mains should be a certain percentage greater area than the sum of the connections, and still lower power consumption can be obtained by using larger branches and mains of equal area. While the rule of thumb method of determining size of mains works very well in many cases, yet it is always desirable to figure the mains and branches of the proper size to give the velocity which has been found best suited to the work to be done.

In certain special cases where explosive or poisonous dusts such as aluminum buffings, grain dust, powdered sugar, or lead dust are handled, increasing the size of the mains unduly would introduce a serious hazard.

The maintained resistance of the exhaust system is composed of three factors: (1) loss through the hoods; (2) collector drop; and (3) friction drop in the pipes.

The collector drop in inches of water is given roughly by equation (2)

Table 4. Cubic Feet of Air Handled Per Minute Through Average Collecting Hoods

Based on Coefficient of Orifice of 0.71 with 10 Per Cent Added for Leakage

Diameter of Connection Pipe In.	Maintained Suction—In. Water Gage						
	1	1½	2	2½	3	4	5
1½	38	47	54	61	67	76	86
2	68	84	97	108	118	136	153
2½	107	131	161	168	185	214	238
3	153	188	217	243	266	306	343
3½	209	256	296	330	362	418	466
4	273	334	386	431	473	546	609
4½	345	423	488	546	598	690	775
5	427	523	605	676	741	854	955
6	614	751	867	970	1062	1228	1373
7	835	1023	1181	1322	1448	1670	1870
8	1092	1337	1546	1727	1892	2184	2440
9	1381	1694	1953	2184	2387	2762	3091
10	1705	2090	2409	2695	2959	3410	3806

but where possible the resistance of the particular collector to be used should be ascertained from the manufacturer as these resistances differ quite widely.

$$\text{Drop} = C\left(\frac{V}{1{,}000}\right)^2 \qquad (2)$$

where

C = a constant which depends upon the type of collector and ranges from 0.065 to 0.145.

V = velocity in feet per minute of air entering the collector.

Friction drop in the pipes must be computed for each section where there is a change in area or in velocity. Find the velocities in each section of pipe starting with the branch most remote from the fan. The friction drop for these sections can be determined by reference to Table 5. Total friction loss in the piping system is the friction drop in the most remote branch plus the drop in the various sections of the main, plus the drop in the discharge pipe.

TYPICAL LAYOUT AND CALCULATIONS

To illustrate the method of laying out and calculating the elements of an exhaust system, assume a small wood-working shop, having one 16 in. diameter rip saw, one 12 in. diameter cut-off saw, one band saw with 2 in. blades, and one planer with 10 in. knives, and with the general arrangement of the machines and exhaust system as shown in Fig. 1.

First, determine the sizes to be used for the branch connection to the hoods. These sizes can be taken from Table 1 giving due consideration to the type and size of machines as well as the class of work handled. (See Table 6).

Table 5. Frictional Resistance of Straight Conveyor Pipe

To Flow of Air Per 100 Feet of Pipe

Vel. of Air in Ft. per Min.	Loss of Pressure in Inches for Given Diameter Pipe						
	4″	5″	6″	7″	8″	10″	12″
2000	1.92	1.53	1.28	1.09	0.962	0.770	0.640
2200	2.32	1.85	1.55	1.32	1.16	0.932	0.778
2400	2.77	2.22	1.84	1.58	1.39	1.01	0.924
2600	3.26	2.60	2.17	1.86	1.63	1.30	1.08
2800	3.76	3.01	2.52	2.15	1.89	1.51	1.26
3000	4.33	3.46	2.88	2.47	2.08	1.73	1.44
3200	4.93	3.94	3.28	2.82	2.47	1.97	1.64
3400	5.56	4.45	3.71	3.18	2.78	2.22	1.85
3600	6.23	4.98	4.15	3.56	3.12	2.49	2.08
3800	6.95	5.55	4.62	3.97	3.48	2.78	2.32
4000	7.69	6.15	5.13	4.40	3.85	3.08	2.57
4200	8.48	6.78	5.65	4.85	4.25	3.49	2.83
4400	9.26	7.41	6.18	5.30	4.63	3.71	3.09
4800	11.05	8.85	7.38	6.32	5.55	4.43	3.69
5200	13.00	10.50	8.66	7.44	6.50	5.21	4.34
5600	15.25	12.05	10.05	8.61	7.55	6.03	5.05
6000	17.30	13.85	11.52	9.89	8.66	6.92	5.76
	14″	16″	18″	20″	22″	24″	30″
2000	0.550	0.482	0.428	0.385	0.350	0.320	0.257
2200	0.655	0.582	0.578	0.465	0.423	0.388	0.310
2400	0.790	0.693	0.617	0.553	0.504	0.462	0.369
2600	0.930	0.810	0.722	0.650	0.590	0.542	0.434
2800	1.07	0.932	0.838	0.754	0.685	0.628	0.503
3000	1.24	1.08	0.961	0.865	0.788	0.722	0.577
3200	1.41	1.23	1.09	0.985	0.895	0.820	0.657
3400	1.59	1.43	1.24	1.11	1.01	0.925	0.742
3600	1.78	1.56	1.38	1.25	1.13	1.04	0.832
3800	1.99	1.74	1.54	1.39	1.26	1.16	0.926
4000	2.20	1.92	1.71	1.54	1.40	1.28	1.03
4200	2.43	2.12	1.88	1.70	1.54	1.42	1.13
4400	2.66	2.33	2.06	1.85	1.68	1.54	1.24
4800	3.17	2.77	2.46	2.22	2.02	1.85	1.48
5200	3.72	3.25	2.89	2.61	2.36	2.16	1.75
5600	4.32	3.78	3.35	3.02	2.74	2.52	2.01
6000	4.95	4.33	3.85	3.46	3.14	2.89	2.31

FRICTIONAL RESISTANCE OF ELBOWS

Elbows having a throat radius equal to the pipe diameter set up a resistance equivalent to a section of straight pipe approximately 10 diameters long. With a throat radius of 1½ times the diameter the resistance is about the same as seven diameters of straight pipe.