equations of heat transfer, mean temperature difference and coil efficiency:

$$Q_s = f_a \times a \times MTD_a \tag{7}$$

$$MTD_a = \frac{t_1 - t_2}{2.3 \log_{10}\left(\frac{t_1 - t_s}{t_2 - t_s}\right)} \tag{8}$$

$$E = \frac{t_1 - t_2}{t_1 - t_s} \text{ (by definition)} \tag{9}$$

$$Q_s = 0.245 \times w \times (t_1 - t_2) \tag{10}$$

where

Q_s = sensible heat transferred, Btu per hour per square foot of coil face area.
t_1 = temperature of air entering coil, degrees Fahrenheit.
t_2 = temperature of air leaving coil, degrees Fahrenheit.
t_s = average temperature of coil external surface, degrees Fahrenheit.
MTD_a = logarithmic mean temperature difference between air and coil surface.

Coil Efficiency

One method of expressing air-coil contact efficiency is the ratio between the weight of air that actually contacts the coil surface and the total weight of air passing through the coil. Due to the fact that the specific heat of air is fairly constant over a wide range of temperature, coil efficiency[5] can be expressed as equal to the number of degrees that the entire amount of air is cooled, divided by the number of degrees between the entering air temperature and the coil surface temperature.

For a particular heat transfer surface, coil efficiency is only a function of the mass velocity of the air, which may be observed by equating Formulae 5 and 6 and combining all constants into D and u:

$$\log_{10}\left(\frac{1}{1\text{-}E}\right) = \frac{D}{w^u} \tag{11}$$

This equation can be used in graphical form by plotting coil efficiency against mass velocity as shown in Fig. 12. The significance of coil efficiency can be visualized in Fig. 13, where the length of the line C-D, divided by the length of line C-E, measures the coil efficiency. The relation between coil capacity and coil efficiency is given by:

$$Q = Ew\,(h_1 - h_s) \tag{12}$$

where

h_1 = specific enthalpy of air entering coil, Btu per pound.
h_s = specific enthalpy of saturated air at surface temperature, Btu per pound.

When no latent heat is being removed from air, the change in enthalpy is equal to the change in temperature times the specific heat, so Equation 12 can be changed to:

$$Q = Ew\,(t_1 - t_s)\,0.245 \tag{13}$$

Dehumidification of Air

When moisture is being condensed on the coil surface Equation 12 can be used. If a coil has an efficiency of 0.8 (80 per cent) for the removal of sensible heat, it will at the same time remove 80 per cent of the difference in moisture content between the entering air and saturated air at the surface temperature. This is due to the fact that 80 per cent of the air particles contact the surface and attain a dew-point temperature equal to the surface temperature. This condition is expressed graphically in Fig. 13.

This psychrometric chart is constructed so that equal increments along the horizontal axis represent equal changes in sensible heat content, and

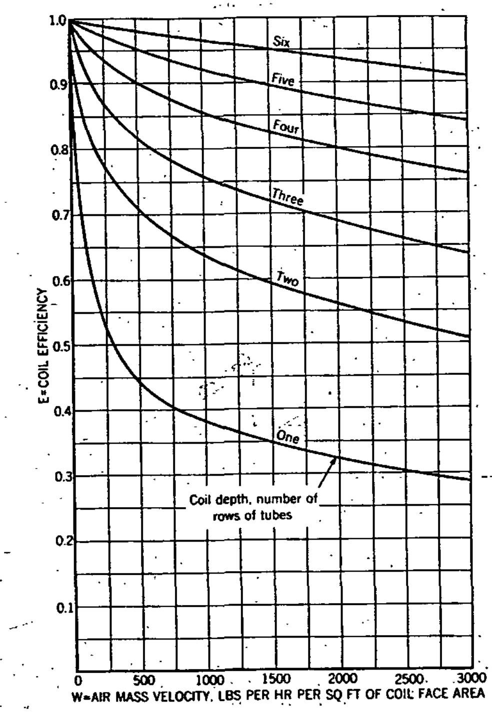

FIG. 12. RELATION OF COIL EFFICIENCY TO MASS VELOCITY

equal increments along the vertical axis represent equal changes in latent heat content of air. Point A represents the condition of return or recirculated air, point B that of outside air, point C the mixture of two-thirds recirculated air and one-third outside air, and point E the average surface temperature. Point D, which represents the air leaving the coil, lies on a line which connects points C and E, and its distance from point C is equal to the length of the line C-E times the coil efficiency. The ratio between the vertical distance from C to D and the horizontal distance from C to D, expressed in heat units, is the ratio between latent heat and sensible heat removed. It can be shown by trigonometric relations that the slope of

[5]When coil efficiency is used herein it is intended to express air-coil contact efficiency and does not express total performance efficiency.