Owner's Room, 2nd floor:

15,030 ÷ 167 = 90 sq in. leader area. See Summary Table; also Example under Standard Code,[3] Art. 3, Basis of working rules for pipes.

Leader diameter = 11.4, say 12 in.

Stack area = 0.7 × 90 = 63 sq in. = say 5 × 12 in.

Register area = 90 sq in. net area. Gross area = net area ÷ 0.7 = 12 × 12 or 12 × 14 in.

In like manner the leaders, stacks and registers are calculated for each room in the house.

Leaders, Stacks and Registers. (Code[3] Method. See Art. 3, Sec. 1, 2, 3.)

Living Room (Glass = 90, Net wall = 405, Cubic contents = 2405)

$$\text{Leader} = \left(\frac{90}{12} + \frac{405}{60} + \frac{2405}{800}\right) 9 = 155 \text{ sq in.}$$

Register, same as Direct Method.

Owner's Room (Glass = 68, Net wall = 394, Cubic contents = 2275)

$$\text{Leader} = \left(\frac{68}{12} + \frac{394}{60} + \frac{2275}{800}\right) 6 = 90 \text{ sq in.}$$

Stack and Register, same as Direct Method.

Assuming all air recirculated, the minimum furnace for the plant will be:

Grate Area = 0.0034 × 132,370 = 450 sq in. = 24 in. diam. at 175 F. register temperature. (7)

Grate Area = 0.0040 × 132,370 = 530 sq in. = 26 in. diam. at 160 F. register temperature. (8) (10)

If provision shall be made for certain outside air circulation, then increase the building heat loss by, say 25 per cent and obtain by equation 7 a 27-in. grate and by equations 8 and 10 a 29-in. grate.

FORCED OR BOOSTER CIRCULATION

Experiments at the University of Illinois[4] have shown that the capacity of a furnace may be increased nearly three times by an adequate fan, with a constant register or delivery temperature maintained, *provided that the rate of fuel consumption can be increased to provide the necessary heat.* In other words, the capacity of a forced circulation system *is limited by the ability of the chimney to produce a sufficient draft.*

Booster fans often may be arranged to operate when the gas and oil burners operate and to stop automatically when the burners shut down. The booster equipment is most effective in increasing output at low operating temperatures. According to tests, efficiencies may be advanced from 60 per cent for gravity to 70 per cent with boosters at low operating temperatures, but at high operating temperatures gravity and booster efficiencies are almost identical.[5] (See Chapter 31).

[4]See University of Ill. Eng. Exp. Sta. Bul. 120, p. 129.
[5]See Univ. of Ill. Eng. Exp. Sta. Bul. 141, p. 79.

Chapter 6

RADIATORS

Types of Radiators; Output of Radiators; Weights and Volumes of Radiators; Heating up the Unit; Location and Selection.

AN exposed heating unit placed in the room or space to be heated is termed a *radiator.* If it is placed in an enclosure located within, adjacent to, or exterior to a room or space to be heated, it is usually termed a *convector.* (See Chapter 7). A shielded heating unit located within the space to be heated may also be termed a *convector.*

All heating units emit heat by *radiation* and *conduction.* The percentage of heat emitted by each of these two processes depends upon whether or not the heating unit is exposed or enclosed, and upon the contour and surface characteristics of the material. The heat emission also depends upon the difference in temperature between the heating medium in the unit and the surrounding air. An exposed heating unit (radiator) emits less than half of its heat by radiation depending upon the size and number of sections. The balance of the emission is by conduction to the air in contact with the heating surface and the resulting circulation of the air thus warmed is known as *convection.*

TYPES OF RADIATORS

Radiators may be classified as tubular, wall, window and pipe coil. The column-type radiator is no longer listed by manufacturers in the United States. Radiators are made of cast or sheet ferrous and of sheet non-ferrous metals and of pipe or tubing.

Tubular-Type Radiators

The new tubular radiators are similar to the old column type radiators but have smaller columns, they are lighter and have less internal volume and more air space around the columns. They are more attractive in appearance since they do not look so ponderous as the column type which they have supplanted.

Wall Radiators

The wall-type radiator has been developed in recent years until it is now as efficient as the pipe-coil radiator and is much easier to handle because it is made up in unit sections of approximately 5, 7 or 9 sq ft (equivalent) in area, each of which may be assembled by screw or push nipples to secure a single radiator of any desired amount of surface. The space occupied by wall-type heating units is 30 to 60 per cent less than