

trated in Fig. 6, are not to be generally recommended for hot water systems unless the water temperature can be maintained at a reasonably high temperature and rapid circulation of the water can be obtained.

PROBLEMS IN PRACTICE

1 ● What are the principal differences between a radiator and a convector?

A radiator is commonly thought of as a commercial heating unit having a maximum amount of direct heating surface, whereas a convector is a heating device in which the extended or secondary surface may be several times that of the prime surface and which is specially designed to utilize to the fullest extent the convection principal of heating. The radiator ordinarily has vertical tubular chambers for the heating medium but most convectors have horizontal tubular chambers to which fins are attached so as to form vertical flues for the passage of air. While radiators are either exposed, enclosed, or shielded, convectors are concealed by means of a tight-fitting enclosure. Radiators are commonly made of cast-iron but convectors may be made of a combination of metals, such as copper and brass, or copper and aluminum, as well as entirely of cast-iron.

2 ● How did the term heating effect come into use?

It has been found that a room requiring a radiator of a certain determined capacity could under certain conditions be properly heated, with less temperature gradient between floor and ceiling and with less steam condensation, by the same radiator or by one of a different design having the same commercially rated capacity. This resulted in the use of the term *heating effect* to apply to the useful heat output of a radiator, in the comfort zone of a room, as related to the total input to the radiator.

3 ● On what basis are the capacities of convectors published?

Published ratings of convectors are expressed in equivalent square feet of direct cast-iron radiation. Some manufacturers have increased their ratings by as much as 30 per cent to allow for a supposed improved heating effect. Tests indicate that the credit to be given heating effect is, in all cases, probably less than 10 per cent, and in many cases negligible.

4 ● How are fins of convectors attached to the tubes or prime surface?

Tubes or a solid core may be forced through piercings in the fins under pressure, or the tubes may be expanded into the holes through the fins. In addition a metallic bonding agent is sometimes used to insure permanent contact.

5 ● 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.

6 ● Given a room to be heated to 80 F with outside temperature at 0 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_a .

$$C_a = \left(\frac{t_a - t_r}{215 - 70} \right)^{1.3} = \left(\frac{215 - 80}{215 - 70} \right)^{1.3} = 0.912,$$

and $240 C_a = 240 \times 0.912 = 218.5$ 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 15

STEAM HEATING SYSTEMS

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

THE essential features of the common types of steam heating systems are described in this chapter together with some of the characteristics which influence their successful design and operation. The combination of equipment and piping by which steam is used for space heating, or to warm air for use in ventilating or air conditioning, is known as a steam heating system. They may be classified according to (a) the piping arrangement, (b) the service performed, such as the *split system* where direct radiators are used for space heating and the heat exchanging units are only used for central fan ventilating or air conditioning, (c) the accessories used, (d) the method of returning the condensate to the boiler, (e) the method of expelling air from the system, or (f) the type of control employed. The above classifications are used both where a boiler is included in the system and where the steam supply is from a district heating system.

After the selection of the most suitable type of steam heating system is made on the basis of its operating characteristics, the design of the system should be considered under four headings, namely, (1) determination of load and selection of heating units, (2) the arrangement of the general piping scheme, (3) the sizing of the piping, and (4) the details of connections. Specific information concerning the design and layout of steam heating systems will be found in Chapter 16.

GRAVITY AND MECHANICAL RETURN

When systems are classified according to the method of returning the condensate from the system to the boiler they are known as *gravity* or *mechanical* systems. In *gravity systems* the condensate is returned to the boiler by gravity due to the static head of water in the vertical portion of the return pipes or mains. The elevation of the boiler water line must be sufficiently below the lowest heating unit, steam pipe or dry return pipe to permit the return by gravity. The *water line difference* forming the *static head* must be sufficient to overcome the maximum pressure drop in the system, including the pressure drop due to the condensing effect of the radiation. When radiator and drip traps are used, as in two-pipe vapor