$$\frac{20.270 - h_3}{h_3 - 0.668} = \frac{0.003164 - W_3}{W_3 - 0.000630} = \frac{1}{4}$$

from which $h_3 = 16.350$ and $W_3 = 0.002657$. The enthalpy of the final mixture may also be expressed by Equation 28:

$$h_3 = h_a + \mu h_{as}$$

Since μ by definition is W_3/W_s, Equation 28 may be rewritten as

$$16.350 = h_a + (0.002657/W_s) \times h_{as}$$

At 56 F the right side of the equation is 16.332, and at 57 F it is 16.582. Interpolation gives as the final dry-bulb temperature of the mixture 56.07 F. At this temperature the humidity ratio at saturation is 0.00960 lb of water vapor per lb of dry air. Therefore, the final degree of saturation is

$$\mu = 0.002657/0.00960 = 0.277$$

Solution b. From the A.S.H.V.E. Chart. Equation 34 indicates that the state point of the resulting mixture lies on a straight line connecting the state points of

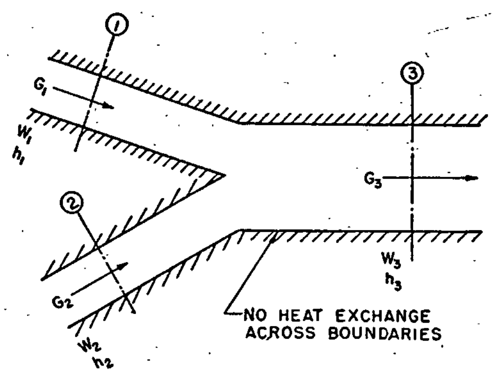

FIG. 10. ILLUSTRATION OF MIXING OF TWO STEADY FLOW STREAMS AT CONSTANT PRESSURE

the two streams being mixed, and divides this line into two segments whose respective lengths are inversely proportional to the rates of dry air flow in the corresponding streams. This is illustrated in Fig. 11. Points 1 and 2 are located and connected by a straight line. The state of the final mixture is set so that

$$\frac{G_1}{G_2} = \frac{D_{2-3}}{D_{3-1}} = \frac{1}{4}$$

Scaling the distances on the chart, the required solution to *Example 5* is 56 F dry-bulb temperature and 0.28 degree of saturation.

Addition of Moisture to an Adiabatic Stream

Consider a stream of moist air flowing adiabatically between two sections, 1 and 2, as in Fig. 12, with moisture addition at the rate $G_1(W_2 - W_1)$ and the moisture having the enthalpy h_w Btu per pound of moisture.

An energy balance yields

$$G_1h_1 + G_1(W_2 - W_1)h_w = G_1h_2 \tag{35}$$

Example 6: Liquid water chilled to 40 F is injected into an air stream initially at

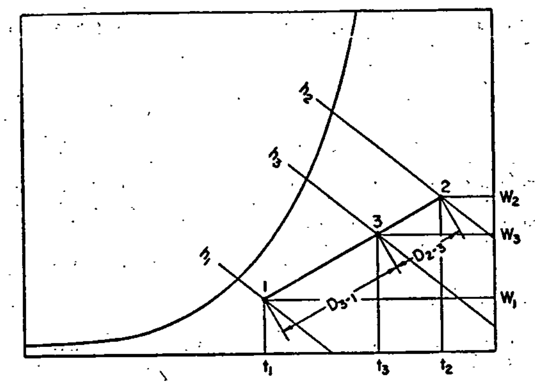

FIG. 11. SOLUTION OF EXAMPLE 5 ON A.S.H.V.E. PSYCHROMETRIC CHART

95 F dry-bulb temperature and 80 F thermodynamic wet-bulb temperature. At what temperature will saturation be reached? How much water must be evaporated to reach saturation?

Solution a: From the data of Table 2. The solution of Equation 35 for h_2 yields

$$h_2 = h_1 + (W_2 - W_1)h_w$$

The initial enthalpy of the moist air h_1 must be found from Equation 8,

$$h_1 = h^* - (W^* - W_1)h_w^*$$

$$22.827 + \mu 40.49 = 43.69 - (0.02233 - 0.03673\mu)\ (48.05)$$

from which $\mu = 0.511$.

Hence, $h_1 = 22.827 + 0.511(40.49)$
$= 43.52$ Btu per lb of dry air

and $W_1 = 0.03673(0.511)$
$= 0.01877$ lb per lb of dry air.

The solution of Equation 35 is

$$h_2 = 43.52 + (W_2 - 0.01877)(8.09)$$

By trial and error, this equation will be satisfied at the temperature 79.87 F. At this temperature the humidity ratio W_2 is 0.02223. The weight of water evaporated is therefore $0.02223 - 0.01877 = 0.00346$ lb per lb of dry air.

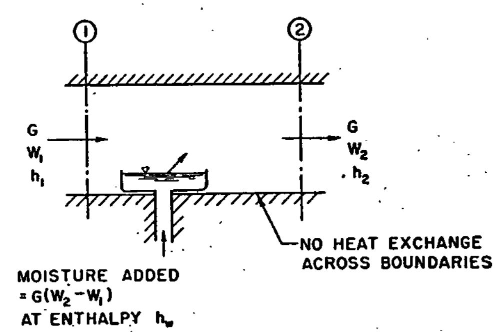

FIG. 12. ILLUSTRATION OF ADDITION OF MOISTURE TO AN ADIABATIC STREAM