

tubes may be expanded into the holes through the fins. In addition a metallic bonding agent is sometimes used to insure permanent contact.

10 • What is the procedure in selecting a convector when the required amount of radiation is known?

First the limiting factor or factors of the enclosure must be determined so the available size of the wall recess can be found. Manufacturers' catalogs show capacities of convectors of each standard length and depth with varying enclosure heights. From these capacity tables, the proper convector of the required capacity can be selected for the available wall recess. If all three dimensions of the wall recess are insufficient to accommodate a convector of the required capacity, the available height and length can be maintained, but greater depth can be obtained by using a partially recessed enclosure.

11 • Given a room to be heated to 80 F with outside temperature at zero F. Assume the heat loss under these conditions to be 10,000 Btu per hour. Determine the size of the steam radiator to be installed.

A square foot of radiation is equivalent to a heat emission of 240 Btu per hour under standard conditions of steam at one pound gage pressure (215 F) and surrounding air at 70 F. With surrounding air at 80 F, the heat emission from a radiator will be less. Under these conditions, the heat emission will not be 240 Btu per square foot of catalog rating per hour, but 240  $C_s$ .

$$C_s = \frac{(t_s - t_r)^{1.25}}{(215 - 70)} = \frac{(215 - 80)^{1.25}}{(215 - 70)} = 0.912,$$

and  $240 C_s = 240 \times 0.912 = 218.5$  Btu. Therefore, the size of the radiator to be selected shall have a catalog rating of 10,000 divided by 218.5 or 45.8 sq ft.

## Chapter 31

# STEAM HEATING SYSTEMS

*Gravity and Mechanical Return, Gravity One-Pipe Air-Vent System, Gravity Two-Pipe Air-Vent System, One-Pipe Vapor System, Two-Pipe Vapor System, Atmospheric System, Vacuum System, Sub-Atmospheric System, Orifice System, Zone Control, Condensation Return Pumps, Vacuum Pumps, Traps*

THE essential features of the common type of steam heating systems are described in this chapter. They may be classified according to the piping arrangement, the accessories used, the method of returning the condensate to the boiler, the method of expelling air from the system, or the type of control employed. Information concerning the design and layout of steam heating systems will be found in Chapter 32.

## GRAVITY AND MECHANICAL RETURN

In *gravity systems* the condensate is returned to the boiler by gravity due to the static head of water in the return mains. The elevation of the boiler water line must consequently be sufficiently below the lowest heating units and steam main and dry return mains to permit the return of condensate by gravity. The *water line difference*<sup>1</sup> must be sufficient to overcome the maximum pressure drop in the system and, when radiator and drip traps are used as in two-pipe vapor systems, the operating pressure of the boiler. This applies only to closed circuit systems, where the condensation is returned to the boiler. If the condensation is wasted, no water line difference is required.

In *mechanical systems* the condensate flows to a receiver and is then forced into the boiler against the boiler pressure. The lowest parts of the supply side of the system must be kept sufficiently above the water line of the receiver to insure adequate drainage of water from the system, but the relative elevation of the boiler water line is unimportant in such cases except that the head on the pump or trap discharge becomes greater as the height of the boiler water line above the trap or pump increases.

There are three general types of mechanical returns in common use, namely, (1) the mechanical return trap, (2) the condensation return pump, and (3) the vacuum return pump. Further information on pumps and traps will be presented later in this chapter.

## GRAVITY ONE-PIPE AIR-VENT SYSTEM

In the gravity one-pipe air-vent system each radiator has but a single connection through which steam must enter and condensation must

<sup>1</sup>The *water line difference* is the distance between the water line of the boiler and the low point of the water in the dry return main.