usual coils for comfort installations, this does not occur unless the evaporating temperature at the coil outlet is about 20 to 25 F. The exact value depends on the design of the coil and the amount of loading. Although it is not customary to choose coil and condensing units to balance at low temperatures at peak loads, there is danger of this occurring when the load decreases. This is further aggravated if a by-pass is used so that less air is passed through the coil at light loads. It may be even worse if the control is arranged for decrease of inside temperature with fall of that outside. Freezing can be avoided by making the full load balance a high evaporating temperature and checking the balance at the minimum load.

Care should be exercised in the design of humidity control to minimize the cycling of the refrigerating compressor because of re-evaporation of moisture from the fins. It is sometimes necessary to by-pass air around a coil when the compressor is not operating.

REFERENCES

1—A.S.H.V.E. Code for Testing Radiators (A.S.H.V.E. TRANSACTIONS, Vol. 33, 1927, p. 18).

2—A.S.H.V.E. Standard Code for Testing and Rating Concealed Gravity Type Radiation (Steam), (A.S.H.V.E. TRANSACTIONS, Vol. 37, 1931, p. 367); (Hot Water), (A.S.H.V.E. TRANSACTIONS, Vol. 39, 1933, p. 237). (See also A.S.H.V.E. TRANSACTIONS, Vol. 41, 1935, p. 38, and Vol. 42, 1936, p. 29).

3—A.S.H.V.E. RESEARCH REPORT No. 998—Factors Affecting the Heat Output of Convectors, by A. P. Kratz, M. K. Fahnestock, and E. L. Broderick (A.S.H.V.E. TRANSACTIONS, Vol. 40, 1934, p. 443).

4—Factors Influencing the Heat Output of Radiators, by A. C. Davis, W. M. Sawdon and David Dropkin (A.S.H.V.E. TRANSACTIONS, Vol. 42, 1942, p. 185) and Cornell University, *Engineering Experiment Station Bulletin* No. 29, April, 1942.

5—Heat Emission from Radiators, by K. F. Rubert (Cornell University, *Engineering Experiment Station Bulletin* No. 24, 1937).

6—Comparative Tests of Radiator Finishes, by W. H. Severns (A.S.H.V.E. TRANSACTIONS, Vol. 33, 1927, p. 41).

7—Heat Loss from Direct Radiation, by J. R. Allen (A.S.H.V.E. TRANSACTIONS, Vol. 26, 1920, p. 11).

8—Heat Output of Concealed Radiators, by E. A. Allcut (University of Toronto, *School of Engineering, Research Bulletin* No. 140, 1933).

9—The Heating Effect of Radiators, by Charles Brabbée (A.S.H.V.E. TRANSACTIONS, Vol. 33, 1927, p. 33).

10—University of Illinois, *Engineering Experiment Station Bulletins* Nos. 192 and 223, and Investigation of Heating Rooms with Direct Steam Radiators Equipped with Enclosures and Shields, by A. C. Willard, A. P. Kratz, M. K. Fahnestock and S. Konzo (A.S.H.V.E. TRANSACTIONS, Vol. 35, 1929, p. 77).

11—A.S.H.V.E. RESEARCH REPORT No. 962—The Application of the Eupatheoscope for Measuring the Performance of Direct Radiators and Convectors in Terms of Equivalent Temperature, by A. C. Willard, A. P. Kratz and M. K. Fahnestock (A.S.H.V.E. TRANSACTIONS, Vol. 39, 1933, p. 303).

12—The Kata Thermometer—Its Value and Defects, by W. J. McConnell and C. P. Yaglogiou. (Reprint No. 953 from *U. S. Public Health Service Report*, pp. 2293-2337, September 5, 1924).

13—The Thermo-Integrator—A New Instrument for the Observation of Thermal Interchanges, by C.-E. A. Winslow and Leonard Greenburg (A.S.H.V.E. TRANSACTIONS, Vol. 41, 1935, p. 149).

14—The Calibration of the Thermo-Integrator, by C.-E. A. Winslow, A. P. Gagge, Leonard Greenburg I. M. Moriyama and E. J. Rodee. (*The American Journal of Hygiene*, Vol. 22, No. 1, July, 1935, pp. 137-156)

15—The Globe Thermometer in Studies of Heating and Ventilation, by T. Bedford and C. G. Warner. (*The Journal of Hygiene*, Vol. 34, No. 4).

16—A.S.H.V.E. RESEARCH REPORT No. 1067—The Cooling and Heating Rates of a Room with Different Types of Steam Radiators and Convectors, by A. P. Kratz, M. K. Fahnestock and E. L. Broderick (A.S.H.V.E. TRANSACTIONS, Vol. 43, 1937, p. 389).

17—University of Illinois, *Engineering Experiment Station Bulletin* No. 230, p. 20.

18—Reheating by Means of Refrigerant Compressor Discharge Gas, by S. F. Nicoll (A.S.H.V.E. TRANSACTIONS, Vol. 47, 1941, p. 239).

Chapter 26

UNIT HEATERS, UNIT VENTILATORS, UNIT HUMIDIFIERS

Definitions; Unit Heaters: Classification, Application, Outlet Velocities, Ratings for Various Types, Temperature, Automatic Control, Location, Piping Connections; Boiler Capacity for Steam Unit Heaters; Unit Ventilators: Ratings, Applications, Location, Exhaust Vents; Window Ventilators; Unit Humidifiers

DESCRIPTIONS of heating, cooling, ventilating, humidifying, and dehumidifying systems are given in other chapters. This chapter deals with unit heaters, unit ventilators, and unit humidifiers. Cooling units, unit air conditioners, and attic fans are described in Chapter 36.

Definitions

The generally accepted meaning of the word *unit* in the terms unit heaters, unit ventilators, and unit humidifiers is that of a factory made, encased assembly of the functional elements indicated by its name. Such units can be shipped complete or in sections so that the only field work necessary is the assembling of the sections, providing proper supports and connecting the unit to sources of heat (or fuel), power and water supply, and, if necessary, to vent pipes for combustion gases.

The term *unit heater* denotes an assembly of elements whose principal function is heating. The essential elements of a unit heater are a fan and motor, a heater, a housing, and outlet vanes or diffusers.

The term *unit ventilator* denotes an assembly whose principal function is to ventilate. It may serve to circulate air within the space, or to introduce air from without the space, or may accomplish both purposes. The essential elements of a unit ventilator are a fan and motor, a heater, a set of dampers, a housing and outlet vanes or diffusers.

The term *unit humidifier* denotes an assembly of elements whose principal function is to humidify. The essential element of a unit humidifier is an atomizer or evaporator. To this may be added a fan, a heater, outlet vanes or diffusers, and a housing to enclose the various parts.

UNIT HEATERS

Classification

The various types of unit heaters which are at present available can usually be classified according to one of the three following methods:

1. *By type of heater.* Under this classification there are three types of heating elements to be considered: (*a*) *the steam or hot water type*, (*b*) *the electric type*, and (*c*) *the direct fired type* which may be *gas*, *oil*, or *coal fired*.

2. *By type of fan.* Under this classification there are two types of fans to be considered: (*a*) the *propeller type*[1] which may be equipped with a horizontal or vertical shaft, and (*b*) the *centrifugal type* which may be designed for *horizontal* or *vertical blow*.

3. *By arrangement of elements.* Under this classification there are two types of heaters to be considered: (*a*) the *draw-through type*, in which the