2. For ducts in outside walls, basements, attics or other exposed places temperature drops should be determined in accordance with the procedure as outlined in Chapter 39.

3. For ducts run underground an allowance shall be made based on the assumption that the average ground temperature will be 55 F.

Heat Supplied Heating Units and Washer

The following cases may arise in practice:

A. The heating of the building is done entirely by means of a central fan system, all of the air being drawn from the outside.

B. Similar to *A*, except that all of the air is recirculated.

C. A portion of the air is recirculated, and the remainder is drawn in from the outside.

D. Air at the same temperature is to be delivered to all the rooms. A constant relative humidity is maintained in the building and all of the air circulated is drawn from outside the building. (Not applicable to the heating of various rooms where individual control of each room is desired.)

E. Outside air, return air, and by-pass air are used with the reheater located in by-pass air chamber.

F. Arrangement of apparatus where individual control of the temperature for each room is required in conjunction with air washer equipment to maintain a constant relative humidity in the rooms. The air washer is provided with a water heater for the spray water, capable of fully saturating the air. A section of preheater may be used for this purpose in place of the water heater. With this arrangement and with a uniform temperature of air entering the rooms, it is impossible to maintain the same room temperature throughout the building because the weight of air to be delivered to each room is determined and fixed by the ventilating requirements.

In analyzing these cases, the following symbols will be used:

H = heat loss of the room or building, Btu per hour.
H_1 = heat to be supplied to the reheater coil, Btu per hour.
H_2 = heat supplied tempering coil, or tempering coil and preheater, Btu per hour.
H_3 = heat supplied air washer by water heater, Btu per hour.
H_4 = heat to be supplied booster coil, Btu per hour.
M = weight of air to be introduced into the room or building, pounds per hour.
M_r = weight of recirculated air, pounds per hour.
M_b = weight of air by-passing washer, pounds per hour.
M_o = weight of air drawn in from outside, pounds per hour.
t_o = mean temperature of outside air, degrees Fahrenheit.
t = mean air temperature to be maintained in the room or building, degrees Fahrenheit.
t_1 = mean temperature of the air entering the reheater coil.
t_2 = mean temperature of the air leaving the reheater coil.
t_z = temperature loss in the duct system.
t_y = temperature of the air leaving the duct outlets.
t_x = average temperature of air entering tempering coil.
t_w = temperature of air entering washer.
0.24 = specific heat of air at constant pressure.

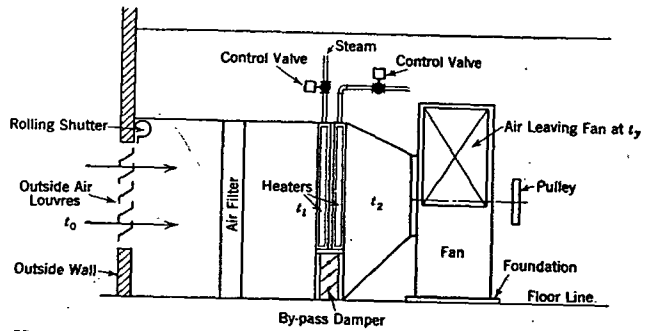

FIG. 3. HEATING UNIT AND FAN ARRANGED FOR OUTSIDE AIR CIRCULATION (*Case A*)

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

$$H_2 = 0.24\ (t_1 - t_o)\ M_o \tag{7}$$

$$H_1 = 0.24\ (t_2 - t_1)\ M_o \tag{8}$$

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; $t_z = 0$, $t_y = t_2$ 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.

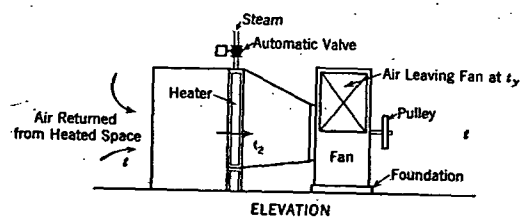

FIG. 4. ARRANGEMENT FOR RECIRCULATION (*Case B*)

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

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