the water sprays will become partially saturated (adiabatically) having a moisture content per pound of air equal to saturated air at 41 F. If the incoming air is warmed to t_w = 88 F (requiring a two-section-depth heating unit) it will be cooled in the washer to 64 F, with a temperature drop of 88 − 64 = 24 deg.

If the *humidifying efficiency* of the washer were 100 per cent, the air would become adiabatically saturated at 52 F after a temperature drop of 88 − 52 = 36 F. The efficiency of the washer is, however, only 67 per cent, so that the actual temperature drop will be 0.67 × 36 deg or 24 deg, as used.

The heat to be supplied the reheater is in this case $H_1 = 0.24\ (t_2 - 64)\ M$ Btu per hour, and the heat to be supplied to the tempering coil and preheater is $H_2 = 0.24\ (88 - t_0)\ M$. The total heat required by the apparatus is $H_1 + H_2$, no heat being supplied to the washer.

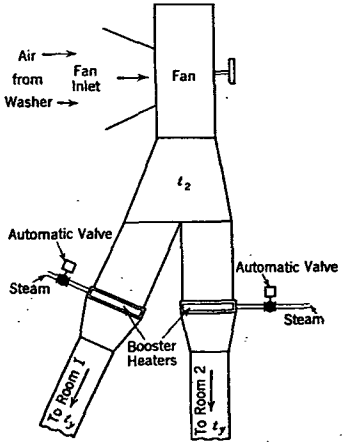

FIG. 7. OUTSIDE AIR CIRCULATED; CONSTANT TEMPERATURE AND RELATIVE HUMIDITY MAINTAINED IN EACH ROOM (*Case E*)

Case E. (Fig. 7) The temperature t_y will ordinarily be different for each room. With H and M fixed, $0.24\ (t_y - t)M = H$, or

$$t_y = \frac{H}{0.24\ M} + t$$

In order to provide the proper temperature for each room, a booster coil is generally installed in each supply duct near the outlet to control the outlet temperature t_y. The amount of steam supplied to these booster units is usually controlled automatically by individual thermostats. The heat required by the booster coils depends on the temperature range through which the air is heated and the quantity of air, or

$$H_4 = 0.24\ (t_y - t_2 + t_2)M \qquad (10)$$

Heat to be Supplied

The amount of heat to be supplied (H') is equal to the sum of the heat requirements of the various heating units and the water heater of the washer, if any, plus the allowance for piping tax. (See preceding *Cases A* to *E*.)

Grate Area, Boiler Selection

The required grate area may be determined by the following formula:

$$G = \frac{H}{F \times E \times C} \qquad (11)$$

where

G = required grate area, square feet.
F = calorific value of fuel, Btu per pound.
C = combustion rate, pounds per square foot of grate per hour.
E = boiler and grate efficiency, per cent.

Example 8. Using the data in Example 6, and assuming coal having a calorific value of 12,000 Btu per pound, a combustion rate of 7 lb per square foot, and a performance efficiency of 0.60, and neglecting the piping tax,

$$G = \frac{1{,}306{,}670}{12{,}000 \times 0.60 \times 7} = 26 \text{ sq ft.}$$

Weight of Condensate

The normal weight of condensate to be handled from central fan systems may be estimated by means of the following formula:

$$W = \frac{60\ dQ \times 0.24 \times \Delta t}{h_{fg}} \qquad (12)$$

where

W = weight of condensate, pounds per hour.
Q = total volume of air, cubic feet per minute.
Δt = temperature rise of air, degrees Fahrenheit.
h_{fg} = latent heat of steam in the system, Btu per pound.

Ducts and Outlets, Air Filters, Air Washers

The design of the duct system should be based on data contained in Chapter 29. Air washers and humidifiers are described in Chapter 25. For information on air filters, see Chapter 26.

Static Pressure

The total static pressure against which the system must operate may be found by summing up the static losses through the complete system from the outside air intake to the discharge outlets or nozzles. This means that the loss due to friction must be determined for each piece of apparatus involved. Most of these values may be obtained from manufacturers' data tables. For a simple system, the following static pressure drops may be assumed:

1. Outside air inlet, comprised of screen, louver and short duct, may have a loss of 0.2 in. of water.
2. A typical oil filter at rated capacity and velocity has a drop of 0.25 in. of water.
3. The loss of one row of a standard make tempering stack equals 0.09 in. water.
4. The loss of one row of a standard make preheater equals 0.10 in. water.
5. A standard humidifier at rated velocity may have a loss of about 0.35 in. water.
6. The loss through one row of a standard make reheater equals 0.12 in. water.
7. A fair assumption for duct losses on a simple system is 0.25 in. water.
8. The static pressure for a nozzle type outlet may be taken as 0.1 in. water.