hour on the basis of 0 F outdoors and 70 F room temperature, is to be heated by a recirculating central heating system with air entering the rooms at 116 F. How many cubic feet per minute, measured at 70 F, will be required?

Substitute in Equation 1. $H = 110{,}100 + 34{,}200 = 144{,}300$ Btu per hour; $t_y = 116$ F; $t = 70$ F; $Q = \dfrac{144{,}300}{60 \times 0.07492 \times 0.24\ (116 - 70)} = 2900$ cfm.

3 ● In the preceding question, if the warm air loses 4 F between heater and rooms, how many pounds of steam per hour at 1-lb gage will the heating sections condense?

$Q = 2900$ cfm, from solution of Question 2; $\Delta t = 116 + 4 - 70 = 50$ F; $h_{fg} = 968$ Btu, from steam table in Chapter 1.

$$W = \frac{60\ dQ \times 0.24 \times \Delta t}{h_{fg}} = \frac{60 \times 0.07492 \times 2900 \times 0.24 \times 50}{968} = 161.8 \text{ lb per hour.}$$

4 ● In central systems for cooling and dehumidifying can the dry-bulb temperature change be fixed arbitrarily?

No, because the change depends on factors at both the conditioner and the room. At the conditioner, temperature of the available water supply may limit the dry-bulb temperature of the leaving air. At the room, the dry-bulb temperature of the entering air may be further limited by: 1. The duct and supply grille arrangement permitted by architectural and structural requirements for the particular space, *e.g.*, ceiling height and obstructions on ceilings, such as beams. 2. The state of activity of the occupants. 3. The velocity at the inlet grille, as limited by noise level requirements. 4. The direction of the jet relative to the occupants.

5 ● Why must the air leaving a dehumidifying type air washer often have its dry-bulb temperature raised before delivery to the occupied zone of room?

The air leaves the dehumidifying air washer saturated at a relatively low temperature which in most cases is lower than the allowable delivery dry-bulb temperature as fixed by factors outlined under Question 4. Also, the air may possibly be carrying a small amount of entrained water which might settle out in the ducts near the washer and cause corrosion difficulties.

6 ● What methods may be used to raise the dry-bulb temperature of the air after it leaves the dehumidifying air washer and before it enters the room?

a. Sensible heat may be added by a reheating method from a source outside the air stream. This method passes all or part of the cold, dehumidified air over steam or hot water coils at the central conditioner or in the ducts, or over electric grids or similar devices. Any available source of sensible heat can be used.

b. A mixing method using sensible heat already in the air stream. In this method the cold, dehumidified air is mixed with air at a higher dry-bulb temperature and the dry-bulb temperature of the resulting mixture is higher than that of the air when it left the conditioner. The air at high dry-bulb temperature is obtained by not passing it through the dehumidifying washer. The mixing may take place at a central conditioner or in the rooms themselves.

c. Combinations of these methods.

Chapter 22

UNIT HEATERS, VENTILATORS, AIR CONDITIONING, COOLING UNITS

Classification of Unitary Equipment and Related Systems, Unit Heaters, Unit Ventilators, Split and Combined Systems, Cooling Units, Air Conditioning Units, Heating, Humidifying and Dehumidification, Filtering, Location of Units, Air Distribution, Residential Central System Units, Costs, Accessories to Unitary Equipment

IN other chapters, complete descriptions have been given of heating, cooling, ventilating, humidifying, and dehumidifying systems. These descriptions have covered the detailed principles of each and have, in general, described the assembled equipment included in the complete systems. The success of such completely engineered, heating, cooling, and air conditioning systems has inevitably led to the production of smaller factory-assembled equipment employing a majority of the principles of these complete systems. As a result, present day practice involves the use of this unitary equipment in the majority of smaller installations where capacity demands are within the limits of such units. Thus, unit heaters, unit ventilators, cooling units and air conditioning units have come to occupy a place of their own in the industry.

With the growth of this unitary industry, it becomes increasingly evident that there is no sharp line of demarcation, on the basis of capacity, between a *unit* and a *central station* system. Definitions contained in a code, Standard Method of Rating and Testing Air Conditioning Equipment[1], have helped to clarify and identify the various types available.

A *unit* is a factory-made encased assembly of the functional elements indicated by its name, such as air conditioning unit, room cooling unit, humidifying unit, etc. Such units are shipped substantially complete or built and shipped in sections so that the only field work necessary is the assembling together of the sections, without resorting to any field fabrication. A unit of this type may be complete in itself, employing its own direct means of air distribution and sources of refrigeration or heating, in which case, it thus represents a complete self-contained unit. Or it may be coupled with separate means of air distribution such as duct work and outlets, in which case, it will still be considered as a unit system, in distinction to the generally accepted term of a field fabricated central station system. The manufacturer of the unit is responsible for the output and

[1]Prepared by a Joint Committee of the *American Society of Refrigerating Engineers*, AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, *Refrigerating Machinery Association*, *National Electrical Manufacturers' Association* and *Air Conditioning Manufacturers' Association*.