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Methods of Ginning in Relation to the Grade and Staple of Cotton



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†As of November 1, 1930.

**In cooperation with U. S. Department of Agriculture.

Considering the large number of gins used to prepare the Texas crop of some 4,000,000 bales annually for market, exact information as to the best uses of gin machinery is of great value to ginners as well as to cotton growers.

This Bulletin reports the results of experiments conducted on an air-blast type of gin from 1926 to 1929, inclusive, at the Texas Agricultural Experiment Station, Main Station Farm, College Station, Texas, to determine the effect which different speeds of saws, densities of breast-roll, and the use of the standard air-line cleaner have on the grade and staple of cotton of varying lengths.

The results of these experiments show, in general, that a saw speed of 760 revolutions per minute, used together with the loose breast-roll and the standard air-line cleaner, provide the most favorable conditions for ginning cotton on the air-blast type of gin used.

The use of the standard air-line cleaner resulted in improving the value of the cotton as much as two grades in some instances by the removal of trash, dirt, and other foreign material. The cleaner did not appear to have any significant effect on the length of lint.

Cotton ginned with a loose breast-roll classed higher at all three saw speeds, 640, 760 and 840 revolutions per minute, than that ginned with a tight breast-roll. Increasing the density of the breast-roll to a high degree had a tendency to damage both the lint cotton and the seed, and also to increase the time required for ginning.

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METHODS OF GINNING IN RELATION TO THE GRADE AND STAPLE OF COTTON

D. T. KILLOUGH AND G. T. McNESS

Cotton, the most important crop produced in Texas, has averaged 3,959,355 bales per year for the 10-year period, 1920 to 1929, inclusive, bringing an average gross annual income of \$458,297,485 to Texas farmers. In view of the great value of the cotton crop, the Texas Agricultural Experiment Station has conducted numerous experiments upon the various phases of cotton production, including fertilizers, spacing, cultivation, varieties, and the improvement of the crop through breeding and selection, a large amount of this work having already been published. Only during the last few years, however, has experimental work been done to determine the effect of various methods of ginning upon the grade and staple of cotton.

The market value of cotton is determined largely by the grade and length of staple, both of which are influenced to a great extent not only by environmental conditions prevailing during the growing and harvesting of the crop, but also by conditions of ginning. The effect of climatic conditions upon grade and staple are beyond the control of the farmer except as he may be able to harvest the cotton before it is damaged. On the other hand, the conditions of ginning are readily controlled, and consequently the effect of these various conditions of ginning on the grade and staple can be determined. The proper preparation of the cotton crop for the market is of great importance, and offers opportunity to enhance the selling value of the crop. Improvements in ginning equipment and a knowledge of the best uses of the machinery are accordingly of great value to the cotton producer.

Within the last few years rapid progress has been made in the improvement of ginning machinery. It is a long step from the days of the old-fashioned mule gin and hand press, having a daily capacity of five bales, to that of the modern four- to eight-stand power-driven gin with hydraulic press, having an output of 60 bales or more per day. The modern gin is now equipped with various cleaning devices not found in the old-style gins. These remove from the seed cotton foreign material such as dirt, burrs, leaves, and other forms of trash, resulting in a better sample of lint. Improvements which have been made in our present-day gins have made it possible to gin more promptly the increased production, and, where the gin is operated efficiently, to preserve

the quality of the lint, thereby retaining its full value. Even with the most modern equipment, however, there is a possibility that the lint will be damaged and consequently reduced in value unless care is taken to maintain optimum conditions of ginning with particular reference to the proper speed of the saws, the use of cleaners, and the proper density of the breast-roll. Cotton ginned under improper conditions or with the machinery carelessly adjusted, may be severely gin-cut, and, in addition, the lint may contain various forms of boll and leaf trash, motes and neps; cotton which is properly ginned, with the machinery properly adjusted, is in most cases free from foreign material and gin-cuts. Cotton that is gin-cut and trashy is less suitable

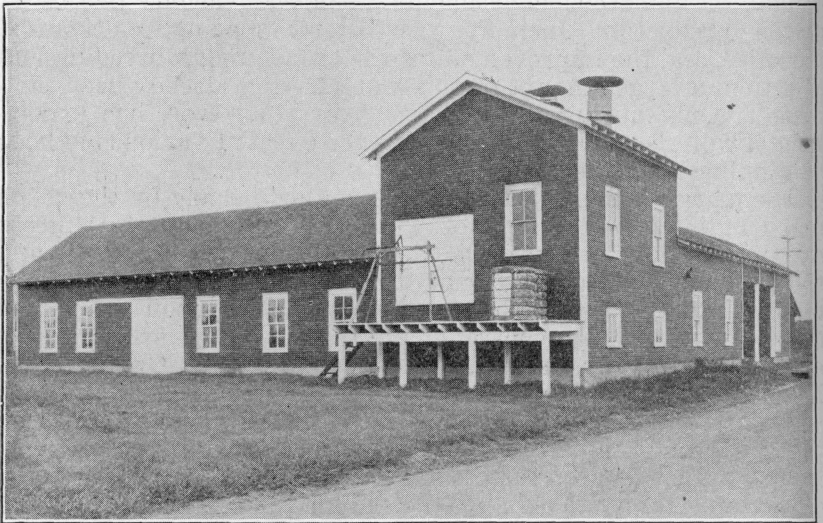


Figure 1.—View of the experimental gin plant on the Main Station Farm, College Station, Texas, where the ginning experiments were conducted.

for spinning since its economic value will be reduced on account of the high percentage of waste in the manufacturing processes.

OBJECT AND PLAN OF EXPERIMENT

Practically no definite information on the various practices used in the operation of current ginning machinery to determine their effect upon the quality and turn-out of lint cotton of various lengths of staple has been published. In view of this fact and recognizing the urgent need for such information, experiments were begun in 1926 to study the effect of saw speeds, density of the breast-roll, and the use of cotton cleaners on the quality of cotton.

Equipment Used

The experiments were conducted on an electrically-driven Murray gin of the air-blast type, having two stands of 70 saws of 12-inch diameter, with standard air-line cleaner (Figure 4). No saws are used on this type of cleaner. It is equipped with long beater arms which revolve inside a cylindered screen. A Fairbanks counter platform scale graduated to the quarter of an ounce, having a capacity of 300 pounds, was used for weighing each lot of seed cotton. A tachometer was used to register the

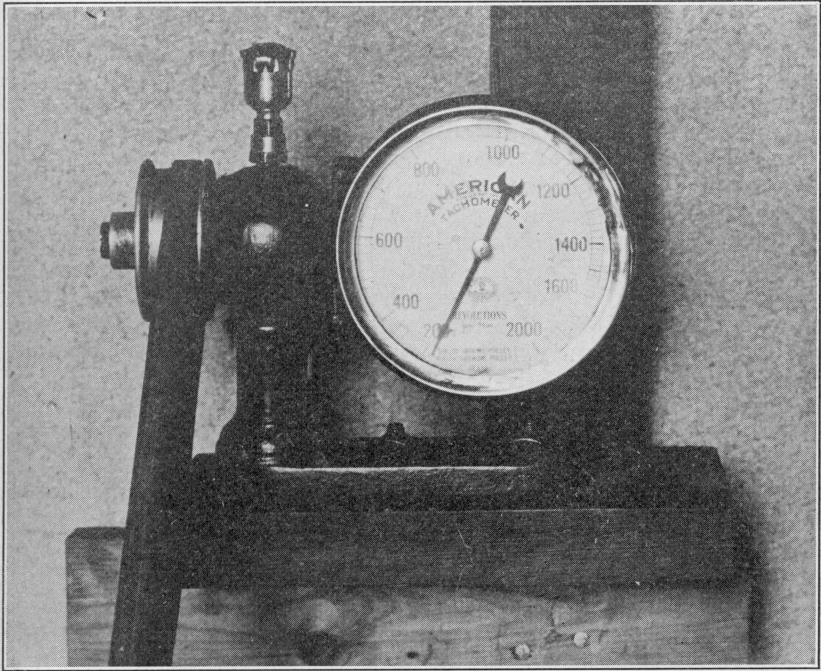


Figure 2.—Tachometer used to show the speed at which the saws were operating. The tachometer was driven by belt directly from the line shaft of the gin saws.

saw speed and to make possible the maintenance of a definite speed throughout the ginning of each lot of cotton (Figure 2).

Types of Cotton Used

The Truitt variety of cotton, representative of the medium-staple type, was used in the first experiment during each of the three years, 1926, 1927, and 1928. The lint varied in length from year to year. In 1926 it averaged $15/16$ inch; in 1927, 1 inch; and in 1928, $7/8$ inch. The cotton was grown in Brazos County, Texas, on upland soil known as Lufkin fine sandy loam.

This soil is of uniform type and has good surface drainage. The cotton was harvested during the early part of September of each year before the fall rains occurred, and stored on a dry floor in a well-ventilated seed house for a short time prior to ginning.

In the second experiment, conducted in 1928 and 1929, cotton of different lengths of staple was used. In 1928 two varieties of cotton were used—the Bennett, representative of the medium-staple cotton, having a length of approximately $\frac{7}{8}$ inch, and the Greer-Wichita, typical of upland long-staple cotton, one selection of which had a staple length of approximately $1\frac{1}{4}$ inches, and the other $1\frac{3}{8}$ inches. In 1929 three varieties of cotton were used: Startex, with a staple of 1 inch; Acala, with a staple of $1\frac{1}{8}$ inches; and a selection of Greer-Wichita with a staple of $1\frac{3}{16}$ inches. The Bennett cotton used in 1928 was grown in Brazos County, Texas, on upland soil classified as Lufkin Fine Sandy Loam. The two lots of Greer-Wichita cotton used the same year were grown in Wichita County, Texas, on Miller Fine Sandy Loam soil under irrigation. In 1929 all of the cotton used in the experiment was grown in Brazos County, Texas. The Startex cotton was grown on upland soil classified as Lufkin Fine Sandy Loam, while the Acala and Greer-Wichita varieties were grown on Miller Clay Loam, an alluvial soil along the Brazos River in Brazos County.

The Bennett cotton used in 1928 and the Startex cotton used in 1929, were harvested during September of each year. One of the lots of Greer-Wichita cotton used in 1928 was harvested early in October before frost and was in good condition for ginning; while the other lot, which was not harvested until December, was in poor condition for ginning owing to the presence of dirt, trash, and stain resulting from unfavorable climatic conditions. The cotton used in the second experiment was stored for a short time before ginning and under similar conditions as those used in the first experiment.

Classification of the Cotton

To determine the effect of the conditions of ginning upon the grade and staple of the cotton, samples of lint were collected from each condition of ginning. The lint was secured from ten different sections in each lot in order that it might be representative of the lot. The classing of the cotton was done by Messrs J. G. Powers, Lonnie E. Dowd, and C. L. Baker, official and licensed cotton classers of the Department of Textile Engineering, Agricultural and Mechanical College of Texas, and the data on grade and staple presented in this Bulletin are based entirely upon their classification. In classing the cotton, special attention was paid to the presence in the samples of motes, neps, gin-cuts, pin trash,

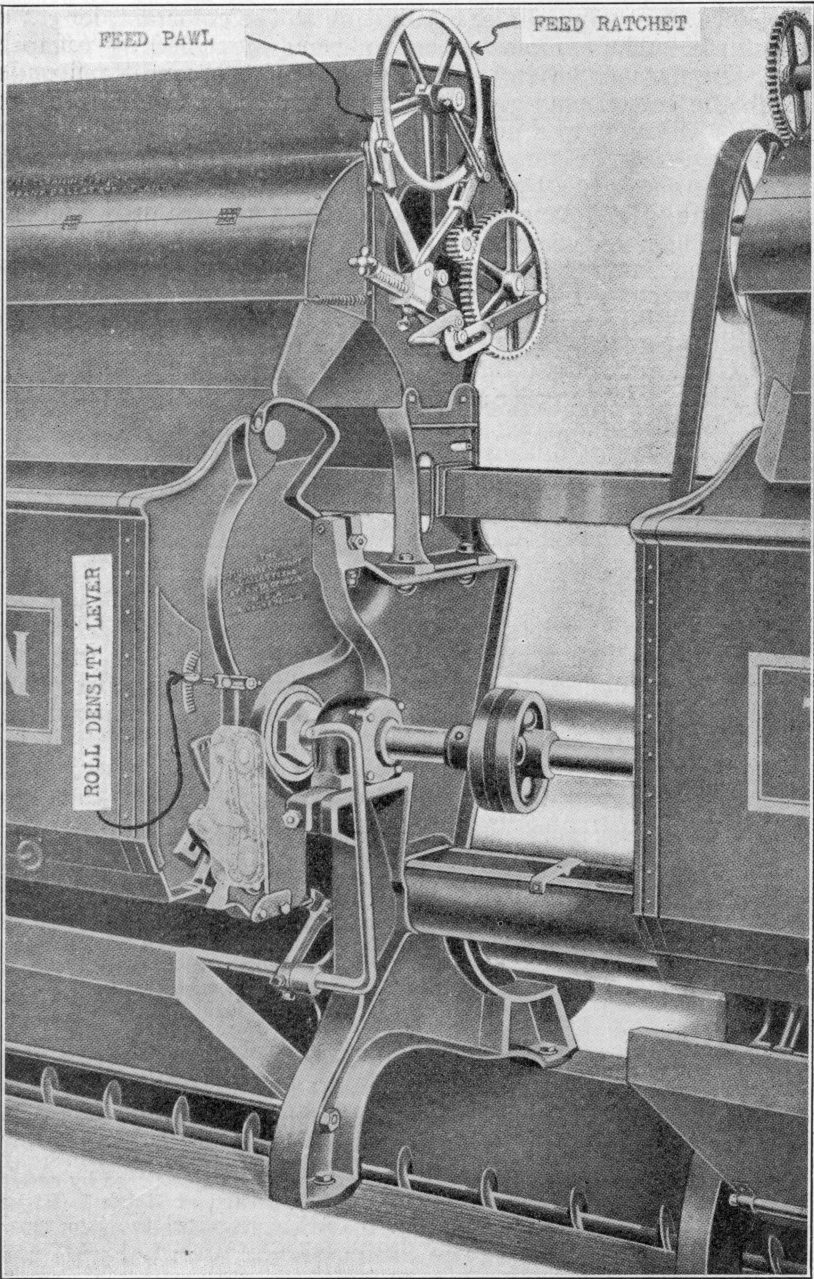


Figure 3.—View of end of the gin stand showing the roll density lever and ratchet feed mechanism by which the density of the breast-roll was adjusted.

large leaf trash, and shale, in addition to the color and length of the staple. The samples of cotton were identified by numbers only, the classers having no knowledge of the conditions under which the cotton was ginned; all possible bias was thereby removed. While it was not possible to have the cotton classed by the same person or persons each year, the samples for any given year were all classed by the same classer.

The nine official American grades of cotton were used in classifying the samples of cotton in the experiments and these grades are designated as follows:

1. Middling fair (MF).
2. Strict good middling (SGM).
3. Good middling (GM).
4. Strict middling (SM).
5. Middling (M).
6. Strict low middling (SLM).
7. Low middling (LM).
8. Strict good ordinary (SGO).
9. Good ordinary (GO).

Classification of the Seed

The seed from the lots of cotton ginned under the different conditions were run out on the gin floor and samples collected at random from each lot to determine the extent of gin damage and whether the seed were well cleaned. The seed were arbitrarily classed as *clean*, *fairly clean*, and *hulled*.

Definition of Terms Used

Style of Ginning: For describing the style of ginning three terms are used, namely, *good*, *medium*, and *rough*.

When the sample of lint had a smooth appearance and was practically free from all forms of trash, neps, and gin-cuts, the style of ginning was termed "good"; when the sample contained small amounts of trash and neps and some gin-cuts, the style of ginning was classed as "medium"; and when the sample contained large amounts of trash, neps, motes, and showed considerable gin-cutting, the style of ginning was classed as "rough."

Condition of the Breast-Roll: The degree of density of the breast-roll is described by three terms, namely, *loose*, *medium*, and *tight*.

When the roll was firm enough to revolve continuously without breaking and where it was possible with only a slight pressure to insert the fingers of the hand into the revolving mass of seed cotton two or three inches, it was termed "a loose roll." This condition of the roll was secured by setting the ratchet lever, located on the side of the gin breast, at Notch 1 (Figure 3). When the ratchet lever was set at Notch 4 it raised the lambrequin fingers inside the roll box, thereby decreasing its capacity. Consequently the mass of seed cotton was compressed more firmly and the fingers of the

hand could not be inserted as easily or as deeply as in the case of the loose breast-roll. The density of the roll in this case was termed "medium."

When the ratchet lever was set at Notch 8 it further decreased the capacity of the roll box to such an extent that it was not possible to readily insert the fingers into the revolving mass of seed cotton. Such a condition was termed "a tight roll."

With each of the three degrees of density of the breast-roll it was necessary to change the rate of flow of seed cotton into the gin breast. In the case of the loose breast-roll the feeding mechanism was so set that the feed pawl traversed eight notches on the feed ratchet wheel at each stroke of the feeding arm, while in the case of the medium breast-roll the feed pawl traversed six notches, and in the case of the tight breast-roll it traversed only four notches (Figure 3). It was possible, therefore, with the loose breast-roll to feed the seed cotton to the gin breast faster on the average than with the tight breast-roll, thereby affecting directly the time required to gin the cotton.

Motes and Neps: The immature seed are called motes, they have a small amount of fuzz. Small rough tangled masses of fibers often result from careless handling and ginning the lint and are called neps.

Gin-Cutting of the Lint: Under certain conditions of ginning the lint is damaged by having some of the fibers cut; this gives the sample a rough appearance and detracts from its value. The three terms, *none*, *slight*, and *excessive*, which are self-explanatory, are used to denote the amount of gin-cutting in the samples of lint.

Condition of the Seed: The condition of the seed after ginning is designated by the terms *clean*, *fairly clean*, and *hulled*.

When the seed are well ginned, having all of the lint removed but none of the seed coat broken, they are termed "clean"; when some of the lint is left on the seed but are otherwise not injured, the seed are termed "fairly clean"; but when the seed are broken and the seed coat removed from the kernel, the seed are spoken of as being "hulled."

Frequently when some of the seed in the breast-roll were hulled, the lint on other seed was not completely removed.

Methods of Procedure

Preparation of the Seed Cotton for Ginning: The seed cotton used in both of the experiments was thoroughly mixed just before being ginned to insure its uniformity. It was then divided into equal lots of 150 pounds, which was the amount of seed cotton used in each test. This amount provided sufficient seed cotton for a full roll. At the time the cotton was ginned it was free from excess moisture. Relatively constant temperature and humidity prevailed in the gin room at all times during the con-

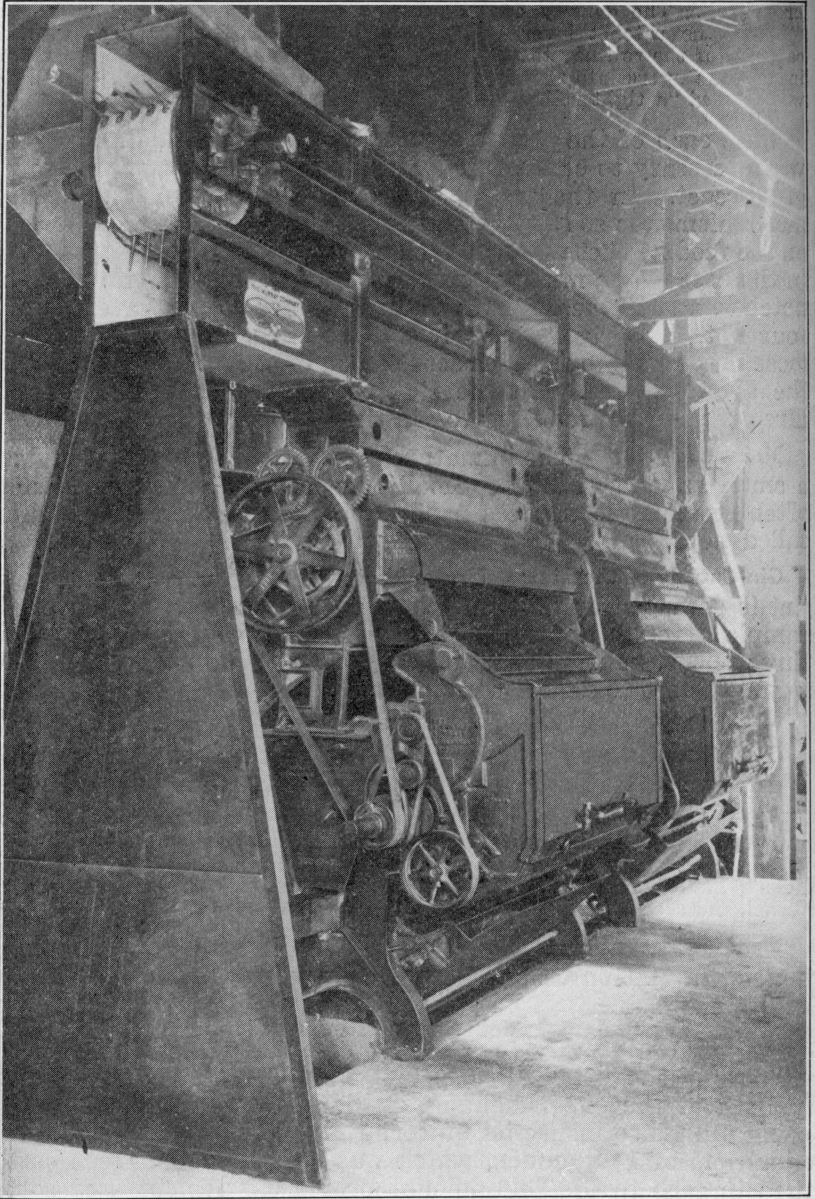


Figure 4.—Gin assembly showing the overflow end of the distributor belt. The belt receives the seed cotton either from the dropper or the standard air-line cleaner and conveys it to the feeder chutes, from which it passes through the feeder-cleaners and thence to the gin breast.

duct of the experiments. All of the cotton used in these experiments was harvested by hand-picking.

Adjustment of the Machinery: The three saw speeds were obtained by using pulleys of varying sizes so as to secure speeds of 640, 760, and 840 revolutions per minute, respectively. A 26-inch pulley was placed on the line shaft to obtain a saw speed of 640 revolutions per minute; a 24-inch pulley for a saw speed of 760 revolutions per minute; and a 22-inch pulley for a saw speed of 840 revolutions per minute. The density of the breast-roll was controlled by adjusting the ratchet lever on the side of the gin-breast. When the lever was set on Notch One, the

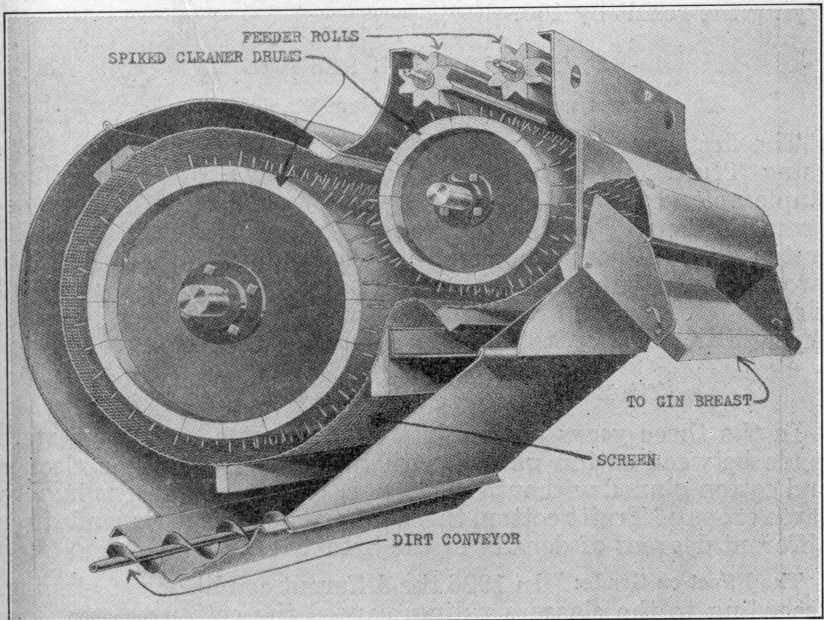


Figure 5.—Cross-section of the feeder-cleaner. The cotton is fed from the feed chute on to the spiked cleaner drums by the feeder rolls. The drums beat and throw the cotton against the screen, allowing the dirt and trash to pass through to the dirt conveyer, while the seed cotton is retained and carried on to the gin breast.

density of the breast-roll was termed "loose"; on Notch Four, it was termed "medium"; and on Notch Eight, it was termed "tight." The flow of the cotton from the feeder-cleaners was regulated to keep the breast-roll full at all times. All of the cotton passed through the feeder-cleaners regardless of whether the standard air-line cleaner was used. The gin saws were kept in good condition throughout the period of the experiment, and were sharpened at the beginning of each ginning season. In the first experiment in which the standard air-line cleaner was used,

the flow of the cotton to be cleaned was directed into the cleaner by means of a by-pass valve. When this valve was cut off, the cotton fell directly upon the distributor belt and into the gin-breast without passing through the air-line cleaner.

Time of Ginning: A record was kept in the first experiment of the time required for the ginning of each lot of cotton.

Gin Turn-Out: In 1927 and 1928, data were recorded on the gin turn-out or percentage of lint of each lot of cotton to determine the effect of the different conditions of ginning on the percentage of lint. The percentage of lint was obtained by dividing the weight of the lint by the weight of the seed cotton and multiplying the result by 100.

EXPERIMENTAL RESULTS

Experiments With a Medium-Staple Cotton

The first experiment was conducted in 1926, 1927, and 1928, using Truitt cotton, which is representative of the medium-staple upland type. Three saw speeds were used with three degrees of density of the breast-roll for each saw speed. The cotton used in these nine conditions of ginning was divided into two equal parts, half of which was passed through the standard air-line cleaner and the other half ginned without passing through the cleaner, totaling 18 conditions of ginning.

The Effects of the Standard Air-Line Cleaner

In the three years of the first experiment comparisons were made between cotton ginned with the standard air-line cleaner and cotton ginned without the cleaner. The comparisons involve three crops of Truitt cotton, three different saw speeds, and three different degrees of density of the breast-roll.

The Effect on Grade: In 1926 the different conditions of ginning, according to the classers ruling, caused the cotton to vary two grades, or from strict middling (SM) to strict low middling (SLM) as shown in Table 1. The samples classed as SLM contained motes, neps, various degrees of gin-cutting, leaf trash; and the style of ginning was termed "medium" to "rough." In seven out of nine cases in which the standard air-line cleaner was used, the samples were classed as strict middling (SM), which, with two exceptions, was one to two grades higher than the cotton which had not passed through the cleaner (Figures 7 and 9). In the two cases out of the nine which showed a grade of middling (M), even though the cleaner was used, the lowering of the grade was caused by excessive gin-cutting due to the use of a tight breast-roll. In 1927 the cotton ginned under the differ-

ent conditions varied only one grade, strict middling (SM) to middling (M) (Table 2). In all five lots which carried the lower grade (middling) the cleaner was not used, and the ginning was termed "medium" to "rough." The grade varied in 1928 from middling (M) to strict low middling (SLM) for the different conditions of ginning, as shown in Table 3. When the cleaner was used, seven of the nine lots of cotton carried the higher grade of middling (M). The lots of cotton ginned without the use of the standard air-line cleaner were classed middling-shy (M—) and strict low middling (SLM). Some of the reduction in grade was due to the excessive gin-cutting of the lint

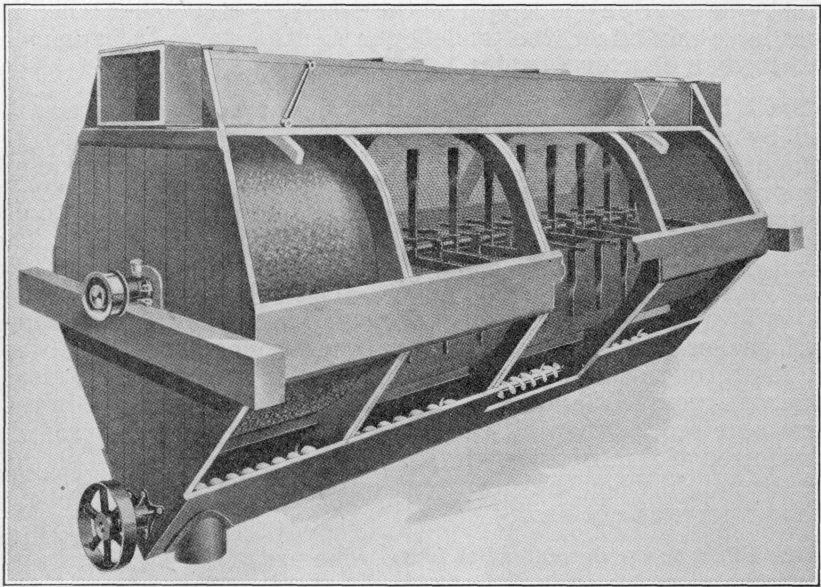


Figure 6.—Sectional view of the standard air-line cleaner. The cotton passes directly from the wagon to the standard air-line cleaner, where it is agitated by long beater arms inside a screen cylinder. As the cotton is passed through the cylinder, dirt, trash, and other foreign material are separated from the seed cotton.

resulting from the use of a tight breast-roll. When the three years are considered together, 19 of the 27 comparisons of the cotton which had been passed through the standard air-line cleaner graded higher than that which had been ginned without the use of the cleaner. In three of these cases the cotton was improved by a half-grade, in 14 cases by a full grade, and in two cases by two grades. In not a single case was the grade lowered by the use of the cleaner. Considering all of the 27 comparisons, the average grade was raised by approximately three-quarters of a grade through the use of the cleaner. This is calculated by

assigning to each grade the official numerical value to which it corresponds and obtaining an average grade by adding these numbers and dividing the total by 27.

The Effect on Length of Lint: It is sometimes claimed that the use of cotton cleaners has a tendency to damage the cotton by shortening the length of the staple. This assumption is not borne out by the data from this experiment. Of the 27 comparisons involved in this test, 17 showed no difference whatever in length of staple, 9 showed an increase of $1/16$ inch in favor of the cleaner, and one showed a decrease of $1/16$ inch when the cleaner was used. Apparently the cleaner usually has no effect whatever on the length of the resulting staple, but when it does have any effect, the tendency is for the staple to be longer rather than shorter (Tables 1, 2, and 3).

The Effect on Style of Ginning: Style of ginning has been classified by the terms *good*, *medium*, and *rough*. In 13 of the 27 comparisons the use of the cleaner had no effect on the style of ginning, in 13 cases it improved it by one class, and in one case it improved it by two classes. It is quite evident that when the cleaner has any effect the tendency is to improve the style of ginning.

The Effect on Time Required for Ginning: In nine of the 27 comparisons less time was required for ginning when the cotton was passed through the standard air-line cleaner; in four cases more time was required; and in 14 cases there was no difference in the time required. When all conditions of ginning were averaged, it required 43.6 minutes to gin 1,500 pounds of seed cotton on the two-stand gin when the cleaner was used and 44.1 minutes when the cleaner was not used.

The Effect on the Percentage of Lint: The use of the standard air-line cleaner reduced slightly the percentage of lint in six of the nine comparisons, increased it in two cases, and in one case there was no difference. Where the cleaner reduced the percentage of lint, the reduction was caused by the removal of dirt and trash from the cotton.

Conclusions on the Effects of the Standard Air-Line Cleaner: The results of the three years' test show, in general, that the standard air-line cleaner improved the grade of the cotton and the style of ginning, but in most cases reduced the percentage of lint on account of the removal of the dirt and trash from the cotton by the cleaner. The cleaner did not have any appreciable effect on the length of lint or the time required for ginning (Tables 1, 2, and 3).

Table 1.—Results secured with different conditions of ginning in 1926

Speed of gin saws, r. p. m.*	Breast-roll setting	Standard air-line cleaner	Grade of lint	Length of lint, inches	Style of ginning	Gin-cut of lint	Minutes required to gin 1500 lbs. seed cotton	Condition of seed
640	loose	used	S M	15/16	good	none	35	clean
640	loose	not used	M	15/16	medium	none	35	fairly clean
640	medium	used	S M	15/16	medium	slight	40	clean
640	medium	not used	S M	15/16	medium	slight	40	clean
640	tight	used	M	15/16	rough	excessive	50	fairly clean
640	tight	not used	M	7/8	rough	slight	50	fairly clean
760	loose	used	S M	15/16	good	none	30	clean
760	loose	not used	M	7/8	medium	none	30	fairly clean
760	medium	used	S M	15/16	medium	none	40	clean
760	medium	not used	S L M	15/16	medium	slight	35	clean
760	tight	used	S M	15/16	rough	slight	50	hulled
760	tight	not used	M	15/16	rough	excessive	45	hulled
840	loose	used	S M	15/16	medium	none	30	clean
840	loose	not used	S L M	15/16	medium	none	30	clean
840	medium	used	S M	15/16	medium	slight	40	fairly clean
840	medium	not used	M	15/16	rough	excessive	40	fairly clean
840	tight	used	M	15/16	rough	excessive	50	fairly clean
840	tight	not used	S L M	7/8	rough	excessive	50	hulled

*Revolutions per minute.

Table 2.—Results secured with different conditions of ginning in 1927

Speed of gin saws r. p. m.	Breast-roll setting	Standard air-line cleaner	Grade of lint	Length of lint, inches	Style of ginning	Gin-cut of lint	Minutes required to gin 1500 lbs. seed cotton	Condition of seed	Percentage of lint
640	loose	used	S M	1	good	none	40	fairly clean	32.6
640	loose	not used	S M	1	medium	none	40	clean	34.7
640	medium	used	S M	1	good	none	50	clean	33.4
640	medium	not used	S M	15/16	medium	slight	50	clean	34.3
640	tight	used	S M	1	medium	slight	55	clean	32.6
640	tight	not used	M	1	rough	slight	50	clean	33.4
760	loose	used	S M	1	good	none	35	clean	31.0
760	loose	not used	M	1	medium	none	35	fairly clean	34.8
760	medium	used	S M	1	medium	none	50	fairly clean	34.5
760	medium	not used	M	1	medium	none	45	fairly clean	33.8
760	tight	used	S M	1	medium	slight	70	hulled	34.1
760	tight	not used	M	1	rough	excessive	70	hulled	34.3
840	loose	used	S M	1	medium	none	30	clean	34.5
840	loose	not used	S M	1	medium	none	35	clean	35.0
840	medium	used	S M	1	medium	slight	50	clean	33.4
840	medium	not used	S M	15/16	rough	excessive	50	clean	33.1
840	tight	used	S M	1	rough	excessive	65	fairly clean	33.4
840	tight	not used	M	1	rough	excessive	70	hulled	33.4

Table 3.—Results secured with different conditions of ginning in 1928

Speed of gin saws, r. p. m.*	Breast-roll setting	Standard air-line cleaner	Grade of lint	Length of lint, inches	Style of ginning	Gin-cut of lint	Minutes required to gin 1500 lbs. seed cotton	Condition of seed
640	loose	used	M	7/8	good	none	35	clean
640	loose	not used	S L M	7/8	good	none	40	clean
640	medium	used	S L M	15/16	medium	none	40	clean
640	medium	not used	S L M	7/8	rough	none	42	clean
640	tight	used	M	15/16	rough	slight	50	fairly clean
640	tight	not used	S L M	7/8	rough	slight	50	fairly clean
760	loose	used	M	7/8	good	none	32	clean
760	loose	not used	S L M	7/8	medium	none	35	clean
760	medium	used	M	7/8	good	none	40	clean
760	medium	not used	M†	7/8	good	none	42	clean
760	tight	used	S L M	7/8	rough	slight	45	hulled
760	tight	not used	S L M	15/16	rough	slight	45	hulled
840	loose	used	M	15/16	good	none	30	clean
840	loose	not used	M†	7/8	medium	none	32	clean
840	medium	used	M	15/16	good	none	40	fairly clean
840	medium	not used	M†	7/8	rough	slight	45	fairly clean
840	tight	used	M	7/8	medium	slight	55	hulled
840	tight	not used	S L M	7/8	rough	excessive	60	hulled

*Revolutions per minute.

†Shy.

The Effects of the Saw Speed

In the test with medium-staple cotton during 1926, 1927, and 1928, three saw speeds were used, namely, 640, 760, and 840 revolutions per minute. These three saw speeds were used with and without the standard air-line cleaner and with various densities of the breast-roll, to determine the effect of the different speeds, if any, upon the grade and length of lint, the style of ginning, the amount of gin-cutting of the lint, the time required in ginning, the condition of the seed, and the percentage of lint.

The Effect on Grade and Length of Lint: Increasing the speed of the gin saws from 640 to 760 and 840 revolutions per minute did not appear to have any appreciable effect on the grade of the cotton or the length of the lint (Tables 1, 2, and 3).

The Effect on Style of Ginning: The style of ginning did not seem to be affected when the gin saws were operated at speeds of 640 and 760 revolutions per minute, but at the highest saw speed, 840 revolutions per minute, the style of ginning in some instances was lowered.

The Effect on Gin-Cutting of Lint: The lint did not appear to be gin-cut in a single instance by increasing the speed of the saws from 640 to 760 or to 840 revolutions per minute, provided a loose breast-roll was used. When the density of the breast-roll was increased, however, there was a tendency for the lint to be gin-cut, especially at the saw speed of 840 revolutions per minute.

The Effect on Time of Ginning: Using a loose breast-roll at the highest saw speed, 840 revolutions per minute, 31.1 minutes were required in which to gin 1,500 pounds of seed cotton as compared with 32.8 minutes for a saw speed of 760 revolutions per minute, and 37.5 minutes for a saw speed of 640 revolutions per minute (Table 4). When the density of the breast-roll was increased to a medium degree, there was only a slight difference

Table 4.—Time required in minutes to gin 1,500 pounds of seed cotton with two 70-saw stands at different saw speeds and densities of the breast-roll

Breast-roll setting	Number of minutes required at the several saw speeds		
	640 r. p. m.	760 r. p. m.	840 r. p. m.
Loose.....	37.5	32.8	31.1
Medium.....	43.6	42.0	44.1
Tight.....	50.8	54.1	58.3

in the time required to gin the cotton at the three different saw speeds, this being 43.6, 42.0, and 44.1 minutes at 640, 760, and 840 revolutions per minute, respectively. When the tight breast-roll was used the time required in ginning the cotton was ma-

terially increased. At a saw speed of 640 revolutions per minute it required 50.8 minutes; at 760 revolutions per minute it required 54.1 minutes; and at the highest speed, 840 revolutions per minute, the time required was 58.3 minutes. It will be noted that it required more time to gin the cotton at the higher saw speeds than at the lower saw speeds when a tight breast-roll was used.

The Effect on Condition of the Seed: Increasing the speed of the saws when the loose breast-roll was used did not have any effect on the condition of the seed, which were well cleaned at all speeds (Figure 9). When the density of the breast-roll was increased to a medium degree, however, *the seed were not as well cleaned* at saw speeds of 760 and 840 revolutions per minute. With a saw speed of 640 revolutions per minute, and a tight breast-roll, the seed were well cleaned in only two of the six cases in which this saw speed was used. At saw speeds of 760 and 840 revolutions per minute with the tight breast-roll the seed were not well cleaned and were damaged by being hulled and cut (Figure 10).

The Effect on Percentage of Lint: The speed of the saws did not have any consistent effect on the percentage of lint, or gin turnout (Table 2).

Conclusions on the Effects of the Saw Speed: The speed of the saws did not appear to have any appreciable effect on the grade of the cotton, length of lint, gin-cutting of the lint, condition of seed, and percentage of lint, provided the loose breast-roll was used. The style of ginning did not seem to be affected when the gin saws were operated at speeds of 640 and 760 revolutions per minute, but at the highest saw speed, 840 revolutions per minute, the style of ginning in some instances was lowered. The only effect which the speed of the saws appeared to have was in influencing the time required in ginning. The highest saw speed required less time when the loose breast-roll was used, but when the density of the breast-roll was increased, a longer time was required.

The Effects of the Density of the Breast-Roll

Three degrees of density of the breast-roll, namely, *loose*, *medium*, and *tight*, were used to determine their effect upon the grade, length of lint, style of ginning, gin-cutting of the lint, time required in ginning, condition of the seed, and the percentage of lint. The three conditions of the breast-roll were used with and without the standard air-line cleaner and with each of the three saw speeds (Tables 1, 2, and 3).

The Effect on the Grade of the Cotton: There was no significant difference in the grade of the cotton when the loose and the

medium breast-roll settings were used. When the tight breast-roll was used, however, the grade of the cotton was slightly lowered.

The Effect on the Length of Lint: The different breast-roll settings had no effect on the length of the lint, so far as the classers could determine.

The Effect on the Style of Ginning: When the loose breast-roll was used in connection with the standard air-line cleaner, it produced the best style of ginning. The sample of lint had a smooth appearance, and was free of trash and dirt, neps and motes, and showed no signs of gin-cutting (Figure 7). When the cleaner was not used in connection with the loose breast-roll, the style of ginning was not as good on account of the presence of trash and dirt. As the breast-roll density was increased from *loose* to *medium*, there was a corresponding lowering in the style of ginning; and when the density was further increased to a tight breast-roll, the style of ginning was further lowered, being classed as *rough* by the classers on account of the presence of motes, neps, and an excessive amount of gin cuts (Figure 8).

The Effect on Gin-Cutting of the Lint: When the loose breast-roll was used, irrespective of the speed of the saws or the use of the standard air-line cleaner, the lint cotton showed no gin-cutting. When the density of the breast-roll was increased to a medium degree, the amount of gin-cutting varied from none to slight. The lint showed excessive gin-cutting in eight of the 18 comparisons when the tight breast-roll was used. In the other 10 comparisons, the lint was slightly gin-cut (Figure 8).

The Effect on the Time Required in Ginning: When the three saw speeds are averaged, the loose breast-roll required 33.8 minutes to gin 1,500 pounds of seed cotton as compared with 43.2 minutes when the medium breast-roll was used and 54.4 minutes when the tight breast-roll was used.

The Effect on Condition of the Seed: No difference was noted in the condition of the seed when the loose and the medium breast-rolls were used. The seed at these breast-roll densities were well cleaned and not damaged (Figure 9). When the tight breast-roll was used, however, the seed were badly damaged, being hulled and cut by the gin saws as well as being poorly cleaned (Figure 10).

The Effect on the Percentage of Lint: Comparisons made between the loose, medium, and tight breast-rolls showed that in four of the six comparisons the percentage of lint was slightly higher when the loose breast-roll was used.

Conclusions on the Effects of the Density of the Breast-Roll: The loose breast-roll gave the best results in practically all cases when used in connection with the standard air-line cleaner, regardless of the speed of the saws. Increasing the density of the breast-roll

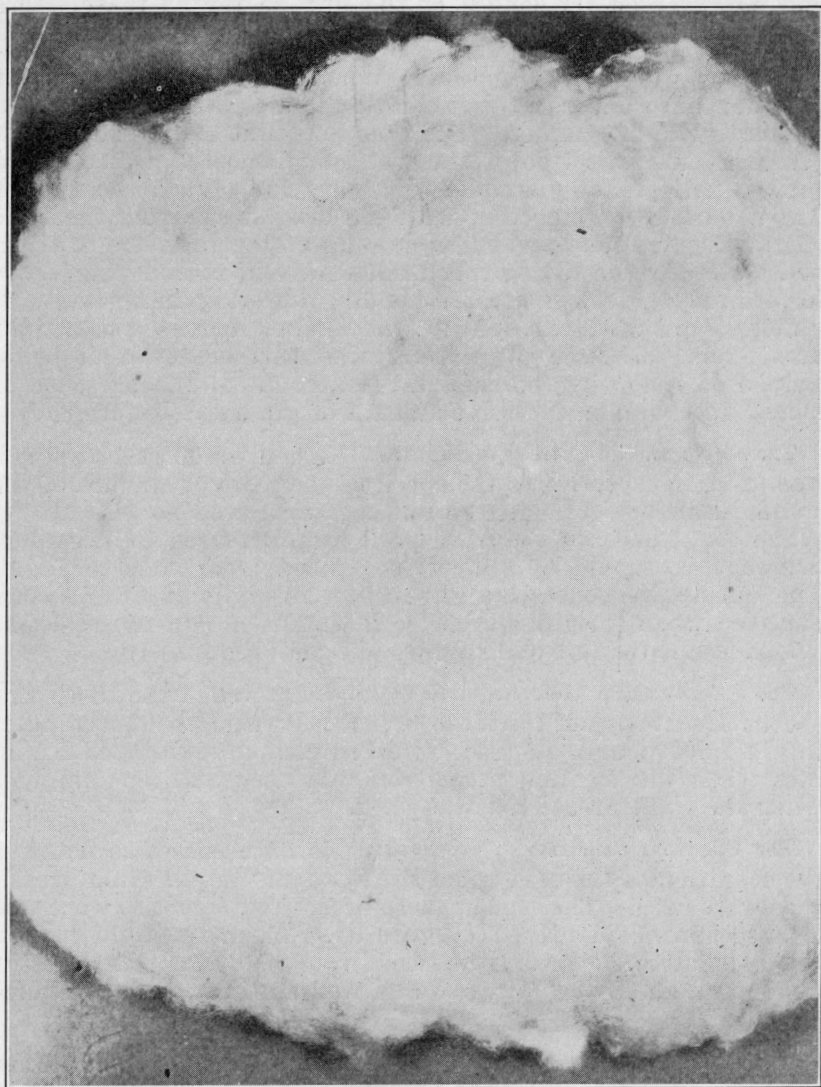


Figure 7.—Sample of lint cotton ginned under good conditions of ginning, which were a saw speed of 760 revolutions per minute, a loose breast-roll, and the use of the standard air-line cleaner. Note the smooth appearance of sample and absence of neps, gin cuts, and trash.

appeared to lower the grade of the cotton and the style of the ginning, to increase the amount of gin-cutting, to lengthen the time required in ginning, to damage the seed, and in some cases to lower the percentage of lint.



Figure 8.—Sample of lint cotton ginned under poor conditions of ginning, which were a saw speed of 840 revolutions per minute, a tight breast-roll, and non-use of the standard air-line cleaner. Note the presence of neps, gin-cuts, and trash.

Experiments with Cotton of Different Lengths of Staple

The second experiment with cotton of different lengths of staple was conducted in 1928 and 1929. In 1928 Bennett cotton



Figure 9.—Sample of seed ginned under good conditions of ginning, which were a saw speed of 760 revolutions per minute, a loose breast-roll, and the use of the standard air-line cleaner.

with a staple approximately of $\frac{7}{8}$ inch, and two selections of Greer-Wichita, one having a staple of $1\frac{1}{4}$ inches and the other having a staple of $1\frac{3}{8}$ inches, were used. In 1929 three varieties



Figure 10.—Sample of seed ginned under poor conditions of ginning, which were a saw speed of 840 revolutions per minute, a tight breast-roll, and non-use of the standard air-line cleaner. Note that some of the seed are not well cleaned, while others are broken and hulled.

of cotton were used: Startex, with a staple of 1 inch; Acala, with a staple of $1\frac{1}{8}$ inches; and Greer-Wichita, with a staple of $1\frac{3}{16}$ inches. These lots of cotton were ginned under the same conditions of saw speed and breast-roll setting as were used in the first experiment. The effect of the standard air-line cleaner was not taken into consideration in the second experiment, as it was used in the ginning of every lot of cotton.

Results in 1928 with Bennett Cotton

The results secured in 1928 with Bennett, a medium-staple cotton $\frac{7}{8}$ to $15/16$ inch in length, are shown in Table 5. The cotton ginned under the different conditions varied only one grade from middling (M) to strict low middling (SLM). The speed of the saws did not seem to have any consistent effect on the grade or length of the lint. In every case, however, when the tight breast-roll was used the lint showed slight gin-cutting, the style of ginning was termed medium to rough, and the seed were not ginned clean and, in some instances, were hulled (Figures 8 and 10).

Gin Turn-out: The percentage of lint or gin turn-out was lower in every case when the tight breast-roll was used. In this connection it was observed that the breast-roll did not revolve with regularity on account of its increased density, and this probably was a contributing factor in the incomplete removal of the lint from the seed.

Results in 1928 with $1\frac{1}{4}$ Inch Greer-Wichita Cotton

Table 6 gives the results secured with a selection of Greer-Wichita long-staple cotton having a staple of $1\frac{3}{16}$ to $1\frac{1}{4}$ inches, which was grown under irrigation. With two exceptions the cotton ginned under the different conditions had the same grade, strict middling (SM). At saw speeds of 640 and 760 revolutions per minute and with a loose breast-roll, the cotton graded slightly higher, strict middling plus (SM+), and at a saw speed of 840 revolutions per minute the cotton graded strict middling (SM).

Density of the Breast-Roll: The cotton ginned with a loose breast-roll irrespective of the speed of the saws was classed as slightly longer than the lots ginned with a medium or tight roll, being $1\frac{1}{4}$ inches or longer. The style of ginning was good, showing no gin-cutting of the lint and the seed were ginned clean (Figures 7 and 9). When the medium breast-roll was used, the cotton was slightly neppy at all three saw speeds. The lint showed no gin-cutting and the seed were ginned clean and free of damage, but on account of the presence of neps in the sample of lint, the style of ginning was classed as medium. In every case when the

Table 5.—Results with 7/8- to 15/16-inch staple (Bennett) in 1928

Speed of gin saws, r. p. m.	Breast-roll setting	Standard air-line cleaner	Grade of lint	Length of lint, inches	Style of ginning	Gin-cut of lint	Condition of seed	Percentage of lint
640	loose	used	M	7/8	good	none	clean	32.9
640	medium	used	S L M	15/16	medium	none	clean	32.9
640	tight	used	M	15/16	rough	slight	fairly clean	29.4
760	loose	used	M	7/8	good	none	clean	31.5
760	medium	used	M	7/8	good	none	clean	32.9
760	tight	used	S L M	7/8	rough	slight	hulled	30.1
840	loose	used	M	15/16	good	none	clean	33.6
840	medium	used	M	15/16	good	none	fairly clean	32.9
840	tight	used	M	7/8	medium	slight	hulled	28.7

Table 6.—Results with 1 3/16- to 1 1/4-inch staple (Greer-Wichita) in 1928

Speed of gin saws, r. p. m.	Breast-roll setting	Standard air-line cleaner	Grade of lint	Length of lint, inches	Style of ginning	Gin-cut of lint	Condition of seed	Percentage of lint
640	loose	used	S M +*	1 1/4 +	good	none	clean	29.5
640	medium	used	S M	1 3/16	medium	none	clean	28.3
640	tight	used	S M	1 7/32	rough	excessive	fairly clean	26.5
760	loose	used	S M +*	1 1/4	good	none	clean	28.9
760	medium	used	S M	1 1/4	medium	none	clean	28.3
760	tight	used	S M	1 7/32	rough	excessive	hulled	27.7
840	loose	used	S M	1 1/4 +	good	none	clean	29.7
840	medium	used	S M	1 7/32	medium	none	clean	27.1
840	tight	used	S M	1 1/4	rough	excessive	hulled	28.9

*Slightly better than strict middling (S M) but not good enough to be classed good middling (G M).

tight breast-roll setting was used with the longer-staple cotton, the style of ginning was rough, the lint showing excessive gin-cutting, and where the two higher saw speeds were used, the seed were hulled (Figures 8 and 10). The loose breast-roll setting at all three saw speeds gave the highest percentages of lint or gin turn-out.

Results in 1928 with 1 $\frac{3}{8}$ Inch Greer-Wichita Cotton

The speed of the saws and the degree of density of the breast-roll apparently had no effect on the length of lint of the longer-staple Greer-Wichita cotton, which measured 1 $\frac{3}{8}$ inches, as shown in Table 7. This cotton was given a lower grade by the classers owing to damage caused by unfavorable weather conditions before being harvested. With two exceptions it was graded strict low middling (SLM), the grade of the other lots being middling (M).

Table 7.—Results with 1 3/8-inch staple (Greer-Wichita) in 1928.

Speed of gin saws, r. p. m.	Breast-roll setting	Standard air-line cleaner	Grade of lint	Length of lint, inches	Style of ginning	Gin-cut of lint	Condition of seed	Percentage of lint
640	loose	used	M	1 3/8	good	none	clean	28.4
640	medium	used	S L M	1 3/8	medium	none	clean	29.7
640	tight	used	S L M	1 3/8	rough	slight	hulled	29.1
760	loose	used	S L M	1 3/8	good	none	clean	29.7
760	medium	used	S L M	1 3/8	good	none	clean	27.2
760	tight	used	S L M	1 3/8	medium	none	fairly clean	29.7
840	loose	used	S L M	1 3/8	good	none	clean	25.9
840	medium	used	M	1 3/8	good	none	fairly clean	25.3
840	tight	used	S L M	1 3/8	rough	excessive	hulled	26.6

Density of the Breast-Roll: The loose breast-roll again gave best results at all saw speeds; the style of ginning was classed good, the lint showed no gin-cutting, and the seed were ginned clean. The cotton ginned with a medium breast-roll setting at saw speeds of 760 and 840 revolutions per minute showed no gin-cutting of the lint, the seed were clean, and the style of ginning was, therefore, termed good. At a saw speed of 640 revolutions per minute, with a medium breast-roll, the ginning was termed medium, owing to the presence of neps in the sample, although there was no gin-cutting of the lint, and the seed were as well cleaned as with the other two saw speeds. At 640 and 840 revolutions per minute with a tight breast-roll setting, the ginning was rough, showing slight to excessive gin-cutting, and the seed were hulled (Figures 8 and 10). The highest saw speed, 840 revolutions per minute, gave the lowest percentage of lint or gin

turn-out at all conditions of the breast-roll setting. These results indicate that cotton of this length of staple, $1\frac{3}{8}$ inches, cannot be ginned satisfactorily at this high saw speed, on account of the irregular turning of the breast-roll, which causes considerable lint to be left on the seed. It therefore appears that a saw speed of 760 revolutions per minute on the gin used in these experiments is a more suitable speed for ginning cotton with a staple as long as $1\frac{3}{8}$ inches.

Results in 1929 with Startex Cotton

The Startex cotton used in the experiment in 1929 had a staple of 1 inch, under the nine conditions of saw speeds and breast-roll settings as shown in Table 8.

Table 8.—Results with 1-inch staple (Startex) in 1929

Speed of gin saws, r. p. m.	Breast-roll setting	Standard air-line cleaner	Grade of lint	Length of lint, inches	Style of ginning	Gin-cut of lint	Condition of seed
640.....	loose.....	used.....	S M	1	medium..	slight....	fairly clean
640.....	medium..	used.....	S M	1	medium..	slight....	clean
640.....	tight.....	used.....	M	1	rough....	slight....	fairly clean
760.....	loose.....	used.....	G M	1	good.....	none.....	fairly clean
760.....	medium..	used.....	S M	1	good.....	none.....	clean
760.....	tight.....	used.....	M	1	rough....	excessive.	fairly clean
840.....	loose.....	used.....	G M	1	good.....	none.....	fairly clean
840.....	medium..	used.....	S M	1	medium..	slight....	clean
840.....	tight.....	used.....	M	1	rough....	excessive.	hulled

Density of the Breast-Roll: Where the loose breast-roll was used at a saw speed of 640 revolutions per minute, the cotton graded strict middling (SM) and on account of the slight gin-cutting, the style of ginning was classed as medium. The seed were ginned only fairly clean. At saw speeds of 760 and 840 revolutions per minute with loose breast-roll, the cotton graded higher, good middling (GM), showing no gin-cutting and the style of ginning was termed good. The seed, however, were only fairly clean. The cotton ginned with the medium breast-roll at all three saw speeds graded strict middling (SM). Owing to the slight gin-cutting of the lint the style of ginning at saw speeds of 640 and 840 revolutions per minute was termed medium. At a saw speed of 760 revolutions per minute, however, there was no gin-cutting of the lint and the style of ginning was termed good. The seed in every lot were ginned clean. The lint graded only middling (M) when the tight breast-roll was used, regardless of the speed of the saws. The cotton showed slight to excessive gin-cutting and for this reason the style of ginning was termed rough. The seed were ginned fairly clean at saw speeds of 640 and 760 revolutions per minute but when the saw speed of 840 revolutions per minute was used, the seed were badly hulled.

It is noticeable that when the loose breast-roll setting was used the seed were only fairly clean. This may be attributed to the fact that the roll was not sufficiently dense to cause a complete removal of the lint from the seed. When the medium breast-roll setting was used, which increased the density of the roll, the seed were ginned clean regardless of the speed of the saws. In the case of the tight breast-roll setting, however, in which the density of the roll was further increased to a point where the roll had difficulty in turning regularly, the seed were only fairly clean, considerable lint remaining on them, at saw speeds of 640 and 760 revolutions per minute while at the saw speed of 840 revolutions per minute the seed were badly hulled and broken (Figure 10).

Results in 1929 with Acala Cotton

Length of Lint: The resultant length of lint of the Acala cotton used in 1929 did not appear to be affected appreciably by the different saw speeds and breast-roll settings. It was classed $1\frac{1}{8}$ inches in all cases except one, in which a saw speed of 840 revolutions per minute was used with a loose breast-roll setting, the difference in length in that case being only $\frac{1}{32}$ of an inch, which is not considered significant (Table 9).

Table 9.—Results with 1 $\frac{1}{8}$ -inch staple (Acala) in 1929

Speed of gin saws, r. p. m.	Breast-roll setting	Standard air-line cleaner	Grade of lint	Length of lint, inches	Style of ginning	Gin-cut of lint	Condition of seed
640.....	loose.....	used.....	S M	1 $\frac{1}{8}$	good.....	none.....	fairly clean
640.....	medium...	used.....	M	1 $\frac{1}{8}$	medium...	slight....	clean
640.....	tight.....	used.....	M	1 $\frac{1}{8}$	rough....	excessive.	clean
760.....	loose.....	used.....	S M	1 $\frac{1}{8}$	good.....	none.....	fairly clean
760.....	medium...	used.....	M	1 $\frac{1}{8}$	medium...	slight....	clean
760.....	tight.....	used.....	M	1 $\frac{1}{8}$	rough....	excessive.	hulled
840.....	loose.....	used.....	S M	1 $\frac{3}{32}$	good.....	none.....	fairly clean
840.....	medium...	used.....	S M	1 $\frac{1}{8}$	medium...	slight....	clean
840.....	tight.....	used.....	M	1 $\frac{1}{8}$	medium...	slight....	clean

Density of the Breast-Roll: The cotton ginned with a loose breast-roll graded strict middling (SM) at all three saw speeds. There was no gin-cutting of the lint and the style of ginning was therefore termed good. The seed were only fairly well cleaned, however, which may be attributed to the looseness of the breast-roll. The medium breast-roll setting resulted in the lint being graded middling (M) when saw speeds of 640 and 760 revolutions per minute were used, but when the saw speed was increased to 840 revolutions per minute the cotton was graded as strict middling (SM). In every lot ginned with the medium breast-roll, there was slight gin-cutting of the lint and the style of ginning was termed medium. The seed were well cleaned in every instance and showed no indications of damage. At all three saw speeds when the tight breast-roll was used, the cotton was graded as

middling (M) ; but when saw speeds of 640 and 760 revolutions per minute were used, the lint was excessively gin-cut, and also showed motes and neps resulting in a rough style of ginning. The seed were ginned clean at saw speeds of 640 and 840 revolutions per minute when the tight breast-roll was used, but at a saw speed of 760 revolutions per minute the seed were damaged considerably by being hulled.

Results in 1929 with Greer-Wichita Cotton

The results with Greer-Wichita cotton, a long-staple upland variety, are given in Table 10. The lint measured $1 \frac{3}{16}$ inches in length for seven of the nine conditions of ginning. For the other two conditions of ginning, the lint measured $1 \frac{3}{32}$ inches with a saw speed of 760 revolutions per minute and a tight breast-roll, and $1 \frac{1}{8}$ inches with a saw speed of 840 revolutions per minute and a medium breast-roll.

Table 10.—Results with $1 \frac{3}{16}$ -inch staple (Greer-Wichita) in 1929

Speed of gin saws, r. p. m.	Breast-roll setting	Standard air-line cleaner	Grade of lint	Length of lint, inches	Style of ginning	Gin-cut of lint	Condition of seed
640.....	loose.....	used.....	S M	$1 \frac{3}{16}$	medium..	slight....	fairly clean
640.....	medium..	used.....	S M	$1 \frac{3}{16}$	medium..	slight....	clean
640.....	tight.....	used.....	S L M	$1 \frac{3}{16}$	rough....	excessive.	hulled
760.....	loose.....	used.....	S M	$1 \frac{3}{16}$	good.....	none.....	fairly clean
760.....	medium..	used.....	M	$1 \frac{3}{16}$	medium..	slight....	clean
760.....	tight.....	used.....	S L M	$1 \frac{3}{32}$	rough....	excessive.	hulled
840.....	loose.....	used.....	S M	$1 \frac{3}{16}$	good.....	none.....	fairly clean
840.....	medium..	used.....	M	$1 \frac{1}{8}$	medium..	slight....	clean
840.....	tight.....	used.....	S L M	$1 \frac{3}{16}$	rough....	excessive.	hulled

Density of the Breast-Roll: The cotton ginned at the different saw speeds and breast-roll settings varied two grades, from strict middling (SM) to strict low middling (SLM). The use of the loose breast-roll gave the highest grade, strict middling, under all conditions of saw speed. As a result of the slight gin-cutting of the lint, the style of ginning was classed medium at a saw speed of 640 revolutions per minute. At saw speeds of 760 and 840 revolutions per minute, however, the lint showed no gin-cutting and the style of ginning was termed good. The seed were fairly well cleaned at the three saw speeds when the loose breast-roll was used. When the medium breast-roll was used, the lint graded strict middling (SM) at a saw speed of 640 revolutions per minute, and middling (M) at the two higher saw speeds. The style of ginning was only medium as a result of slight gin-cutting of the lint, but the seed were well cleaned. The cotton was graded strict low middling (SLM) when the tight breast-roll was used regardless of the speed of the saws. In every instance there was excessive gin-cutting of the lint when the tight breast-roll was used, which, according to the classers' report, contributed largely to the lowering of the grade and to a

rough style of ginning. The seed were also badly damaged by being hulled and broken.

SUMMARY

During the four years, 1926 to 1929, inclusive, cotton of different lengths of staple was ginned under varying conditions of saw speed and breast-roll density, with and without the use of the standard air-line cleaner, to determine the effect of these conditions upon the grade and staple of cotton. In these experiments a two-stand, 70-saw, air-blast gin was used.

In the first experiment a medium-staple cotton, ranging in length from $\frac{7}{8}$ to 1 inch, was used. In the second experiment several different kinds of cotton were used, and these ranged in length of staple from $\frac{7}{8}$ to $1\frac{3}{8}$ inches.

The Effects of the Standard Air-Line Cleaner: The results of three years' test with a medium-staple cotton show, in general, that the standard air-line cleaner improved the grade of the cotton and the style of ginning. In most cases it slightly reduced the percentage of lint as compared with cotton not cleaned, by removing the dirt and trash from the cotton. The cleaner did not appear to have any appreciable effect on the length of lint or the time required for ginning and is withal a profitable attachment.

The Effects of the Saw Speed: Increasing the speed of the saws from 640 to 760 and 840 revolutions per minute, provided the loose breast-roll was used, did not seem to have any significant effect on the grade of the cotton, the length of lint, the gin-cutting of the lint, or in the condition of the seed. Cotton of varying lengths of staple were used, ranging from $\frac{7}{8}$ to $1\frac{3}{8}$ inches. The style of ginning did not seem to be affected when the gin saws were operated at speeds of 640 and 760 revolutions per minute. At the highest saw speed, 840 revolutions per minute, however, the style of ginning was in a few instances slightly lowered. Increasing the speed of the saws appeared to reduce the time required in ginning when a loose breast-roll was used.

The Effects of the Density of the Breast-Roll: The loose breast-roll in most cases gave better results with all lengths of staple than did the medium or tight breast-rolls. Increasing the density of the breast-roll appeared to lower the grade of the cotton and the style of ginning, to increase the amount of gin-cutting, to lengthen the time required in ginning, to damage the seed, and in some cases to lower the percentage of lint.

The results of these experiments with cotton of various lengths of staple show, in general, that a saw speed of 760 revolutions per minute, used together with the loose breast-roll and the standard air-line cleaner, provided the most favorable conditions for ginning cotton on the air-blast type of gin used.