$$\frac{h_a A_1 N}{0.243 G_1} = \log_e \frac{t_1 - t_{dp1}}{t_2 - t_{dp2}} = \log_e \frac{102 - 80}{1.8} = \log_e 12.22 = 2.5$$

Then substituting values for h_a, A_1, and G_1, N may be found as follows:

$$\frac{10.7 \times 15N}{0.243 \times 1740} = 2.5 \text{ from which, } N = 6.58$$

(2) This establishes the maximum whole number of coil rows that can be used as 6 and it is now possible to determine the actual location of the exit air conditions from Equation 7 by solving for the actual value of $t_2 - t_{dp2}$ for a 6 row coil.

$$\frac{10.7 \times 15 \times 6}{0.243 \times 1740} = \log_e \frac{102 - 80}{t_1 - t_{dp2}} = 2.275$$

This establishes values of 9.78 for $\frac{t_1 - t_{dp1}}{t_2 - t_{dp2}} = R$ and 2.25 for $t_2 - t_{dp2}$.

(3) Next, the exit air condition at 57.3 F dry-bulb and 56 F wet-bulb as shown at B, is found by locating a point on the load ratio line at a horizontal distance of 2.25 dry-bulb degrees from the saturation curve.

(4) The surface temperature may now be found from Equation 7 which may also be written as:

$$t_s = \frac{Bt_2 - t_1}{B - 1}$$

where

$$B = \frac{t_1 - t_{dp1}}{t_2 - t_{dp2}}$$

$$t_s = \frac{9.78 \times 57.3 - 102}{8.78} = 52.3$$

(5) The total coil load may be calculated from the enthalpy difference across the coil and the air quantity using the weight of dry air instead of the weight of the mixture.

$$\begin{aligned} q_t &= G_a (h_1 - h_2) \\ &= 1700 (49.24 - 23.77) \\ &= 43{,}200 \text{ Btu per (hour) (square foot of face area)} \end{aligned}$$

where

G_a = Weight of dry air per (hour) (square foot of coil face area).
h_1 = enthalpy of air vapor mixture entering coil, Btu per pound of dry air.
h_2 = enthalpy of air vapor mixture leaving coil, Btu per pound of dry air.

(6) The refrigerant temperature may be found from Equation 9

$$\frac{43{,}200}{15 \times 6 \times \frac{325}{15}} = (t_s - t_r) = 22.1$$

Therefore, $t_r = (52.3 - 22.1) = 30.2$.

Thus a coil 6 rows deep operating at a refrigerant temperature of 30.2 F and a face velocity of 400 fpm is required and it will carry a total load of 43,200 Btu per (hour) (square foot of face area). The air conditions leaving the coil are too low for the conditions of the problem and therefore it is necessary to by-pass air at the entering condition to obtain the desired result of 80.5 F dry-bulb and 73 F wet-bulb.

Although the preceding solution is satisfactory, it may be more desirable in some cases to use a higher refrigerant temperature and employ reheat to obtain the desired load ratio. Such a solution is shown in Fig. 15. In this case the coil load ratio line intersects the saturation curve and therefore a coil of any depth may be selected.

If a coil depth of 6 rows is maintained, the exit air conditions for the coil are indicated at point B Fig. 15 as 72.3 F dry-bulb and 70.8 F wet-bulb and the surface temperature will be:

$$t_s = \frac{9.78 \times 72.3 - 102}{878} = 69.0$$

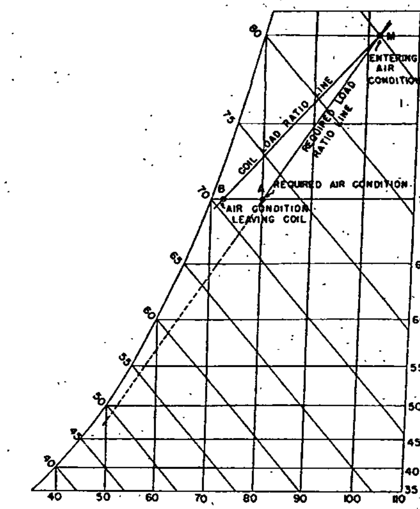

FIG. 15. PSYCHROMETRIC LAYOUT FOR COIL SELECTION

The coil load will be:

q_t = 1700 (49.24 − 34.66) = 24,800 Btu per (hour) (square foot of face area) and the refrigerant temperature will be found from Equation 9:

$$\frac{24{,}800}{15 \times 6 \times \frac{325}{15}} = (t_s - t_r) = 12.7$$

Therefore, $t_r = 69.0 - 12.7 = 56.3$.

Thus, for the case where reheat is used, a coil 6 rows deep operating at a refrigerant temperature of 56.3 F is required. The total coil load will be 24,800 Btu per (hour) (square foot of face area) but the actual effective load will be less by the amount of reheat required. Therefore, for a given load, a larger coil and more refrigerating capacity are required when reheat is used.

LETTER SYMBOLS USED IN CHAPTER

η = fin efficiency.
A = external area of coil, square feet per (square foot of coil face area) (row of coil depth).
$B = \frac{t_1 - t_{dp1}}{t_2 - t_{dp2}}$
D = internal diameter of tube, inches.
G = air mass velocity, pounds per (hour) (square foot of coil face area).
G_a = dry air mass velocity, pounds dry air per (hour) (square foot of coil face area).
h_1 = enthalpy of air-vapor mixture entering coil, Btu per pound of dry air.
h_2 = enthalpy of air-vapor mixture leaving coil, Btu per pound of dry air.
h_a = film coefficient of heat transfer between air and external coil surface, Btu per (hour) (square foot external surface) (Fahrenheit degree mean temperature difference between air and coil).