25 percent of the air introduced were outdoor air, the solution would be as follows:

$$H_t = 24{,}000 + 0.24 \times 0.075 \times 60 \times 0.25 \times 1000\ (70 - 0) = 42{,}900$$

$$t_r = \frac{24{,}000}{0.24 \times 0.075 \times 60 \times 1000} + 70 = 92.2$$

The only difference from *Example 1* is that, in the latter case, the ventilation load has been reduced.

Applications of Unit Ventilators

Items to be considered in the application of unit ventilators are: (1) combination with other means of heating, (2) selection of unit ventilator size, (3) cycle of control, (4) location of units, and (5) method of venting and exhausting.

In a *split* system the unit ventilator heat output is supplemented by that of additional radiators or convectors, and consequently a corresponding reduction in required unit ventilator heating capacity may be made.

The *combined* system employs a unit ventilator with sufficient heating capacity for both ventilation and normal heat losses. In such a case no direct radiation is required. The cost of installation of a combined system is usually less than that of a split system. The unit ventilator is normally arranged so that a fixed minimum of outdoor air is introduced at all times. The amount of outdoor air may be governed by state or local codes, or may be calculated by the engineer to meet the need of the application. In some cases, a variable amount of outdoor air is introduced depending on outside temperatures. This is done in order to conserve fuel, with some sacrifice of ventilation.

Selection of Unit Ventilator Size

The primary consideration in the selection of the size of unit ventilator is the number of occupants in the space. Other factors to be considered are state and local code requirements, volume of the room, density of occupancy, and the usage of the room. A safe rule for determining air capacity is to allow a total air quantity of 30 cfm per person, or six to nine room air changes through the unit, whichever is greater. If the ventilation requirements are less than this value, some air may be recirculated from the room. With this quantity of air handled, it is possible to obtain satisfactory cooling in mild weather. Since cooling is an important function, the unit ventilator must be selected to supply adequate air quantities.

After selecting the basic size of unit, the coil capacity to meet the heating requirement can be determined from the manufacturer's tables.

Control of Unit Ventilators

Three cycles of control are available for use with unit ventilators. These cycles of control determine the sequence of operation of the dampers and heating element as follows:

Cycle X—All Outdoor Air. During the heating-up period, the damper remains closed to outdoor air and the unit ventilator recirculates room air. Just before the desired room temperature is reached, the room thermostat operates the damper to admit only outdoor air. No recirculation takes place during the periods of room occupancy.

Cycle Y—A Variable Quantity of Outdoor Air with a Fixed Minimum. During the heating-up period, the damper remains closed to outdoor air and the unit ventilator recirculates room air. Just before the desired room temperature is reached, the room thermostat causes the damper to open to admit the desired minimum quantity of outdoor air, the balance of the air being taken from the room. As long as the minimum quantity of outdoor air is sufficient to prevent overheating, the damper remains in this minimum position. If more outdoor air is needed for cooling, the damper, under control of the room thermostat and the air stream thermostat, is operated to increase the proportion of outdoor air as needed, up to the maximum.

Cycle Z—A Variable Quantity of Outdoor Air without a Fixed Minimum. During the heating-up period, the damper remains closed to outdoor air and the unit ventilator recirculates room air. Just before the desired room temperature is reached, the air stream thermostat, placed ahead of the heating element to control the mixture of room air and outdoor air, assumes full control over the damper. Thereafter, this instrument positions the damper to maintain a predetermined constant-temperature mixture of indoor and outdoor air during all occupied periods. Meanwhile, the heating element, under the control of the room thermostat, adds just sufficient heat to the air mixture to maintain the desired room temperature.

Location of Unit Ventilator

The location of the unit ventilator in a room is important. Wherever possible it should be placed against an outside wall and on the center line of the room. It is difficult to obtain proper air distribution if the unit is installed either on an inside wall or in a corner of the room. Standard units discharge the air stream upward, but for special cases units may be installed to discharge air horizontally. Units may be set against the wall or partially recessed into the wall to save space without materially affecting the results.

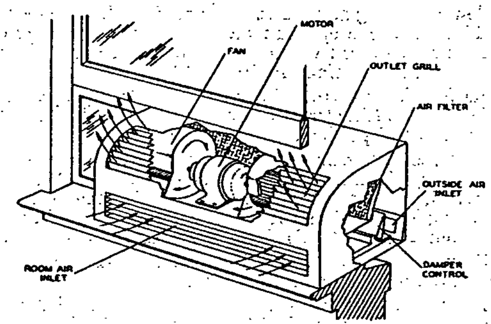

Fig. 11. Typical Window Ventilator

Air Exhaust Vents and Flues

The size and location of the air exhaust vent[6] outlet are important and in many cases, are regulated by laws for public buildings. Where no codes govern, the location and size of vents are left to the discretion of the engineer.

Best results have been obtained with a velocity through the vent openings nearly equal to that at which the air is introduced into the room, thus maintaining a slight pressure in the room. Calculated velocities at the vent openings of from 600 to 800 fpm produce the best diffusion results from this system. Many states, however, have regulations that will not permit velocities as high as 800 fpm. If a vent opening at or near the floor is near a desk or place where a person is seated, a velocity of 800 fpm in the