coil capacity in relation to the total air flow over the coil as well as in relation to the overall coefficient of heat transfer.

The capacity of any heating or dry cooling coil can be expressed by either one of the two following equations:

$$Q_1 = W \times 0.24 \times (t_1 - t_2) \quad (6)$$

where

Q_1 = total coil capacity, Btu per hour.
W = total weight of air passing over the coil, pounds per hour.
0.24 = specific heat of air, Btu per pound per degree Fahrenheit.
$t_1 - t_2$ = difference in temperature of air entering and leaving coil, degrees Fahrenheit.

and

$$Q_2 = U \times MTD \times A \quad (7)$$

where

Q_2 = total coil capacity, Btu per hour.
U = overall coefficient of heat transfer between the air and the fluid within the coil, Btu per hour per square foot per degree Fahrenheit.
MTD = logarithmic mean temperature difference, degrees Fahrenheit.
A = total external coil surface, square feet.

Obviously, the closer the leaving air temperature approaches the temperature of the fluid within the coil, the greater will become the value of the total capacity, Q_1, as determined by Equation 6, because $t_1 - t_2$ increases; and on the other hand, the smaller will become the total capacity as computed by Equation 7, because MTD decreases. Since the Equations 6 and 7 are independent of each other, the graphical balance between them is the simplest method of solution. A typical graphical approach to solution of the coil capacity is shown in Fig. 12. Obviously, the heat loss or gain in the heating or cooling medium must equal the heat gain or loss of the air. Therefore, the actual coil capacity must lie at the intersection of the straight line curve representing Equations 6 and 7.

COIL PERFORMANCE OPERATING WITH DEHUMIDIFICATION

The foregoing theory pertaining to heating and cooling coils (operating dry) applies equally to the performance of cooling coils operating with dehumidification. However, there are also other factors which affect the performance of cooling coils operating wet which have no influence on either heating coils or cooling coils operating without dehumidification.

Since the force which causes condensation of moisture from the air upon the external surface of the cooling coil has its origin in the vapor pressure difference between the mass of air passing over the coil and that corresponding to temperature of the wetted coil surface, it is obvious that the latent coefficient of heat transfer depends upon several factors:

1. The average dew-point temperature of the air passing over the cooling coil.
2. The average temperature of the external coil surface (fins and tubes) exposed to the air stream.
3. Other factors applicable to dry cooling coils, as discussed, also affect the coefficient of latent heat transfer.

Furthermore, the coil may be wet throughout or wet at the cooler points and dry elsewhere. In the latter case the action is partly as a dry, and partly as a dehumidifying surface. As it is difficult to determine the proportions, approximations must be used. Since the dew-point temperature of the air passing over the coil is dependent upon the inside and outside atmospheric design conditions, it is not subject to control at will and must be accepted as found. Consequently, regulation of the average temperature of the external coil surface is the primary means for controlling the moisture removal from the air passing over the coil.

Total Capacity of Coil Operating With Dehumidification

While a coil operating dry transfers heat to or from the air by merely changing the temperature of the air, the cooling coil operating wet also

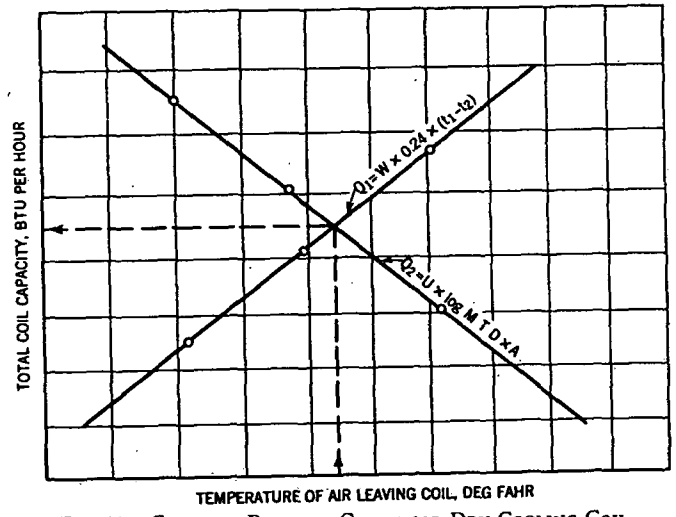

FIG. 12. CAPACITY BALANCE CHART FOR DRY COOLING COIL

transfers heat from the air by condensing some of the moisture carried by it. Because of this, the *dry* coils are said to transfer sensible heat only, while the *wet* cooling coils are said to transfer latent as well as sensible heat. The sum of sensible and latent heat transferred by a dehumidifying cooling coil is the *total heat*. For practical reasons, the latent heat removal capacity of cooling coils is usually given as a percentage of the total heat removal, and this percentage is called the heat load ratio.

Although much research has been already conducted and more is in progress, there is no general agreement as to the most satisfactory and convenient manner in which to rate dehumidifying coils. A large number of methods are now in use, most of them combinations of theory and empirical presentations of test data. Information is given, usually in the form of tables or curves to determine the total cooling capacity, with supplementary devices to ascertain the proportions of sensible and latent.