EFFECTIVENESS OF AIR-TYPE LINT CLEANERS AT COMMERCIAL GINS

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Abstract

Experiments were conducted at two commercial gins to study the characteristics and efficiency of flow-through air-type lint cleaners operating under standard field conditions. Overall, one air lint cleaner gave a cleaning efficiency of 12 percent compared to 28 percent for one saw lint cleaner. However, the air-type cleaners caused less fiber damage than the saw-type cleaners. Although textile mills prefer that ginned lint be cleaned at gins with only one saw-type lint cleaner, many gins use two stages of saw lint cleaning to obtain higher grades. The results indicate that air-type lint cleaners may better supplement lint cleaning with only one saw-cylinder lint cleaner and ensure acceptable market return.

Introduction

Saw-type lint cleaners are used in cotton gins to remove leaf particles, bract, seed-coat fragments, motes, grass and bark; comb the fibers to produce a "smooth" appearance; and to blend spots. Virtually all cotton gins in the United States have lint-cleaning facilities, and most saw-type gins have two or more stages of lint cleaning. The lint cleaners for saw gins are of two general types, flow-through air type and controlled-batt saw type.

The flow-through air lint cleaner, commercially known as the Air Jet/Super Jet, Centrifugal Cleaner, or Super Mote Lint Cleaner, has no saws, brushes, or moving parts (10). It is usually installed immediately behind the saw gin stand. Loose lint from the gin stand is blown through a duct within the chamber of the air lint cleaner. Air and cotton moving through the duct make an abrupt change in direction as they pass across a narrow trash-ejection slot. Foreign matter that is heavier than the cotton fibers and is not too tightly held by fibers is ejected through the slot by inertial force. The amount of trash taken out by the air jet is controlled by opening and closing this cleaning slot. In some cases boost air is added to maintain an air velocity of 10,000 to 12,000 ft/min at the cleaning nozzle.

The controlled-batt saw cleaner is the most common in the saw-type ginning industry. Lint from the gin stand or a preceding lint cleaner is formed into a batt on a condenser screen drum. The batt is then fed through one or more sets of compression rollers, passed between a very closely fitted feed roller and feed plate or bar, and fed onto a saw-cylinder. The feed roller and plate grip the batt so that a combing action takes place as the sawteeth seize the fibers. While the fibers are on the saw cylinder, they are cleaned by a combination of centrifugal force, scrubbing action between saw cylinder and grid bars, and gravity assisted by an air current. The fibers are usually doffed from the sawteeth by a revolving brush. The number of stages of saw cleaning refers to the number of saws over which the fibers pass.

Flow-through air lint cleaners are less effective than saw lint cleaners in improving the grade of cotton because they do not comb the fibers, but they also remove less fiber from the bale. Fiber length, strength, and neps are unaffected by the air lint cleaner (4, 8).

In one study an air-type lint cleaner extracted an average 4.3 lb of waste per bale compared to 18.8 lb/bale for one saw-cylinder lint cleaner, and improved the classer's leaf factor of grade by about one-half grade. It also reduced the weight of seed-coat fragments in ginned lint by 12 percent. By weight the seed-coat fragments, motes, and funiculi together comprised about 55 percent of the waste extracted by the air-type cleaner (7).

Lint cleaning generally improves the grade classification of the lint. As the number of lint cleaners increase, grade tends to increase. However, as grades improve bale weights are reduced and staple length may decrease; and these opposing factors affect bale value. In some cases, such offsetting losses may cause the bale value to be reduced by lint cleaning. When price spreads between grades are small, the grower can obtain maximum bale value most often on upland variety cottons by using one saw lint cleaner on early-season clean cottons and two stages of saw lint cleaning on late-season, more trashy, or Light Spotted cottons (3, 6).

Perhaps the best index to cotton quality is the performance of the fibers during spinning at the mill. Increasing the number of saw lint cleaners at the gin decreases the manufacturing waste during spinning, but often has the adverse effects of increasing neps in the card web and lowering yarn strength, appearance, and processing efficiency. A decline in appearance is greater for the finer carded yarns. From a spinning standpoint, the use of more than two saw lint cleaners in series has been strongly discouraged (5, 6).

The number and aggressiveness of lint cleaners used at gins have a significant affect on cleaning efficiency. Yarn manufacturers are focusing more attention on the need for cotton gins to provide improved cleaning efficiency with less fiber damage. This would reduce yarn imperfections and percent short fiber content at the mill. Therefore, the USDA-ARS Cotton Ginning Research Group and equipment manufacturers have started investigations to examine concepts of air-type lint cleaning that give

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acceptable cleanliness and grades for the grower, and yet produce the fiber qualities desired at the mill. The investigations involve field and laboratory tests and design work to make air-type lint cleaners more efficient in removing foreign matter and improving the cotton classer's grade. Improved air-type lint cleaners, in place of adding a second stage of saw-type lint cleaning, might be sufficient to supplement lint cleaning with one saw-cylinder lint cleaner. Field tests were conducted to determine the effectiveness of air-type lint cleaners under standard operating conditions and influence new cleaner designs. This paper discusses the results from the field tests.

Methodology

Experimental Equipment

The experimental ginnings were conducted in 1994 at two commercial gins in the Mississippi Delta near Stoneville, MS. These will be identified in this report as Gins A and B. Both gin plants included flow-through air-type lint cleaners behind each gin stand in their lint cleaning sequence (Figure 1).

Gin A: The seed-cotton drying and cleaning sequence of Gin A consisted of tower drier, 6-cylinder cleaner, stick machine, tower drier, and 6-cylinder cleaner. This cleaning system was a split stream arrangement with the temperature control sensor located at the top of the driers. There were three gin stands, two with 158 saws and one with 108 saws, each stand followed by the air-type lint cleaner and two saw lint cleaners with the split or series option. Seed fingers on the gin stands operated in the almost completely open position. Model "108" saw lint cleaners were used with the 158-saw gin stands and a Model "86" saw cleaner with the 108-saw gin stand. This gin plant normally operated at a ginning rate of 25-30 bales per hour.

Gin B: Gin B also was a slit-stream system. The seed-cotton drying and cleaning sequence of Gin B consisted of a tower drier, 6-cylinder cleaner, stick machine, tower drier, and 6-cylinder cleaner. Temperature sensors near the bottom of the driers controlled the drying temperature. There were three 158-saw gin stands, each followed by an air-type lint cleaner and two Model "86" saw lint cleaners having the split or series option. Seed fingers on the gin stands were set at the fully open position. The plant normally operated at a ginning rate of about 30 bales per hour.

Procedures

Seed cotton used in the experiments was grown and spindle-harvested in the Mississippi Delta in 1994 by customers of the gins. Ten one-bale size test lots were sampled at each of the two commercial gin plants. The 10 bales were selected from six modules at Gin A and from five modules at Gin B. In most cases two bales out of 8 to 10 ginned from each module were selected as test Each set of 10 test bales were grown by a single grower. The cottons were ginned in October 1994.

During the processing of each experimental lot, samples were obtained for seed cotton moisture and foreign matter contents at the module and after seed cotton cleaning at the feeder apron, and for cottonseed moisture level. Lint was sampled for moisture content before lint cleaning; and for classer's grade and staple length, lint foreign-matter content and lint cleaning efficiency, and fiber tests (1) before air-type lint cleaning, (2) after air-type lint cleaning, and (3) after air and saw-type lint cleaning. This procedure allowed comparisons between the air and saw lint cleaner types. At both gins the lint cleaners located behind the first gin stand were sampled.

Gin A: During ginning the drying temperatures on both tower driers were set for 130-135 degrees F. The sampled air-type lint cleaner was eight feet wide and the cleaning slot adjuster was set to a 50% open position. One stage of standard saw-type lint cleaning was used.

Gin B: The drying temperatures were set on about 175 degrees F on the first tower drier and 135 degrees F on the second drier during the tests. An 8-1/2 foot wide air-type lint cleaner was sampled with the cleaning slot adjuster set to a 40% open position. Cleaning slot adjusters were visually set by the ginner to extract a reasonable amount of motes with minimum cotton loss. The saw lint cleaners were operated in the single stage split mode at a 2X combing ratio.

Fiber tests included High Volume Instrument (HVI) measurements, nep counts, Peyer length measurements, and seed-coat fragment levels. The U.S. Agricultural Marketing Service classed the samples and made the HVI measurements at Dumas, AR. Lint foreign-matter content, Peyer length measurements, nep count tests, and seed-coat fragment counts were made at the U.S. Cotton Ginning Laboratory, Stoneville, MS.

Lint foreign-matter content was determined by the Shirley Analyser nonlint tests, ASTM Standard Method D 2812 (1). Lint-cleaners' cleaning efficiency was calculated from lint foreign-matter (total and visible) determinations. Cleaning efficiency is defined as the ratio of foreign matter removed from cotton to the foreign matter content of the cotton as it entered the cleaner, expressed as a percentage.

Samples for the nep count analyses were tested using the Advanced Fiber Information System (AFIS). Seed-coat fragment, cottonseed, mote, and funiculi counts and weights were made on three-gram lint specimens from each test sample. Measurements were made by operators using illuminated magnifiers, analytical balances, and forceps as described in ASTM Method D2496 (2).

The study was analyzed as two experiments, one experiment conducted at each of the two gins. Modules were the replications. Data were averaged over lots within modules prior to the analysis. There were three lint cleaner treatments per test lot--(1) before lint cleaning, (2) after one air lint cleaner, and (3) after one air and one saw lint cleaners. Comparisons were made between lint cleaner treatments at the 0.05 level of probability using the least significant difference (lsd) t-test (9). Comparisons were made for the individual experiments (gins) and after pooling data from the two experiments.

Results and Discussion

Ginning rate for Gin A averaged 28.5 bale/h for the study which loaded the air lint cleaners at a rate of 1.4 bale/h per foot of cleaner width and the saw lint cleaners (standard) at a rate of 1.1 bale/h per foot of saw-cylinder length. Corresponding measurements for Gin B were a 26.4 bale/h ginning rate, 1.0 bale/h per foot loading of the air lint cleaners, and 0.6 bale/hr per foot loading (split stream) of the saw cylinders.

Table 1 shows module averages at each gin plant for seed-cotton and moisture content data. Tables 2-6 depict the lint cleaner study averages for the cleaning, classer's grade, and quality data.

Seed-cotton Foreign Matter

Fractionation tests showed that the initial seed-cotton foreign-matter contents averaged 7.4 percent for the modules ginned at Gin A and 4.8 percent for those at Gin B (Table 1). After seed-cotton drying and cleaning, corresponding foreign-matter contents of the seed-cotton averaged 2.0 and 1.8 percent; the difference between cottons had been removed.

Cotton Moisture Contents

Moisture determinations showed that the initial seed-cotton moisture averaged 9.5 and 8.4 percent for the Gin A and Gin B cottons (Table 1). After seed-cotton drying, moisture content of the seed cotton averaged 8.1 and 6.7 percent for the Gin A and Gin B harvestings. Cottonseed and lint samples showed that seed moisture after ginning at Gins A and B averaged 10.5 and 9.4 percent, respectively, and the corresponding lint moisture contents averaged 4.1 and 3.0 percent. Thus, the moisture contents were different for each material at each location.

Lint Foreign Matter Content

The foreign matter content in ginned lint before lint cleaning (0 lint cleaner treatment), as measured by the Shirley Analyser total waste content, averaged 5.8 percent at Gin A and 5.2 percent at Gin B (Table 2). At Gin A the air-type lint cleaner reduced the foreign-matter content to 5.2 percent and the one saw lint cleaner (standard) further reduced the foreign matter level to 4.0 percent. The air and saw (split) lint cleaners at Gin B gave corresponding foreign matter contents of 4.4 and 2.9 percent. Overall for both gin plants, the air-type lint cleaner reduced the foreign matter 0.7 percent and the one saw lint cleaner reduced it an additional 1.4 percent. The lint foreign-matter content reductions attributed to both the air and saw lint cleaners were statistically significant at the 5-percent level. Foreign matter content in ginned lint, based on the Shirley Analyser visible waste data, averaged about 1.8 percent lower than that based on total waste content.

Cleaning Efficiency

Foreign matter content removal data (total waste) presented as cleaning efficiency, showed that the efficiencies of the air-type lint cleaners (treatment 1) averaged 10 percent at Gin A and 14 percent at Gin B (Table 2). The one saw lint cleaner (treatment 2A) gave an average cleaning efficiency of 22 percent at Gin A and 33 percent at Gin B. Overall, the air lint cleaner gave an efficiency of 12 percent compared to 28 percent for the one saw lint cleaner. Using the visible waste data to calculate lint cleaner efficiency gave somewhat higher cleaning efficiencies, averaging 18 percent for the air cleaner and 40 percent for the saw lint cleaner. The cleaning efficiency of the saw lint cleaner was significantly higher than that for the air lint cleaner. The efficiency of the air and saw lint cleaner in series (treatment 2) was also significantly higher than that for the saw lint cleaner alone.

Classer's Grades and Staple Lengths

The cotton classer's manual color grade index showed a trend toward some improvement with saw lint cleaning (Table 3). The air lint cleaners did not change the color grade but the saw lint cleaners blended light spots out of most of the test lots and moved these bales into the white grades. The lint cleaners appeared to improve the color factors, probably by removing background trash. Color grade designations averaged 42 before and after the air lint cleaner, and were mainly 41/31 after the one saw lint cleaner.

The leaf grade index improved significantly with both the air-type and saw-type lint cleaners. Over the entire test, the air lint cleaner improved the leaf grade designation from 3.9 to 3.5, and the saw lint cleaner gave a further improvement to 2.8.

At Gin A some test lots were discounted at level 1 (light) for extraneous matter (bark), and at Gin B some lots were discounted for preparation. After one saw lint cleaner, only 2 percent of the samples were discounted for bark and none for preparation.

There was a trend toward a shortening of the staple length with lint cleaning. Average staple length for the study decreased 0.3 one-thirty-seconds of an inch with the one air-type lint cleaner and an additional 0.8 one-thirty-seconds with the one saw-type cleaner. Over the study, both decreases were significant at the 5-percent level.

High Volume Instrument Measurement
The High Volume Instrument (HVI) measurements supported the manual classing and lint foreign matter content data (Table 4). The reflectance (Rd) values increased, visible trash (HVI) content was lowered, and there was some improvement in the color grade index with increased lint cleaning.

The micronaire reading averaged 4.4 for the cottons ginned at Gin A and 4.0 for those processed at Gin B. Fiber strength (1/8-inch gage) averaged 26.0 grams per tex for the cottons processed at Gin A and 27.0 g/tex for bales handled at Gin B. Overall, the air lint cleaner did not affect the fiber strength but the saw lint cleaner gave a 0.9 g/tex reduction which was significant.

Fiber Tests
Neps per gram, measured on the AFIS-N, increased slightly but not significantly with the use of the air-type lint cleaner (Table 5). The further increase in nep count for the saw-type lint cleaner was significant. These nep increases occurred at Gins A and B. Before lint cleaning, after one air lint cleaner, and after the saw lint cleaner the counts averaged 185, 190, and 251 neps/g, respectively.

Fiber HVI length and length uniformity decreased with lint cleaning. The 0.01 inch length decrease with one air lint cleaner was not significant at the 5-percent level but the 0.02 inch decrease with one saw lint cleaner was significant.

Peyer length measurements showed a trend toward decreased fiber length with both air and saw-type lint cleaning. The decreases in upper 25 percent length and mean length, and increases in short fiber content were not significant for air-type lint cleaning at either gin, but the further length decreases attributed to the saw-type lint cleaner were significant at Gin B. Over the whole study, short fiber contents average 7.0 and 7.4 percent before and after the air lint cleaner, and 9.3 percent after the saw lint cleaner.

Seed-Coat Fragment Content
Seed-coat fragment counts in 3 grams of lint averaged 57 and 56 before and after the air-type lint cleaner, and 60 after the one stage of saw-cylinder lint cleaning (Table 6). Corresponding weights for the fragments averaged 32.7, 31.1, and 27.8 mg/3 g. The counts ranged from 55 to 64 fragments/3 g among the three lint cleaner sampling locations at the two gins. Among these samplings, only the decrease in fragment weight with air lint cleaning at Gin B was significant.

Motes in the ginned lint averaged 4 to 5 per 3 g among the lint cleaner samplings and showed no significant trend. However, there was a decrease in the mote weight with lint cleanings at Gin B.

Full cottonseeds in ginned lint numbered about 1 per 3 g before lint cleaning. Most of these were extracted by the air lint cleaner; none were measured after the saw lint cleaner.

Funiculi counted in ginned lint before lint cleaning, after the air-type cleaner, and following the one stage of saw lint cleaner averaged 16.0, 14.4, and 8.4 per 3 g for the study. The slight decreases in funiculi count and weight with air lint cleaning at Gin B were not significant, but the total reductions in count and weight after the saw lint cleaner were significant at both gin plants.

Summary and Conclusions

Experiments were conducted in 1994 at two commercial gins to study the characteristics and efficiency of flow-through air-type lint cleaners operating under standard field conditions. Comparisons were also made to a controlled-batt saw-type lint cleaner. Twenty bales were sampled from 11 modules of seed cotton. Measurements included lint foreign matter content, classer's grade, HVI data, nep count, and seed-coat fragment content.

Overall, the air-type lint cleaner gave a cleaning efficiency of 12 percent compared to 28 percent for one saw-type lint cleaner. The air lint cleaners did not change the color grade but improved the leaf grade index significantly. Over the entire test, the air lint cleaner improved the leaf grade designation from 3.9 to 3.5, and the saw lint cleaner gave a further improvement to 2.8.

Average staple length for the study decreased 0.3 one-thirty-seconds of an inch with the one air-type lint cleaner and an additional 0.8 one-thirty-seconds with the one saw-type cleaner. Corresponding decreases in fiber HVI length were 0.01 and 0.02 inch. Peyer short fiber content averaged 7.0 and 7.4 percent before and after air lint cleaning, and 9.3 percent after the saw lint cleaner.

Nep count increased slightly but not significantly with one air lint cleaner, but a larger nep increase attributed to one saw lint cleaner was significant. Most of the full cottonseeds in the ginned lint were extracted by the air lint cleaner, and those few remaining were removed by the saw lint cleaner. There was a slight but consistent decrease in the seed-coat fragment, mote, and funiculi counts and weights with air lint cleaning at one gin plant; the decrease in fragment weight was significant.

The textile industry prefers that ginned lint be cleaned at gins with only one saw-type lint cleaner. This helps to preserve fiber quality by minimizing the nep and short fiber content in the bale. Improved air-type lint cleaners used in combinations with one saw lint cleaner can help to ensure an acceptable market return. New air-type lint cleaner designs will be studied to further improve the performance of these cleaners. Air-type cleaners should remove most of the motes and large trash particles first. This prevents these from breaking into greater numbers of smaller components and becoming entangled in the lint during further saw cleaning.

Disclaimer

Mention of a trade name, propriety product or specific equipment does not constitute a guarantee or warranty by the U.S. Department of Agriculture and does not imply approval of a product to the exclusion of others that may be suitable.

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Table 1. Seed-cotton data, and cottonseed and lint moisture contents, lint cleaning experiment, crop of 1994

		Seed Cotton					
		Moisture Content (%)		**Foreign-Matter Content (%)**		**Moisture Content (%)**	
Gin Plant No.[1]	**Module No.[2]**	**Wagon**	**Feeder Apron**	**Wagon**	**Feeder Apron**	**Cotton-seed**	**Lint**
A	1	9.4	7.6	6.6	2.1	9.6	4.0
A	2	8.5	7.8	6.6	1.8	11.0	3.6
A	3	10.0	8.9	7.2	2.2	11.9	4.4
A	4	10.9	9.0	7.9	1.8	10.6	4.5
A	5	7.9	6.7	7.7	2.0	8.4	3.4
A	6	9.5	7.9	10.0	2.1	10.0	4.2
Avg.		**9.5a**	**8.1a**	**7.4a**	**2.0a**	**10.5a**	**4.1a**
B	7	8.5	6.8	5.1	1.8	9.4	3.0
B	8	8.1	6.4	5.3	1.8	9.0	3.2
B	9	8.4	6.6	4.8	1.8	9.2	3.0
B	10	9.1	7.0	4.2	1.6	10.0	3.1
B	11	8.0	6.7	4.4	2.0	9.2	3.0
Avg.		**8.4b**	**6.7b**	**4.8b**	**1.8a**	**9.4b**	**3.0b**
Exp. Avg.		**9.0**	**7.4**	**6.1**	**1.9**	**9.9**	**3.6**

[1]Significant differences noted between gin plant averages were determined at the 5-percent level using the (lsd) t-test.
[2]Data for each module is the average from two test lots, except for modules 5 and 6 which used one test lot.

Table 2. Lint foreign-matter content and cleaning efficiency, lint cleaning experiment, crop of 1994[1]

Lint Cleaner Treatment Number	Gin Plant Number A	Gin Plant Number B	Average
Foreign-matter content (total waste) (%)[2]			
0	5.82a	5.16a	5.49a
1	5.21b	4.41b	4.81b
2	4.02c	2.91c	3.46c
Foreign-matter content (visible waste) (%)[2]			
0	3.72a	3.48a	3.60a
1	3.16b	2.74b	2.95b
2	2.14c	1.41c	1.77c
Lint cleaner efficiency (total waste basis) (%)[3]			
1	10.2c	14.2b	12.2c
2A	22.5b	33.5a	28.0b
2	30.5a	43.6a	37.1a
Lint cleaner efficiency (visible waste basis) (%)[3]			
1	14.9c	20.8c	17.8c
2A	32.3b	48.4b	40.4b
2	42.7a	59.6a	51.1a

[1]Data are the average of ten test lots at each gin plant. Means in a column for lint cleaner treatment numbers followed by different letters are significantly different at the 0.05 level of probability according to the least significant difference (lsd) t-test.
[2]Treatments are before lint cleaning (0), after one air-type lint cleaner (1), and after one air and one saw-type lint cleaner (2).
[3]Treatments are one air-type lint cleaner (1), one saw-type lint cleaner (2A), and one air and one saw-type lint cleaner (2).

Table 3. Classer's grade and staple length data for lint samples in lint cleaning experiment, crop of 1994[1]

Lint Cleaner Treatment Number[2]	Gin Plant Number A	B	Average
	Color grade index[3]		
0	86.4b	94.0b	90.2b
1	87.8b	92.8b	90.3b
2	92.7a	97.4a	95.1a
	Color grade designation[3]		
0	52/42	42/32	42
1	42	42/32	42
2	42/41/32	41/31	41/31
	Leaf grade index		
0	95.0b	93.9b	94.4c
1	99.2a	94.2b	96.7b
2	101.0a	100.4a	100.7a
	Leaf grade designation		
0	3.8a	4.0b	3.9a
1	3.1b	3.9a	3.5b
2	2.7c	2.9a	2.8c
	Extraneous matter reductions (bark) (%)		
0	2a	0	1a
1	11a	0	5a
2	2a	0	1a
	Extraneous matter reductions (Prep) (%)		
0	0	20a	10a
1	0	0b	0b
2	0	0b	0b
	Staple length (1/32-in.)		
0	35.5a	35.8a	35.7a
1	35.0ab	35.7a	35.4b
2	34.9b	34.3b	34.6c

[1]Data at each gin plant are the average for ten test lots.
[2]Treatments are before lint cleaning (0), after one air-type lint cleaner (1), and after one air and one saw-type lint cleaner (2).
[3]Grade index and corresponding grade designations: 100 = 31, 94 = 41, 32 = 97, 42 = 89, 52 = 80.

Table 4. High Volume Instrument (HVI) measurements for lint samples, lint cleaning experiment, crop of 1994[1]

Lint Cleaner Treatment Number[2]	Gin Plant Number A	B	Average
	Micronaire reading		
0	4.37a	4.02b	4.20a
1	4.35a	4.08a	4.21a
2	4.37a	4.00b	4.19a
	Strength (⅛-in. Gage) (g/tex)		
0	26.7a	27.0b	26.8a
1	25.6b	27.9a	26.8a
2	25.7b	26.2c	25.9b
	Color grade index		
0	90.5b	94.6b	92.6b
1	92.2ab	94.2b	93.2b
2	93.5a	99.7a	96.6a
	Color grade designation		
0	51/41	41	41
1	41	41	41
2	41	31	41/31
	Color reflectance (RD) (%)		
0	70.8c	73.6b	72.2b
1	71.6b	73.1b	72.3d
2	72.7a	75.8a	74.3a
	Color +b value (units)		
0	7.9b	8.3b	8.1b
1	7.9b	8.3b	8.1b
2	8.1a	8.6a	8.4a
	Trash (non-lint) content (%)		
0	0.7a	0.7a	0.7a
1	0.6a	0.6a	0.6a
2	0.4b	0.3b	0.3b

[1]Data at each gin plant are the average of ten test lots. Means in a column for lint cleaner treatment numbers followed by different letters are significantly different at the 0.05 level of probability according to the least significant difference (lsd) t-test.
[2]Treatments are before lint cleaning (0), after one air-type lint cleaner (1), and after one air and one saw-type lint cleaner (2).

Table 5. Nep count, and HVI and Peyer length data for lint samples, lint cleaning experiment, crop of 1994[1]

Lint Cleaner Treatment Number[2]	Gin Plant Number A	B	Average
	Nep count (no./g)		
0	177b	192b	185b
1	184b	196b	190b
2	234a	267a	251a
	HVI length (in.)		
0	1.108a	1.111a	1.110a
1	1.090b	1.115a	1.103a
2	1.088b	1.071b	1.079a
	HVI length uniformity (%)		
0	82.8a	82.3a	82.5a
1	82.2b	82.4a	82.3b
2	82.0b	80.7b	81.3c
	Peyer 25% length (in.)		
0	1.049a	1.059a	1.054a
1	0.048a	1.050a	1.049a
2	1.039a	1.002b	1.021b
	Peyer mean length (in.)		
0	0.881a	0.887a	0.884a
1	0.878a	0.880a	0.879a
2	0.871a	0.827b	0.849b
	Peyer fibers shorter than 0.5 in, (%)		
0	6.8a	7.2b	7.0b
1	7.2a	7.6b	7.4b
2	7.5a	11.2a	9.3a
	Peyer coefficient of variability (%)		
0	26.2b	26.4b	26.3b
1	28.8a	26.8b	27.8a
2	26.5b	28.4a	27.4a

[1]Data at each gin plant are the average of ten test lots. Means in a column for lint cleaner treatment numbers followed by different letters are significantly different at the 0.05 level of probability according to the least significant difference (lsd) t-test.

[2]Treatments are before lint cleaning (0), after one air-type lint cleaner (1), and after one air and one saw-type lint cleaner (2).

Table 6. Seed-coat fragment in 3-g-of-lint data for samples, lint cleaning experiments, crop of 1994[1]

Lint Cleaner Treatment Number[2]	Gin Plant Number A	B	Average
	Fragments (no.)		
0	56.7a	58.2a	57.4a
1	57.6a	55.2a	56.4a
2	64.3a	56.4a	60.4a
	Fragments (mg)		
0	27.9a	37.5a	32.7a
1	32.5a	29.7b	31.1a
2	28.3a	27.4b	27.8a
	Motes (no.)		
0	4.7a	5.2a	4.9a
1	4.8a	4.3a	4.6a
2	5.3a	5.1a	5.2a
	Motes (mg)		
0	12.9a	25.7a	19.3a
1	12.8a	17.4ab	15.1a
2	14.1a	13.9b	14.0a
	Funiculi (no.)		
0	14.0a	18.0a	16.0a
1	14.5a	14.2a	14.4a
2	8.8b	7.9b	8.4b
	Funiculi (mg)		
0	3.9a	5.1a	4.5a
1	4.2a	3.8ab	4.0a
2	1.9b	2.2b	2.0b
	Cottonseed (no.)		
0	1.2a	0.2a	0.7a
1	0.1ab	0.1a	0.1ab
2	0.0b	0.0a	0.0b
	Cottonseed (mg)		
0	75.5a	3.8a	39.7a
1	6.4a	1.8a	4.1a
2	0.0a	0.0a	0.0a

[1]Data at each gin plant are the average of ten test lots. Means in a column for lint cleaner treatment numbers followed by different letters are significantly different at the 0.05 level of probability according to the least significant difference (lsd) t-test.

[2]Treatments are before lint cleaning (0), after one air-type lint cleaner (1), and after one air and one saw-type lint cleaner (2).

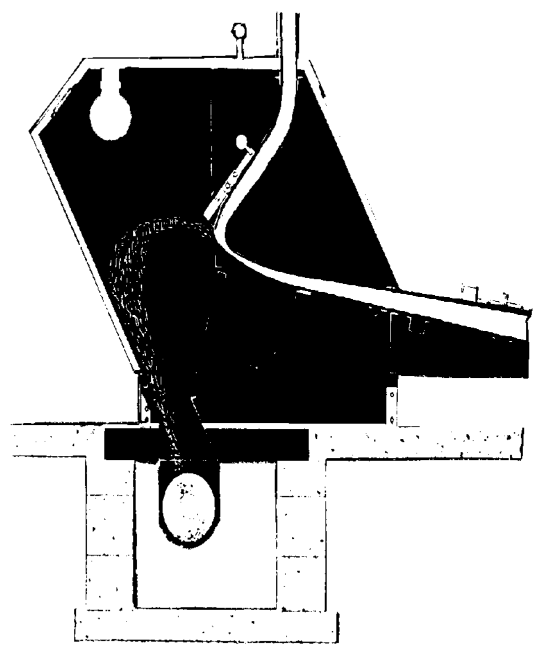

Figure 1. Unit flow-through air lint cleaner used in experiment