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Editorial and Executive Offices

GRANT BUILDING
ATLANTA, GEORGIA

SOUTHERN POWER AND INDUSTRY

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PRACTICAL DISCUSSION

DEPARTMENTS

Dust Exhaust Systems—

By C. C. Hermann

This article discusses the scale of effectiveness of dust collection systems and presents methods for checking air velocity and resistance.

THE effectiveness of a dust exhaust and separation system is not measured by the weight of solids removed, the weight of air handled or the efficiency of the separating equipment but by the ability of the system to reduce the dust count in the working area to an acceptable safe minimum. The safe limits for several common atmospheric dusts are set forth in Table I.

The allowable amounts vary for different cities and states which accounts for the spread given in the table. It is advisable to consult local and state codes for verification in every case. This is the yard stick by which the effectiveness of the dust collection system must be measured.

Dust Collector

The effectiveness of the dust collector lies in the amount of fine dust it fails to remove from the air. The dust loading from the productive operations may be high, 50 to 100 grains of solids per cubic foot of air, but the air discharged from the collector should not exceed the city and/or state codes which in some instances is specified but in most instances is not. While it is true that the air from the collector discharge is liberated outside, an over burden of contaminates may result as a plant nuisance, a neighborhood nuisance or even a hazard to health. The contaminated air may short circuit back into the work rooms of the plant through open windows or doors. It is well then to bear in mind that the dust collector has a job to do.

Exhaust Fan

The efficiency of the exhaust fan is very well established by the design and the original system was installed with a clear knowledge of what this efficiency was. The fan efficiency will not remain constant since many things can happen to the fan. The belt may be slipping resulting in a reduction in speed and since the volume handled by the fan and its static capacity are functions of speed there will be a considerable change in volume handled. The fan blades may become bent or coated with material from the air stream and the internal walls of the housing may become badly worn, rusted or caked with material all of which will effect its efficiency.

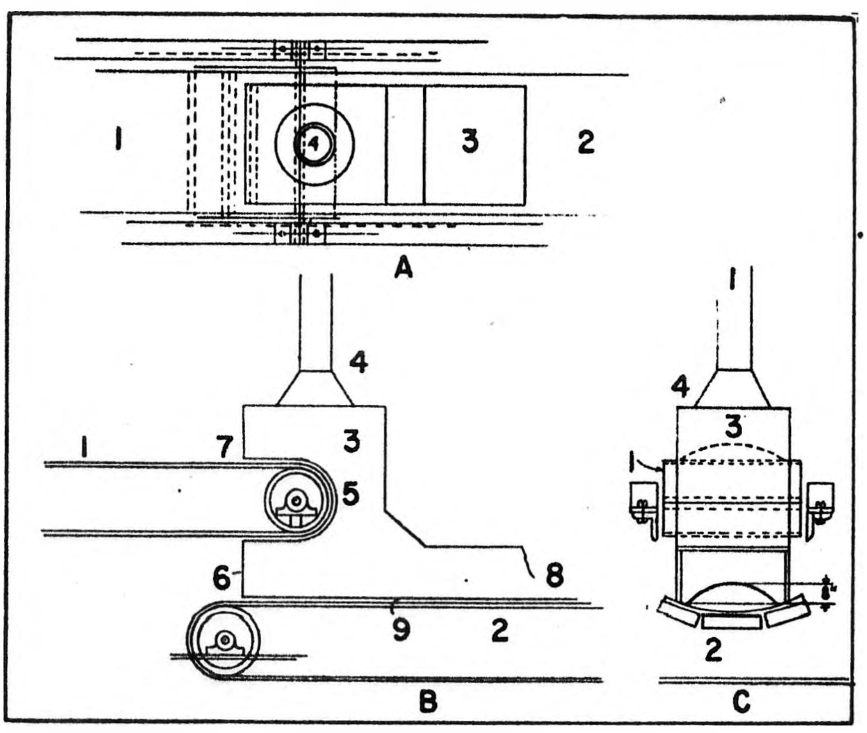
Duct Work

The duct work connecting the various dust points to the dust collector may acquire a heavy internal coat of solids. Solids may have precipitated out of the air stream and lay in the bottom of the pipes. All of these things cause a change in the functioning of the system and they all show up at the points of production in the way of reduced ventilation and a subsequent increase in the dust count of the atmosphere at this point.

Hood

It is often possible to correct a deficiency in ventilation and keep the dust count down at a given production point by making a change in the hood. Take for example the belt transfer point on a foundry sand handling system, as shown in Fig. 1, in which "A" is a plan view, "B" is a side elevation and "C" is an end elevation. The delivery belt is shown at 1, the take-away belt at 2, the dust hood at 3, and the exhaust duct at 4. The belts are 24" wide and the material handled is molding sand removed from the shake-out but still of sufficient high temperature to produce a very heavy dust cloud at the point where the sand is transferred from one belt to another by falling through the space

FIG. 1. FOUNDRY SAND HANDLING SYSTEM.



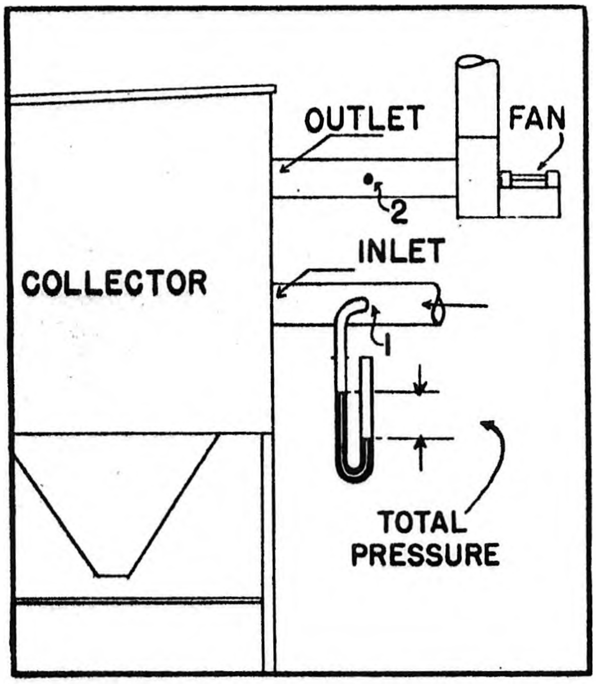


FIG. 2. MEASURING RESISTANCE ACROSS DUST COLLECTOR.

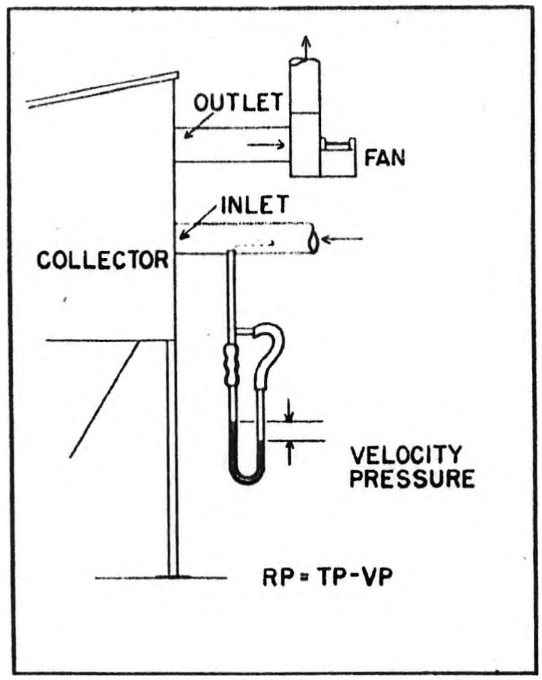


FIG. 3. USE OF THE STATIC TUBE IN CHECKING RESISTANCE.

between the two belts.

After many experiments and trials it has been found that a hood such as shown provides a very effective means for capturing the dust. The dust particles may be as small as a fraction of a micron in size and never settle in a moving atmosphere. Left open to the general atmosphere the particles would contaminate the air for a considerable distance around the belt transfer point. Properly hooded the hazardous dust can be readily removed, i.e., force as much air into the hood as it is designed to take out. The proper ventilation for a 24" or 30" belt is 750 cfm and for a 36" to 42" belt 1000 cfm.

The air is removed from the hood through the duct connection 4 located at the high point of the hood. The replacement air is admitted through the openings at 5, 6, 7, 8 and 9. The opening at 6 is a free opening while the others are restricted. A piece of leather secured to the top edge of the openings 7 and 8 restrict these since the leather will ride on the sand heap allowing air to enter at each side where the sand slopes away toward the edge of the belt. The opening along the sides at 9 and around the pulley and belt at 5 are restricted as much as possible. The total openings are tabulated as follows:

		Sq. In.
5. 1½" clearance around the belt, 14" pulley	=	81
6. 24" wide by 12" high between belts	=	288
7. Sand heap 8" high, each opening 36 sq in	=	72
8. Same as No. 7	=	72
9. 1½" x 36" each side	=	108

a total of 621 sq in or 4.31 sq ft. Then 750 cfm/4.31 = 175 fpm velocity of the inflowing air. Where there are no strong cross drafts existing this velocity is satisfactory, however, it is near the minimum as any appreciable decrease in the volume handled by the exhaust system would drop the input velocity below the desired minimum.

One way to determine if such hood is performing as it should would be to make a dust check of the atmosphere in the vicinity of the hood. In the absence of a dust counting apparatus or skilled assistance to make such count, the air volume handled by the pipe leading away from the hood can be determined and compared with the design figures. The mere taking of static readings at this point would be of slight value. Observations made with the eye would, likewise, be questionable in view of the microscopic nature of the dust.

Air Velocity

A velometer or any other type of pitot tube can be used to make air velocity readings direct in a duct. The jet is connected to the

(*Continued on page* 84)

TABLE I

Approximate safe limits for atmosphere dusts

Substance	Free silica content	Millions of particles per cu. ft. of air by light field, low power counting technic.
Silica dust	10% or more by weight	5 to 10
Silica dust	Less than 10% by weight	30 to 100
Asbestos dust		5
Blast cleaning		10
Foundry general		30

Dust Systems

(*Continued from page* 65)

indicator and a hole large enough to receive the staff is made in the side wall of the duct. The staff is inserted to the centerline of the pipe, the staff being marked off in inches and fractions for convenience in locating the jet. Readings, taken for each inch of radius of the pipe are added and divided by the number of readings to obtain an average velocity.

Table II shows velocities in fpm corresponding velocity pressure and the volume of air carried by pipes of different diameters. Suppose the average of our readings was 3,750 fpm and the diameter of the air duct was, by measurement 6″. Going down the column of figures below the 3,750 fpm heading to the 6″ dia. pipe line we find that the volume handled is 736 cfm. This is within 14 cfm of the design. But suppose the velocity read only 3,000 fpm—under the 3000 fpm heading we find 589 cfm as the volume flowing in a 6″ pipe. Dividing this by 4.31 sq ft as found to be the hood opening above, we have an inlet velocity of 136 fpm or a reduction of 22½% and to return the inlet velocity to the original design amount of 175 fpm we must close off at opening No. 6 to 1.4 sq ft. The alternative would be to go through the system and determine the cause of the reduction in velocity and correct the trouble at its source. This latter course is the logical one since other vent points must be affected in a similar manner.

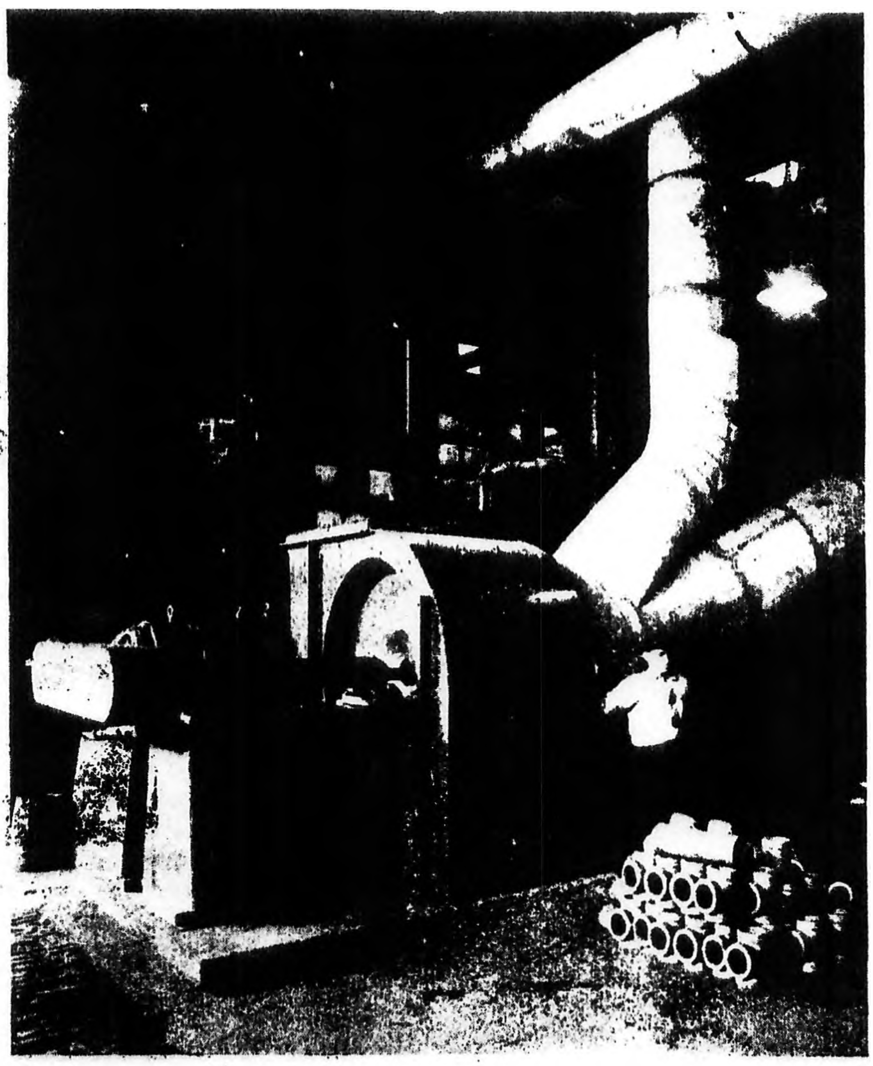
Resistance Check

When dealing with a system which has been in service for a considerable period of time and trouble of this character is discovered the next logical step would be to take a resistance test across the dust collector. The resistance of dust collectors varies in different makes. The resistance of the dry type collector varies from 1″ to 3″ water gauge, and in a wet type collector the resistance from inlet to outlet is approximately 3″ water gauge. The standard resistance for a given type and make collector should be obtained from the manufacturer.

To measure the resistance across the collector, regardless of type and make, static readings should be made at point 1 on the dirty air side of the unit as shown in Fig. 3 and at 2 on the clean air side of the unit. There may be a slight difference in the velocity at the respective points but for the present purpose this may be ignored. Subtract the pressure reading at 1 from the pressure reading at 2 if the fan is beyond 2 or on the clean air side. The difference in total pressure thus obtained is the approximate resistance of the unit.

If a pitot tube is being used take the RP at the two points and make the subtraction to obtain the resistance of the unit. If the fan is on the dirty air side of the collector and is blowing through use the static tube as shown in Fig. 3 and subtract reading NO. 2 from NO. 1 to obtain the resistance of the unit. Compare this with the manufacturer's standard and if it is high it indicates that a plug is forming, or has formed in some part of the collector. Perhaps it merely needs cleaning. Filter type collectors will increase in resistance when used without periodic shaking but will reduce in resistance when worn out or contain damaged cloth or bags.

FIG. 4. EXHAUST FAN DRIVE INSTALLATION.
Courtesy American Foundry Equip. Co.



Exhaust Fan Drives

Exhaust fan drives give considerable trouble from slipping particularly when the motor is mounted wrong and the pull of the belt is on the top stands instead of the bottom for wide center drives. Fig. 4 is an excellent drive design. One improvement could have been made by lowering the motor somewhat as the angle drive has some desirable features. The motor is on the discharge side of the fan and the bottom strand of belt is

TABLE II

Air Volume in Pipes at Specific Velocities and V. P.
$VP = (V/4006)^2$

Dia., inches	Area, sq ft	3000′ V 0.56 VP	3500′ V 0.76 VP	3750′ V 0.88 VP	4000′ V 0.997 VP	4500′ V 1.26 VP	5000′ V 1.56 VP
2	.0218	65	76	82	87	98	109
3	.0491	147	172	184	196	221	246
4	.0873	262	306	327	349	393	437
5	.1364	409	477	512	546	614	682
6	.1964	589	687	736	786	884	982
7	.2673	802	936	1002	1069	1203	1337
8	.3491	1047	1222	1309	1396	1571	1746
9	.4418	1325	1546	1652	1767	1988	2209
10	.5454	1636	1909	2046	2182	2454	2727
11	.6600	1980	2310	2475	2640	2970	3300
12	.7854	2356	2749	2946	3142	3534	3927
13	.9218	2765	3226	3507	3687	4148	4609
14	1.0690	3207	3742	4009	4276	4811	5345
15	1.2272	3682	4295	4602	4909	5522	6136
16	1.3963	4189	4887	5236	5585	6383	6982
17	1.5763	4729	5517	5911	6305	7093	7882
18	1.7671	5301	6185	6627	7068	7952	8836
19	1.9690	5907	6892	7384	7876	8861	9845
20	2.1817	6545	7636	8182	8727	9818	10908
21	2.4053	7216	8419	9020	9621	10826	12027
22	2.6398	7919	9239	9899	10559	11879	13199
23	2.8852	8656	10098	10820	11541	12983	14426
24	3.1416	9425	10996	11781	12566	14137	15708
25	3.4088	10226	11931	12783	13635	15340	17044
26	3.6870	11061	12905	13827	14748	16592	18435
27	3.9761	11928	13916	14910	15904	17892	19880
28	4.2761	12828	14966	16035	17104	19242	21381
29	4.5869	13761	16054	17151	18348	20641	22935
30	4.9087	14726	17180	18408	19635	22089	24544

under tension when power is on while the top strand may lay down thus increasing the angle of contact. The drive is nearly a ratio 1:1 and is protected by a heavy sheet metal shield. The motor is provided with a take-up base. A desired feature of belt guards is an opening opposite the shaft ends so that shaft speeds may be taken without the necessity for removal of the guard. Knowing the design speed for the fan and having the name plate speed of the motor it is a simple matter to check the slippage by aid of a revolution counter.

Reconstruction of Italy's Utilities

(Continued from page 67)

In Sicily, Sardinia, and Southern Italy, the Germans did comparatively little damage to the power systems. There was little heavy industry in this part of Italy, hence they did not see the necessity of demolishing power facilities, and the war was moving so rapidly that they had no time to plan extensive demolition. Then, too, they thought that they would soon be back and would need this equipment.

However, things could hardly be said to have been left undisturbed. In order to obtain conductors to repair a 70,000 v trunk line in Sicily, it was necessary to recover and use much of the overhead trolley-wire of the street-car system of wrecked Messena.

A group of Hydro-electric plants in Calabria (the part of Southern Italy so well known to the readers of Norman Douglas) with a capacity of 170,000 kw was left practically undamaged. This capacity was soon in operation and supplied Naples, Toronto, Bari, and Foggia. Before the transmission line from these plants to Naples was put in service, the city was supplied with power from submarines in the harbor. Naples' own steam plant (normally a standby), which was considerably damaged, was repaired by the Royal Navy, and its three 15,000 kw units went into operation in May, August, and November of 1944.

Central Italy

Conditions were quite different in central Italy. By this time the fighting was moving forward slowly, the Germans were angry with the Italians for quitting, and they began to see that there was little likelihood of their regaining much lost territory. With these things in mind, the Germans did a thorough job of demolition, destroying 93% of all power generating capacity between Naples and Florence. The effective generating capacity in this area had amounted to about one million kw, but after the Germans left, only 57,000 kw were in operating condition. Of this, 30,000 kw were in two old standby steam plants in Rome.

The Electrical Division and other Allied Military Units went to work immediately and within six months had increased the plant capacity to 170,000 kw and then added another 170,000 in the following year. This was accomplished primarily by rebuilding wrecked machinery without the import of new parts. Construction materials, as well as food, were in the black market, and in 1943-44 it took six months to receive an order from the states. Major overhaul jobs were undertaken and completed in the field that would have been considered impossible under most favorable peace-time conditions. For example, the main casting for a 12,000 kw, 3000 rpm steam turbine was cast, machined, and assembled without blueprints (the factory in Northern Italy being in German hands) and with only the broken and scattered pieces of the demolished casting to use as a pattern.

Sheet mica for insulating commutator bars and generator coils