pressure difference, in inches of water, existing at that opening from any causes or combination of causes.

With V known, the flow, Q, at the opening can then be easily computed by the familiar relation.

$$Q = AVC \qquad (4)$$

where Q is the flow in cubic feet per minute; A is the area in square feet, and C is a coefficient.

For openings such as result from swinging or sliding windows and doors, where the aperture is essentially an orifice, the value of C will be about 0.60.

It would be comparatively easy to calculate flow through an opening, if the pressure difference could be determined. However, so many factors participate in the general action that it is very difficult to evaluate a pressure difference arising from a given wind velocity and temperature. The difficulty is further augmented by the fact that the pressure difference is likely to have a different value for every different opening or group of openings of a building.

NATURAL VENTILATION METHODS

Ventilation by the use of natural forces is produced by means of openings of various kinds between the interior and exterior of a building. These may consist of:

1. Windows (or doors) representing apertures in walls or roofs.
2. Roof ventilators of the unit type designed to develop an inductive force when acted upon by the wind.
3. Roof ventilators of the continuous type providing a ridge opening throughout the length of the building, but not particularly designed to develop an inductive force.
4. Stacks or shafts providing communication between localized interior points and a region above the roof.

Windows have the advantage of transmitting light, as well as providing ventilating area when open. Their movable parts are arranged to open in various ways; they may open by sliding as in the ordinary double-hung, wood window; by tilting on horizontal pivots at or near the center; or by swinging on pivots at top or bottom. Whatever the form and type of window used the thing of essential importance in ventilation is the amount of clear area that can be made available. The motive head to produce flow through windows is almost entirely dependent upon the distribution of those motive forces in and about a building, as discussed under wind and temperature difference. A pivoted window, projecting out from the plane of the wall is bound to impose some obstructive influence upon such air currents as exist in that particular vicinity, and may result in the production of some localized pressure or suction that will influence flow there, and to that degree, one type of window might give more or less active ventilation than another. But, speaking generally, the motive head causing flow through a window is determined by the forces of wind and temperature difference existing there, and not by the kind of window, except in so far as the kind of window establishes the area of opening.

Windows may be arranged for individual operation, or they may be

grouped in long runs, as in factory buildings. Those used in office buildings may have deflecting devices at the sills for avoiding direct draft upon occupants, or a bottom pivoted ventilator, arranged to swing in at the top, may serve the same purpose.

ROOF VENTILATORS

A roof ventilator consists of a structure built up around a roof opening in such a way as to cause the wind to *induce* a suction in the vicinity of the opening, and so create an outflow. Since roof ventilators are

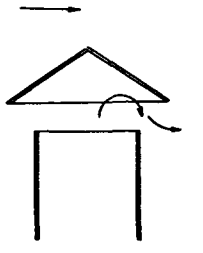

FIG. 2

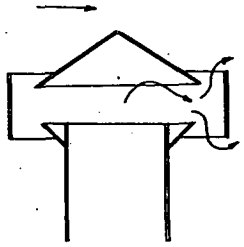

FIG. 3

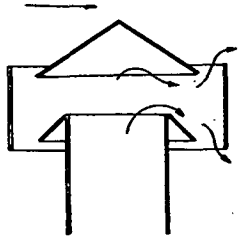

FIG. 4

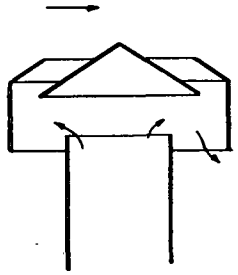

FIG. 5

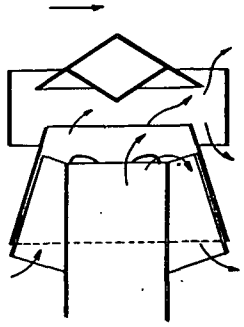

FIG. 6

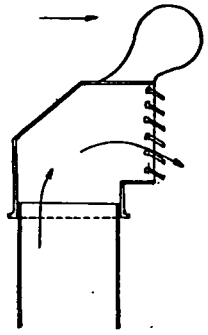

FIG. 7

VARIOUS STYLES OF ROOF VENTILATORS

intended for installation on roofs of buildings, and function as outflow openings only, they constitute but a part of a ventilating system, and attention must be given to the provision of openings for inflow. It is evident that such ventilators could not function even in the strongest wind, and with the maximum temperature difference, without inlet openings. Often such ventilators must depend upon infiltration only for inflow. Inlet openings of about twice the area of the roof ventilators should be provided where natural ventilation is used. Dampers should be installed in ventilators with adequate and accessible operating mechanism.