absolute atmospheric pressure. The opposite of draft will be called *positive pressure* and will be defined as a positive differential pressure.

Draft is usually measured in inches of water. It is most commonly measured at the thimble, where the breeching enters the chimney proper, although it may be measured in the firebox, the smoke breeching, the base of the chimney, or elsewhere, depending upon the type of chimney installation.

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

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 lighter 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. As the density of the air in either chimney is inversely proportional to its absolute temperature, 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.

As the pressure at the bottom of an unheated (and uncooled) chimney will be the same as that of the air outside, 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:

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