Design Based on Total Air Flow

Where the foregoing factors are not known, the usual method of designing an exhaust system is to base the air flow through the system on rates of flow (through each hood) which have been found by experience to provide adequate control. For woodworking systems the sizes of branch connections in common use are given in Table 2.

Similar data for grinding and buffing wheels are given in Table 3.

Velocity Contours

It is possible by use of a specially constructed Pitot tube[12] to map contours of equal velocity in any axial plane located in the field of influence. It has been found that the positions of these contours for any hood can be

TABLE 3. BRANCH PIPE SIZES FOR GRINDING AND BUFFING HOODS
Based on a Pipe Velocity of 4500 fpm.

Type of Wheel	Wheel Size Diameter, In.		Maximum		Branch Pipe Minimum Diameter, In.
	Min.	Max.	Width In.	Area Sq In.	
Grinding	—	9	1	30	3
	9	18	3	175	4
	18	24	4	300	5
	24	30	5	500	6
	30	36	6	700	7
Disc Grinding	—	20	—	300	4
	20	30	—	—	5
Buffing, Polishing and Scratch Brushing	—	8	2	50	3½
	8	16	3	150	4
	16	24	4	300	5
	24	30	6	600	6

expressed as percentages of the velocity at the hood opening and are purely functions of the shape of the hood[13].

Further, the velocity contours are identical for similar hood shapes when the hoods are reduced to the same basis of comparison. These facts are applicable to all hood problems so that when the velocity contour distribution is known, the air flow required can be determined. Fig. 1 shows the contour distribution in two axial planes perpendicular to the sides of a rectangular hood with a side ratio of one-half. The distribution shown is identical for all openings with a similar side ratio, provided the mapping is as shown in the figure. The contours, of course, are expressed as percentages of the velocity at the opening.

Low Velocity Systems

On multiple installations of the same operation, it is often possible to institute a great saving in power cost by designing an exhaust system using low velocities in the main ducts. Such a system for use in grinding and shaping porcelain has been described[14]. In these operations, the separate machines are grouped around a central plenum chamber and exhausted by means of a low pressure fan connected to the plenum. In

one such case a power saving of over 90 per cent was obtained. A similar design technique[15] has been described for use in ventilating plating tanks.

Canopy Hoods

Canopy hoods are being replaced by other types of hoods, such as slotted hoods at tank operations. Where canopy hoods are used, they should

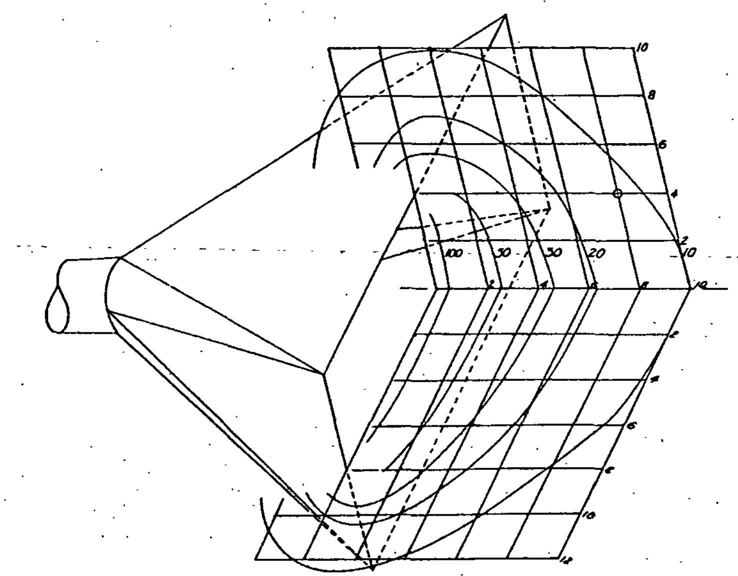

FIG. 1. VELOCITY CONTOURS FOR RECTANGULAR OPENING WITH A SIDE RATIO OF ONE-HALF. CONTOURS ARE EXPRESSED AS PERCENTAGES OF THE VELOCITY AT THE OPENING

extend 6 in. laterally from the tank for every 12 in. elevation, and wherever possible they should have side and rear aprons so as to prevent short circuiting of air from spaces not directly over the vats or tanks. In most cases, hoods of this type take advantage of the natural tendency of the vapors to rise, and air velocities may be kept low. Cross drafts from open doors or windows disturb the rise of the vapors, and therefore provision must be made for them. The air velocities required also depend upon the character of the vapors given off. The recommended minimum capture velocity is 100 fpm.

The quantity of air which must be exhausted to obtain any given capture velocity is expressed by the following equation:

$$Q = 1.4\,PDV \quad (5)$$

where

Q = quantity of air exhausted by hood, cubic feet per minute.
P = perimeter of the tank, feet.
D = distance between tank and hood opening, feet.
V = capture velocity, feet per minute.