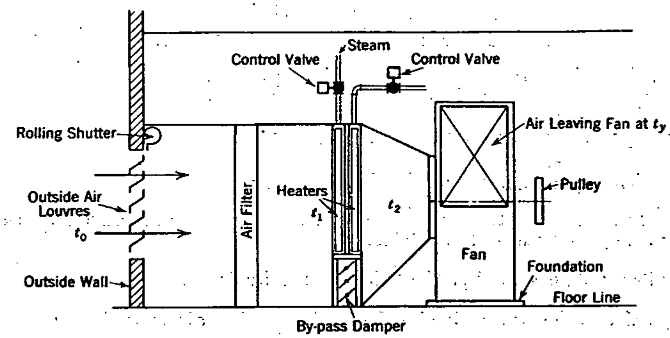

FIG. 3. HEATING UNIT AND FAN ARRANGED FOR OUTSIDE AIR CIRCULATION (*Case A*)

Case A. (Fig. 3) All of the air circulated to be drawn from outside the building, in which case $t_x = t_o$.

$$H_2 = 0.24\ (t_1 - t_o)\ M_o \tag{10}$$

$$H_1 = 0.24\ (t_2 - t_1)\ M_o \tag{11}$$

Example 6. The heat loss H for a certain factory building is 700,000 Btu per hour. The mean inside temperature t to be maintained is 65 F. The assumed outside air temperature t_o is 0 F; $t_x = 0$, $t_y = t_2$ and is assumed to be 140 F. The temperature leaving the tempering coil is assumed to be 35 F. Required, H_1 and H_2. From Equation 4,

$$M = \frac{700{,}000}{0.24\ (140 - 65)} = 38{,}889 \text{ lb per hour.}$$

$H_2 = 0.24 \times (35 - 0) \times 38{,}889 = 326{,}667$ Btu per hour.
$H_1 = 0.24 \times (140 - 35) \times 38{,}889 = 980{,}003$ Btu per hour.
$H_2 + H_1 = 326{,}667 + 980{,}003 = 1{,}306{,}670$ Btu per hour.

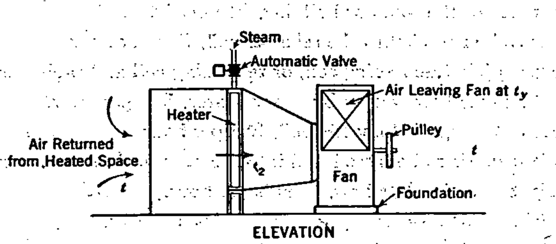

FIG. 4. ARRANGEMENT FOR RECIRCULATION (*Case B*)

Case B. (Fig. 4) All of the air is to be recirculated, in which case $t_1 = t$.

$M_r = 38{,}889$ lb
$M_1 = 0.24\ (t_2 - t_1)\ M_r$
$H_1 = 0.24\ (140 - 65) \times 38{,}889 = 700{,}000$ Btu per hour.

This example illustrates the saving in fuel consumption by the recirculation of the air. The heat to be supplied the apparatus is the same as that required for a direct system of heating and is equal to the heat loss of the building ($H_1 = H$), in the example 700,000 Btu per hour as compared with 1,306,670 for *Case A*.

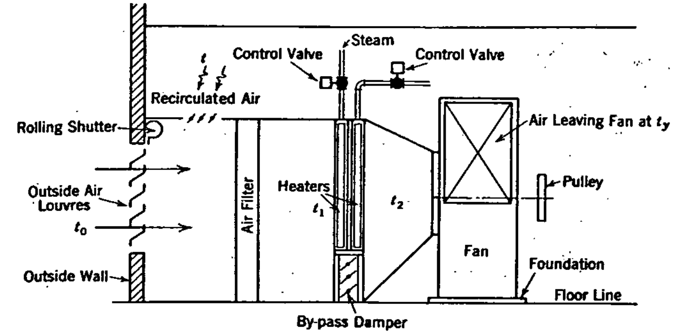

FIG. 5. COMBINATION OF RECIRCULATED AIR AND OUTSIDE AIR (*Case C*)

Case C. (Fig. 5) A portion of the air circulated is recirculated air and the remainder, as may be required for ventilating purposes, is drawn in from the outside. According to Equations 4 and 5,

$$M = M_o + M_r = \frac{H}{0.24\ (t_y - t)}$$

The temperature of the resulting mixture of outside and recirculated air entering the tempering coil is:

$$t_x = \frac{M_o t_o + M_r t}{M} \tag{12}$$

Example 7. Assuming that a positive supply of outside air ($d_o = 0.0864$) is required for ventilation at the rate of 90,000 cu ft per hour in the preceding example, then $M_o = 0.0864 \times 90{,}000 = 7776$ lb per hour are required, measured at 65 F.

$$M_r = M - M_o = 38{,}889 - 7776 = 31{,}113 \text{ lb}$$

$$t_x = \frac{7776 \times 0 + 31{,}113 \times 65}{38{,}889} = 52 \text{ F}$$

$$H_1 = 38{,}889 \times 0.24\ (140 - 52) = 821{,}336 \text{ Btu.}$$

This amount of work may be accomplished with one or more banks of heating units, that is, either a single reheater or a tempering coil and reheater.

The three preceding cases refer to installations in which conditioning the air to maintain certain relative humidity requirements does not enter into the problem, as for example, certain types of industrial installations. In practically all modern public buildings, theaters, schools, and in many industrial installations, the ventilating requirements include the provision for washing and humidifying the air delivered to the various rooms of the structure.

In the following cases it is assumed that in addition to maintaining a mean room temperature t, the heating and ventilating apparatus is required to maintain a constant relative humidity in the rooms.