The heated air then rises through vertical flues, due to its diminished density, and flows into the rooms above under the influence of gravity only. The temperature and volume of the air entering at the register must be great enough so that in cooling from the initial temperature to the room temperature the heat available will just equal the heat loss during the same time. It is not only necessary to provide ducts for supplying air to each room heated, but in order to establish and maintain a constant flow, provision must be made for positively removing the air in

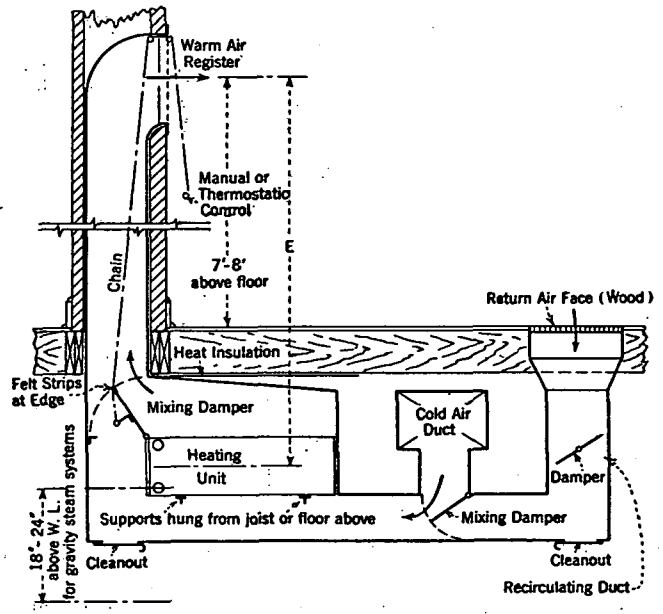

FIG. 9. GRAVITY-INDIRECT HEATING SYSTEM[6]

the room, after it has cooled to the desired room temperature, by a system of vent flues or ducts which take air at or near the floor line.

This system is very similar in principle to the ordinary gravity warm-air furnace system, except that it uses steam or hot water as the heating medium instead of hot furnace gases. It differs from the central fan system in that no fan or blower is used to force the air through the system, as the air flow is maintained entirely by gravity or natural draft conditions. Since this gravity head is very slight, it is necessary to make all ducts as short as possible, especially the runs from the heating units to the base of the vertical hot-air flues. In cases where ventilation is a requirement the air volume required for this purpose may become so large that the entering air temperature will be but slightly above the room temperature.

[6]See Mechanical Equipment of Buildings, by Harding and Willard, Vol. I, second edition, 1929.

Chapter 8

HOT WATER HEATING SYSTEMS AND PIPE SIZES

Heating Units; Piping Arrangements; Pipe Sizes; Forced Circulation System; Pipe Size Tables; Modulating Valves and Orifices; Permissible Variations in Pipe Sizes; Gravity Circulation; Expansion Tanks; Circulating Pumps; Piping Details; General Details.

HOT water heating systems may be divided into two general types, *forced circulation* and *gravity circulation* systems. In forced circulation systems the pressure heads maintaining flow are produced by pumps; in gravity circulation systems they are produced by the differences in weight of the water in the flow and return risers.

In designing a hot water heating system, it is necessary to determine:

1. The heat losses of the rooms or spaces to be heated. (See Chapter 2).
2. The size and type of heater. (See Chapters 14 and 20).
3. The location, type, and size of heating units. (See Chapters 6 and 7).
4. The type and size of piping.
5. The type and size of circulating pump (if forced circulation).
6. The type and size of expansion tank.
7. Piping details.

HEATING UNITS

Information relating to heating units may be found in Chapter 6, Radiators; and Chapter 7, Gravity Convectors. For steam radiators it is customary to use the *equivalent square foot* of heating surface which is the emission of 240 Btu per hour when the radiator is placed in air at 70 F, and filled with steam at 215 F, as explained in Chapter 6. This 240-Btu unit is also applicable to hot water heating when the average water temperature in the radiators is 215 F and the temperature of the surrounding air is 70 F.

Factors for obtaining the heat emission for mean temperatures other than 215 F are given in Table 3, Chapter 6. It would be well to abandon, as soon as practicable, the use of the *equivalent square foot* in hot water heating calculations and to base all calculations on units of 1000 Btu, and, having done that, to find from data supplied by manufacturers, the size radiators or convectors to be selected for the required number of 1000 Btu and for the average water temperature which is to exist in the radiators or convectors.

PIPING ARRANGEMENTS

Pipe systems may be divided into two general types, namely, *two-pipe* and *one-pipe* systems. In a two-pipe system the piping is arranged so that