Insulating Effect of Successive Air Spaces Bounded by Bright Metallic Surfaces, by L. W. Schad (A.S.H.V.E. TRANSACTIONS, Vol. 37, 1931, p. 285).

Condensation of Moisture and Its Relation to Building Construction and Operation, by F. B. Rowley, A. B. Algren and C. E. Lund (A.S.H.V.E. TRANSACTIONS, Vol. 45, 1939, p. 231).

A Theory Covering the Transfer of Vapor Through Materials, by F. B. Rowley (A.S.H.V.E. TRANSACTIONS, Vol. 45, 1939, p. 545).

Thermal Conductivity of Wood, by J. D. MacLean (A.S.H.V.E. TRANSACTIONS, Vol. 47, 1941, p. 323).

The Specific Heat of Thermal Insulating Materials, by G. B. Wilkes and C. O Wood (A.S.H.V.E. TRANSACTIONS, Vol. 48, 1942, p. 493).

Heat Loss Studies in Four Identical Buildings to Determine the Effect of Insulation, by D. B. Anderson (A.S.H.V.E. TRANSACTIONS, Vol. 48, 1942, p. 471).

Simultaneous Heat and Vapor Transfer Characteristics of an Insulating Material, by F. G. Hechler, E. R. McLaughlin and E. R. Queer (A.S.H.V.E. Transactions, Vol. 48, 1942, p. 505).

Comparative Resistance to Vapor Transmission of Various Building Materials, by L. V. Teesdale (A.S.H.V.E. TRANSACTIONS, Vol. 49, 1943, p. 124).

The Diffusion of Water Vapor Through Various Building Materials, by J. D. Babbitt (*Canadian Journal of Research*, Vol. 17, February, 1939, p. 15).

Effect of Ceiling Insulation upon Summer Comfort, by T. D. Phillips (*National Bureau of Standards*, Report BMS52, July 1, 1940).

Moisture Condensation in Building Walls, by H. W. Wooley (*National Bureau of Standards*, Report BMS63, December 14, 1940).

Heat Transmission Through Building Materials, by F. B. Rowley and A. B. Algren (University of Minnesota *Engineering Experiment Station Bulletin* No. 8).

Building Insulation, by P. D. Close (*American Technical Society*, Chicago, 1945).

CHAPTER 7

PERFORMANCE OF AIR HEATING AND COOLING COILS

Performance of Heating and Dry Cooling Coils, Over-all Coefficient of Heat Transfer, Performance of Dehumidifying Coils, External Film Coefficient, Internal Film Coefficient, Determining Size of Cooling Coil

THE surfaces described in this chapter are for heating or cooling an air stream under the conditions of forced convection. Such surfaces may be made up of a number of banks of tubes assembled in the field or the entire assembly may be factory constructed. They may be made of either bare or finned tubing, but regardless of their construction they are generally referred to as *coils*. A description of the types, application, and selection of such coils is given in Chapter 25. Therefore, this chapter is confined to the theoretical considerations which affect the calculation of the performance of these coils.

HEATING AND DRY COOLING COILS

The performance of heating and dry cooling coils depends in general upon:

1. The over-all coefficient of heat transfer from the fluid within the coil to the air it heats or cools.
2. The mean temperature difference between the fluid within the coil and the air flowing over the coil.
3. The physical dimensions of the coil.

Thus, for any one definite operating condition, the heating or cooling capacity of a given coil is expressed by the following basic formula:

$$q_t = U \times (MTD) \times A \times N \qquad (1)$$

where

q_t = total heat transferred by the coil, Btu per (hour) (square foot of coil face area).

U = over-all coefficient of heat transfer, Btu per (hour) (square foot of external coil surface) (Fahrenheit degree temperature difference between the fluid within the coil and the air flowing over the coil).

MTD = mean temperature difference, Fahrenheit degrees, between the fluid within the coil and the air passing over it. (This is commonly taken as the logarithmic mean temperature difference.)

A = external surface area of the given coil, square feet per (square foot of coil face area) (row of coil depth).

N = number of rows of coil depth.

Over-all Coefficient of Heat Transfer

Of all factors affecting the performance of heating or dry cooling coils, the over-all coefficient of heat transfer is the most difficult to determine as