preferably have a throat radius of at least one and one-half times the diameter of the pipe.

Every pipe should be kept open and unobstructed throughout its entire length, and no fixed screen should be placed in it, although the use of a trap at the junction of the hood and branch pipe is permissible, provided it is not allowed to fill up completely.

The passing of pipes through fire-walls should be avoided wherever possible, and sweep-up connections should be so arranged that foreign material cannot be easily introduced into them.

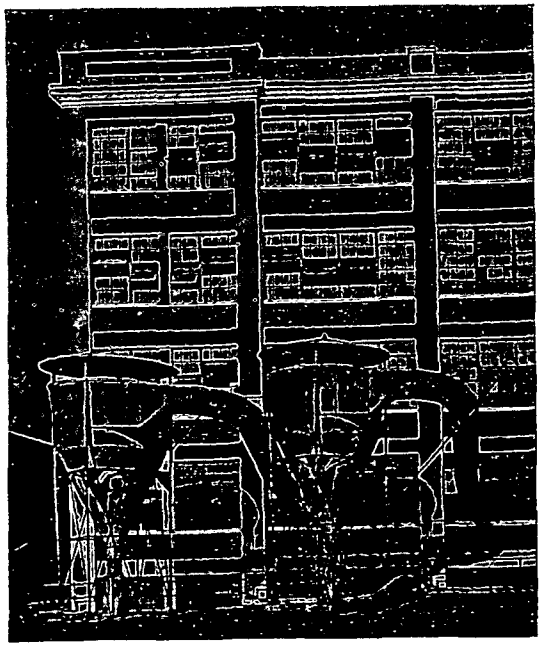

FIG. 1. COLLECTORS ON ROOF PIANO FACTORY

MAINTENANCE OF SYSTEM

Because of its simplicity the exhaust system usually receives but little attention once it is installed; however, to obtain the best results, it should be inspected at suitable intervals and necessary adjustments made.

The exhaust fan should be given proper attention the same as any other high-speed machine. It should be kept in proper alignment and tightly bolted to its foundation.

Suction hoods, which have been removed to adjust the machines, should be replaced as soon as the adjustments are completed.

Never start a machine with the blast gate closed, as the slight air leakage past the blast gate may draw material into the pipe and clog it.

Disconnect furnace feeders from the furnaces when not in operation, and do not overload the system by ill-advised additions.

CHAPTER XXXIII

NATURAL VENTILATION

Motive Forces, Proper Arrangements for Coordinating Temperature Difference and Wind Effects, Fundamental Formulae, Practical Installation Suggestions, Ventilators for Industrial, Residential and Farm Building Types.

NATURAL ventilation requires no motive power equipment and costs nothing for power to operate. Enormous areas can usually be made available for air flow, and rates of air change in excess of those usually feasible with fans may often be attained. On the other hand, natural motive forces being largely beyond human control, natural ventilation is not as amenable to regulation as a fan system.

The natural forces available for utilization in ventilation are (1) the wind, and (2) the temperature difference between the inside and outside of a building. These two forces are entirely separate and distinct, and may either cooperate or oppose each other at any given ventilating opening. If possible, therefore, openings should be arranged so that the two forces always act cooperatively, or the control should be such that only groups of openings at which cooperative action occurs will be in use.

THE WIND

The wind operates to produce regions of pressure or suction about the exterior of a building as compared with the conditions that would exist in these regions if the air were still. The action of the wind is described in a paper by W. C. Randall, Airation of Industrial Buildings, A. S. H. & V. E. JOURNAL, January, 1928. The principal effects of the wind when blowing directly against one face of a building are illustrated in Fig. 1. The maximum intensity of pressure at point C is approximately given by the equation.

$$P_w = 0.00048M^2 \qquad (1)$$

where P_w is pressure in inches of water, and M is velocity of wind in miles per hour. The mean pressure over the windward face is somewhat less, being perhaps 75 per cent of the maximum.

The maximum suction occurs at point B at roof and sides, and in magnitude is about three-quarters of the maximum pressure as given by equation (1). The distance A, measuring the extent of the suction regions on sidewalls and roof, caused by the leap, or splash, of the wind from the windward face, seems to be determined by the height and width of the windward face, and is independent of the wind velocity. The intensity of the suction diminishes from the maximum at B to zero at the point where the stream lines again flow parallel to the surfaces of the building.

Maximum effect of the wind in producing ventilation can be obtained by providing openings in the windward face for ingress of air and in the

Material for this Chapter was prepared especially for THE GUIDE by the following committee: Prof. J. E. Emswiler, *chairman:* Prof. J. P. Calderwood, Prof. F. L. Fairbanks and W. C. Randall.