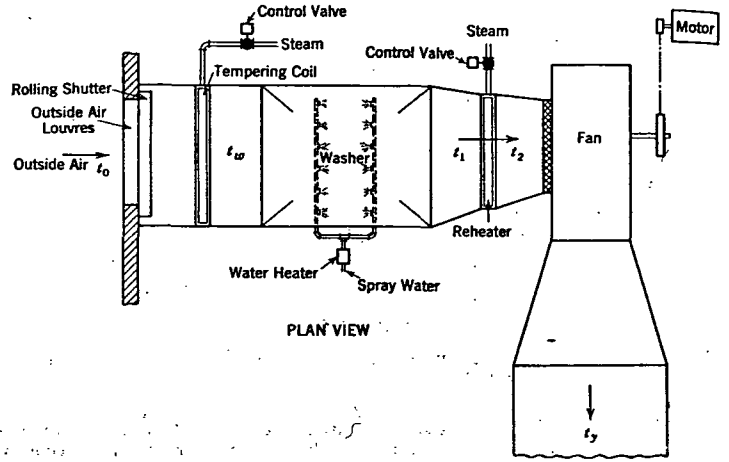

FIG. 6. OUTSIDE AIR CIRCULATED; CONSTANT RELATIVE HUMIDITY IN ROOM (*Case D*)

Case D. (Fig. 6) The maximum relative humidity that may be maintained within the building without the precipitation of moisture on single glazed sash when the outside temperature is 30 F is approximately 35 per cent. If the inside temperature t is 70 F, 35 per cent relative humidity corresponds to a dew-point temperature of 41 F. (See psychrometric chart.)

The installation shown in Fig. 6 contemplates the use of a tempering coil, an air washer provided with a water heater, and a reheater. The tempering coil, one section in depth, warms the incoming air to approximately 35 F to prevent freezing any of the spray water. The air passing through the spray chamber is saturated and leaves at a temperature of $t_1 = 41$ F.

The heat to be supplied the reheater is:

$$H_1 = 0.24\ (t_2 - 41)M \text{ Btu per hour.}$$

The heat to be supplied the tempering coil is:

$$H_2 = 0.24\ (35 - t_o)M \text{ Btu per hour.}$$

The amount of heat, per pound of air circulated, to be supplied the humidifying washer or humidifier is the difference between the heat content of the assumed dry air entering the washer at a temperature of $t_w = 35$ F and that of the leaving saturated air at $t_1 = 41$ F (Table 6, Chapter 1), or:

$$15.657 - 8.397 = 7.26 \text{ Btu per pound of dry air.}$$

The amount of heat required for the washer is:

$$H_3 = 7.26\ M \text{ Btu per hour.}$$

The total amount of heat required by the apparatus is, therefore:

$$H_1 + H_2 + H_3 \text{ Btu per hour.}$$

If a washer having a *humidifying efficiency* of 67 per cent *without water heater* is employed it will be necessary to heat the outside air drawn into the apparatus by means of the tempering and preheater coils to such a temperature that the air in passing through

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 $H_2 = 0.24\ (88 - t_o)\ M$. The total heat required by the apparatus is $H_1 + H_2$, no heat being supplied to the washer.

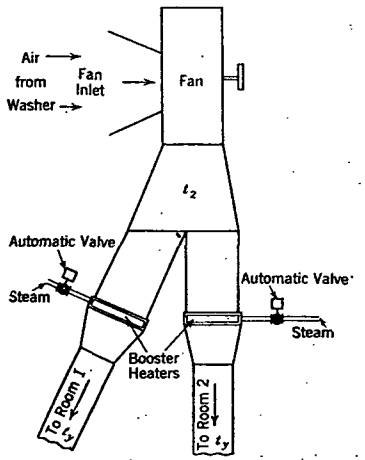

FIG. 7. OUTSIDE AIR CIRCULATED; CONSTANT TEMPERATURE AND RELATIVE HUMIDITY MAINTAINED IN EACH ROOM (*Case E*)

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

$$H_4 = 0.24\ (t_y - t_2 - t_z)M \qquad (13)$$

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*.)