pumping unit. The spray-generating nozzle which is of the impact type is located in a cylindrical casing. A drainage pan provides for the collection and return of unevaporated water which flows through a return pipe to a filter tank, from which it is recirculated. A powerful air current is forced through the humidifier by means of a fan mounted above the unit.

The air enters from above, is drawn through the head, charged with moisture, and cooled to the wet-bulb temperature. It then escapes from the opening below at a high velocity in a complete and nearly horizontal circle. The spray is quickly evaporated and the resulting vapor is rapidly and thoroughly diffused. This effective distribution of fine spray over the maximum possible area insures complete and extremely rapid vaporization even at the highest humidities.

Spray Humidifiers

This type of humidifier consists of an impact spray nozzle in a cylindrical casing with a drainage pan below it. The aspirating effect of the spray nozzle induces a moderate air current through the casing which distributes the entrained spray. The general method of circulating and returning the water is similar to that employed for high-duty humidifiers. A suitable pump and centrally-located filter tank are required.

The spray and high-duty types of humidifiers have many features in common but the latter, because of its finer spray and greater capacity, is often considered better adapted for producing high humidities.

Self-Contained Humidifiers

The self-contained or centrifugal humidifier has the ability to generate and distribute spray without the use of air compressors, pumps, or other auxiliaries. These may be used either singly or in groups. In large installations, where suitable connections are provided to permit the cleaning and servicing of individual units without affecting the room as a whole, group control of the water and power may be employed.

Where large quantities of power are generated in a limited space and where a comparatively high relative humidity is required, it is often feasible and economical to use a combination of direct and indirect humidification. The indirect humidification provides the desired quantity of ventilation and cooling, and the additional direct humidification provides for increase in humidity without interfering with the ventilation or the cooling effected by the indirect system.

In general, it may be stated that direct humidification is most satisfactory where high humidities are desired but where little cooling, ventilation or air motion is required. Therefore, the indirect system is most applicable where either low or high relative humidities are desired with maximum cooling and ventilation effect. For conditions that require an unusually large amount of heat to be absorbed by ventilation, together with the maintenance of high humidities, it is often preferable to make use of the combination system of indirect and direct humidification. If the indirect system alone were used it would mean an unusually large volume of air to be handled, which might interfere, due to air motion, with production, even though it would result in greater cooling effect. If direct humidification alone were used, no ventilation would be obtained, with consequently higher room temperatures.

PROBLEMS IN PRACTICE

1 ● Determine the per cent saturating efficiency of an air washer used for adiabatical saturation or evaporative cooling if the following temperatures are obtained on the entering and leaving sides of the washer:

Entering air, 84.3 F dry-bulb and 71.2 F wet-bulb.

Leaving air, 73.4 F dry-bulb and 71.2 F wet-bulb.

The equation for determining saturation efficiency is:

$$E = \frac{(db_1 - wb_1) - (db_2 - wb_2)}{db_1 - wb_1} \times 100$$

where

E = saturation efficiency in per cent.
db_1 = dry-bulb temperature of entering air.
wb_1 = wet-bulb temperature of entering air.
db_2 = dry-bulb temperature of leaving air.
wb_2 = wet-bulb temperature of leaving air.

Therefore

$$E = \frac{(84.3 - 71.2) - (73.4 - 71.2)}{84.3 - 71.2} \times 100 = \frac{10.9}{13.1} \times 100 = 83.2 \text{ per cent.}$$

2 ● How may relative humidity be controlled?

a. If constant room temperature is to be maintained:
1. To maintain a constant relative humidity, the dew point must be kept constant.
2. To increase the relative humidity, the dew point must be raised.
3. To decrease the relative humidity, the dew point must be lowered.

b. If constant dew point is to be maintained:
1. To maintain a constant relative humidity, the room temperature must remain constant.
2. To increase the relative humidity, the room temperature must be lowered.
3. To decrease the relative humidity, the room temperature must be raised.

c. With varying dew-point temperatures:
1. To maintain a constant relative humidity, the room temperature must vary directly and in almost equal amount with the dew point.
2. To increase the relative humidity, the difference between room temperature and dew point must be decreased.
3. To decrease the relative humidity, the difference between room temperature and dew point must be increased.

d. With varying room temperatures:
1. To maintain a constant relative humidity, the dew point must vary directly and in almost equal amount with the room temperature.
2. To increase the relative humidity, the difference between dew point and room temperature must be decreased.
3. To decrease the relative humidity, the difference between dew point and room temperature must be increased.

3 ● In industrial air conditioning plants, what are the four sources of heat which must be taken into consideration in the design of a system?

a. Heat transfer from the outside air.
b. Body heat from employees.
c. Sun effect.
d. Heat equivalent of power consumed in driving machinery, in lighting, and in manufacturing processes in general.