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Title: Tests Conducted on Exhausts of Gins Handling Machine Picked Cotton

Oliver L. McCaskill and Richard A. Wesley

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By
OLIVER L. McCASKILL
and
RICHARD A. WESLEY[1]

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Several preliminary test procedures were tried in determining the dust concentration in the exhaust air from cyclones and condensers. The best method was isokinetic sampling of the positive pressure side of the fan and in a straight section of pipe at least ten pipe diameters in length. Isokinetic sampling means the matching of velocity in the sampling nozzle to the velocity in the discharge pipe at the same location.

The equipment necessary for sampling one exhaust system is as follows:

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The diameter of the discharge pipe was selected to obtain a velocity that would be in the range of the high volume sampler for isokinetic sampling. The high volume sampler used has a maximum capacity of approximately 70 c.f.m. through a clean filter but would be operated in the range of 40 to 50 c.f.m. This range will enable compensation of pressure drop due to increase loading of the filter.

The filters used on the high volume air samplers were 8 x 10 inch Gelman Type-A fiberglass. After the test, the filter was carefully folded and placed in an envelope. They were then conditioned in the moisture laboratory for at least 24 hours at 65 degrees RH and 75 degrees F before weighing. The filters were weighed to the nearest ten-thousandth of a gram on an analytical balance. The amount of material collected was obtained by substracting the original filter weight from the final filter weight. The volume of air sampled was calculated from the visifloat reading and time of the test run. The air volume was corrected

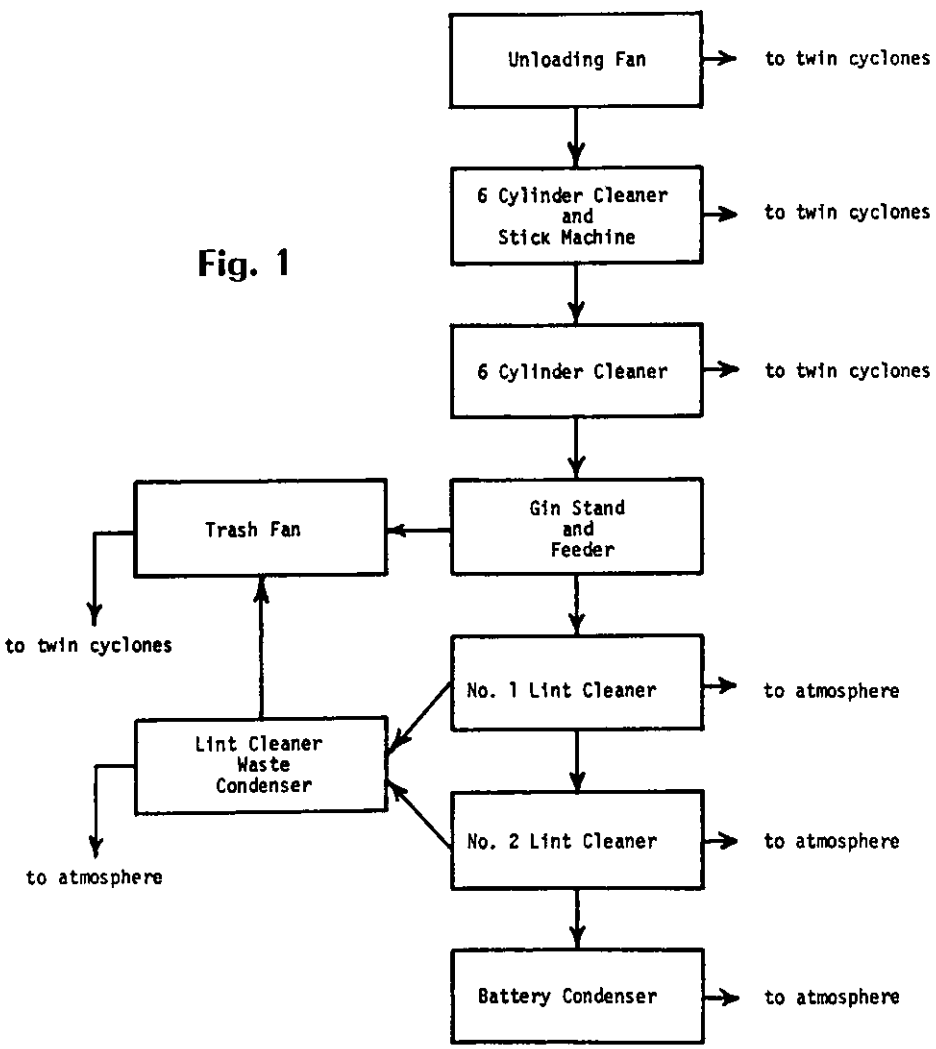

Fig. 1

[1] Agricultural Engineers, Respectively, U.S. Cotton Ginning Research Laboratory, USDA, ARS, AERD, Stoneville, Mississippi.

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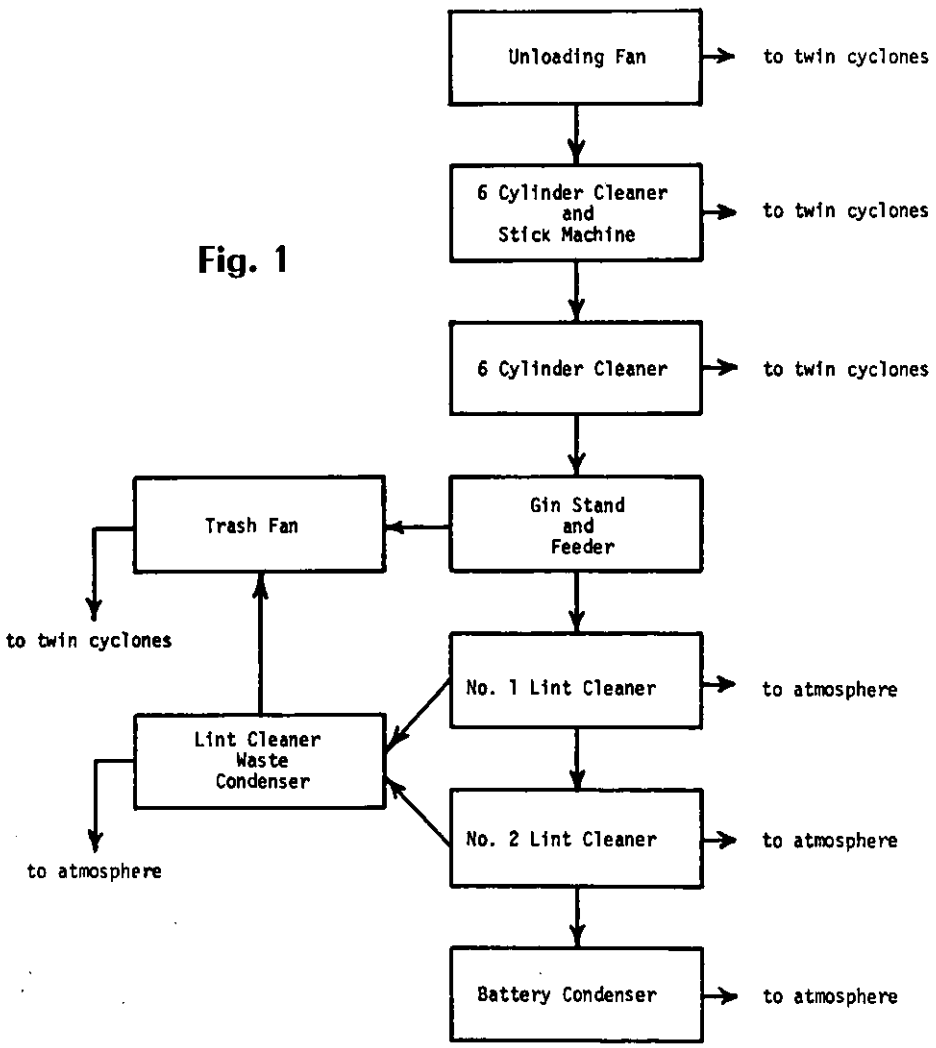

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13.51 pounds per hour. Here again the highest concentration of material is from the unloading fan cyclone exhausts and the lint cleaner condenser exhausts. The amount of material from the condenser exhausts can be substantially reduced by covering the condenser drums with fine mesh bolting cloth or perforated metal having a hole diameter of .033 inches and a minimum open area of 20 per cent. Still further reduction may be accomplished by the installation of inline filters.

TABLE 2.—Dust Concentration for the Lint Cleaner Waste Condenser Exhaust with and without a Pressure Switch[1].

Pressure switch control	Dust concentration		
	High	Low	Average
	Micro gm/m³	Micro gm/m³	Micro gm/m³
Without[2]	63,244	30,175	45,666
With[3]	24,757	11,519	18,127
Efficiency, per cent	60.9	61.8	60.3

[1] Condenser drum covered with 100 x 100 mesh screen. Average ginning rate: 7.43 bales/hr.
[2] Each figure is the average of 37 one bale lots.
[3] Each figure is the average of 10 one bale lots.

TABLE 3.—Dust Emission from Gin Exhausts during the Ginning of Machine Picked Cotton.

Exhausts	Process rate	Total emission per bale		
		High[1]	Low[2]	Average
	Bales/hr.	Grams	Grams	Grams
Cyclone Exhausts				
Unloader fan	12.41	304.47	7.13	64.31
6 cylinder cleaner and stick machine	8.73	5.73	.98	2.44
6 cylinder cleaner	8.73	3.15	.58	1.71
Trash fan	8.73	6.27	1.35	3.00
Condenser Exhausts				
No. 1 lint cleaner	3.80	239.92	10.89	120.29
No. 2 lint cleaner	3.80	96.85	6.21	35.92
Battery	8.30	82.53	26.42	50.05
Lint Cleaner Waste	7.43	87.31	36.58	61.49

[1] Highest single emission of all tests.
[2] Lowest single emission of all tests.

TABLE 4.—Total Emission Adjusted to a 10 Bale per Hour Plant Ginning Machine Picked Cotton.

Exhausts	Total emission			
	High[1]		Average	
	Grams/hr.	Lbs./hr.	Grams/hr.	Lbs./hr.
Cyclone Exhausts				
Unloader fan	2,453.4	5.41	518.2	1.14
6 cylinder cleaner and stick machine	65.6	.14	27.9	.06
6 cylinder cleaner	36.1	.08	19.6	.04
Trash fan	71.8	.16	34.4	.08
Condenser Exhausts				
3 No. 1 Lint cleaners	6,313.7	13.92	3,165.5	6.98
3 No. 2 Lint cleaners	2,548.7	5.62	945.3	2.08
Battery	994.3	2.10	603.0	1.33
Lint Cleaner Waste	1,158.0	2.55	815.5	1.80
Total	13,641.6	30.07	6,129.4	13.51

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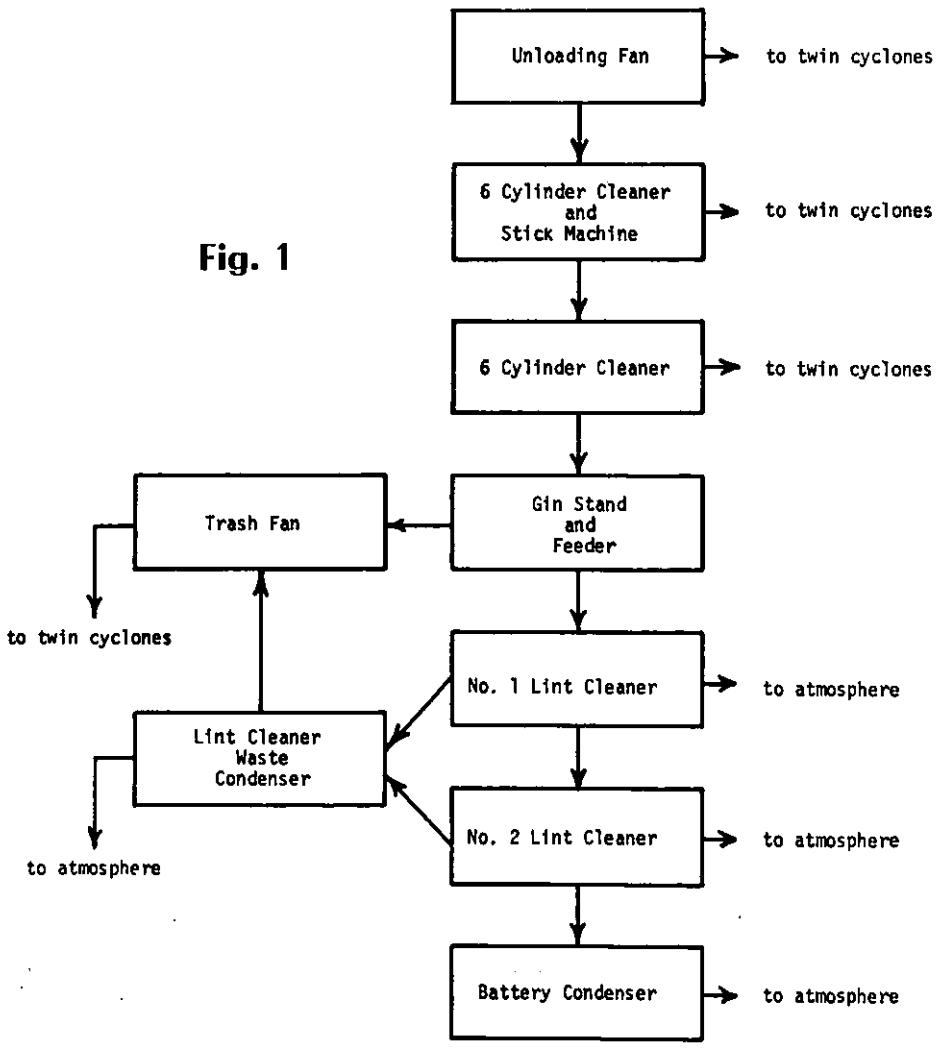

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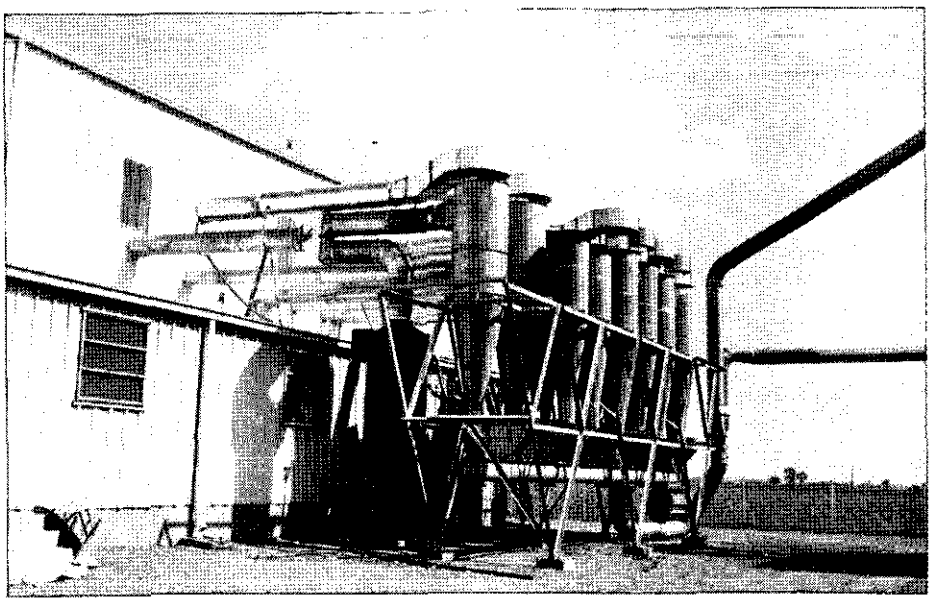

Fig. 2: Cyclones Equipped for Isokinetic Sampling

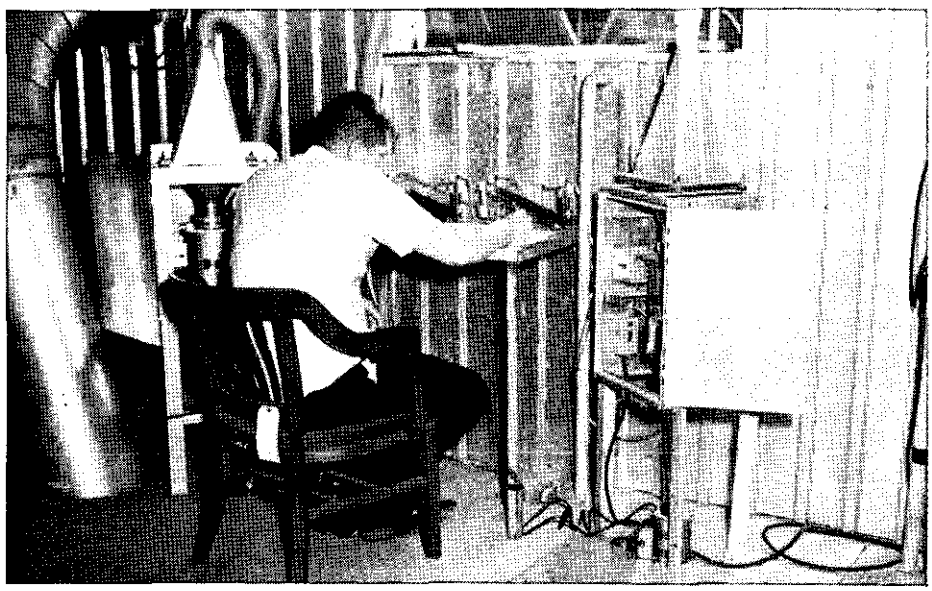

Fig. 3: High Volume Air Sampler Station

to standard conditions (70 degrees F, 50 per cent R.H., 14.696 lb./sq. in.), and the exhaust concentration calculated in micrograms per cubic meter.

This test involved simultaneous sampling of eight exhausts during ginning as follows:

Cyclones:

1. Unloader fan.
2. No. 1 Drying System—6 cylinder cleaner and stick machine Trash.
3. No. 2 Drying System—6 cylinder cleaner Trash.
4. Trash Fan—Extractor feeders, Huller front, motes, and lint cleaner trash.

Condensers:

5. No. 1 Lint Cleaner
6. No. 2 Lint Cleaner
7. Battery
8. Lint Cleaner Waste

One-hundred bales of machine picked Mississippi Delta cotton were sampled in two-bale lots during the ginning season from Oct. 3, 1969, to Nov. 17, 1969, for a total of 50 samples from each exhaust.

The dust concentration from the various exhausts and the extreme variation between readings for each location are given in Table 1. The dust concentration from the unloading fan cyclones is much greater than from any of the other cyclones. This was quite surprising. This may be partially explained by the fact that the large trash entering the other cyclones aide in trapping the very fine dust so that it does not escape with the exhaust air. The condensers are also high contributors to dust emission. The emission from the number 1 lint cleaner exhaust was the highest while the battery condenser was the lowest. It would appear from these tests that the cleaner the lint the less the material coming from the condenser exhaust.

The lint cleaner waste handling system used in these tests is composed of a 48-inch condenser and a 29-inch vaneaxial suction fan equipped with a 20-h.p. motor. The condenser drum was covered with 100 x 100 mesh screen to eliminate the lint fly in the exhaust. It was also equipped with a pressure switch control to operate the condenser on pressure demand. This intermittent operation allowed a batt of lint cleaner waste to cover most of the condenser drum to give additional filtering of the air. The switch was set to operate at two inches differential static pressure across the condenser and cut off at approximately 1.5 inches.

The effect of the intermittent operation has on reducing the discharge from the condenser exhaust is clearly shown in Table 2. The use of the pressure switch increased the dust collection efficiency by 60.3 per cent.

The per-bale dust emission at the wide variation between samples for the various exhausts are given in Table 3. The exhausts emitting the greatest weight of material per bale were the cyclones on the unloading fan and the number one lint cleaner condenser.

To obtain some idea of what the total emission would be from a 10-bale-per-hour plant a straight line relationship between capacity and emission rate was assumed. The results of these projections are given in Table 4. It is noted that the average total rate of emission calculated for a 10-bale-per-hour ginning rate is

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6 cyliinder cleaner and stick machine	8.73	7,346	4,002	679	1,686
6 cylinder cleaner	8.73	8,436	1,795	346	1,049
Trash fan	8.73	8,208	3,807	857	1,874
Condenser Exhausts					
No. 1 lint cleaner	3.80	6,903	83,247	3,284	38,852
No. 2 Lint cleaner	3.80	2,812	73,255	5,257	27,523
Battery	8.30	15,874	23,578	8,637	15,358
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