PERFORMANCE OF AN EXPERIMENTAL MACHINE FOR REMOVING STICKS AND CLEANING MACHINE HARVESTED COTTON

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PREFACE

Since the introduction of mechanical means for harvesting cotton, the trash content of the harvested material as delivered to the gin has shown a marked increase. The removal of hulls, leaf trash and motes has been accomplished through the use of various combinations of gin equipment and machinery; however, the effective removal of limbs, lateral branches and stems has not been readily accomplished with the machinery available. The United States Department of Agriculture Cotton Ginning Research Laboratory, Stoneville, Mississippi, has been cognizant of the problem of stick removal and much effort has been devoted to the solution of the problem. These efforts were culminated in 1953 when a workable "stick remover" was originated at the Stoneville Laboratory by Mr. Gerald N. Franks. Developed primarily for use in those gins handling mechanically stripped cotton, a model of the stick remover was installed in the Research Gin at the Oklahoma Cotton Research Station, Chickasha, Oklahoma, to be tested under field conditions through the cooperative efforts of the Oklahoma Agricultural Experiment Station, Oklahoma Cotton Research Foundation and Cotton Ginning Investigations section of the United States Department of Agriculture.

The author believed that since the problem of stick removal was of such acute nature a more detailed examination, study and report on the performance of the stick remover would be most timely and helpful in the furtherance of mechanization of cotton.

For counsel and cooperation of Professor E. W. Schroeder, Head, and Jay G. Porterfield, Associate Professor, Agricultural Engineering Department, the author is very grateful. He is also indebted to the engineers of the Cotton Ginning Investigations section of the United States Department of Agriculture for their advice and assistance. He wishes further to express his appreciation for having had the opportunity and facilities with which to work at the Oklahoma Cotton Research Station.

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I. INTRODUCTION

Many factors affect the quality of baled lint and determine its end use. One of the factors over which the ginner has greatest control is the foreign matter content of the baled lint. The foreign matter may consist of leaf trash, dirt, sand, motes, seed fragments, bark from the cotton plant, weeds, grass and other extraneous objects. Bark is one of the foreign elements hardest to separate from the cotton fiber. The damage and inconvenience of bark in cotton manufacturing and spinning operations has long been recognized and as a result those bales of lint contaminated with bark are penalized heavily. Bark is the result of the inclusion of limbs and branches of the cotton plant, commonly referred to as "sticks", in the harvested material delivered to the gin for processing. Mechanical stripping of cotton generally includes a large amount of sticks in the harvested cotton. Obviously the elimination of sticks from mechanically stripped cotton would open the way for further application of this method of harvest.

Agricultural engineers have worked many years to perfect machines or processes which would eliminate sticks from mechanically stripped cotton. Variations in size and condition of cotton plants as influenced by environmental conditions of growth have rendered the problem of elimination of sticks during harvest insurmountable at a significant level of operation across the Cotton Belt. Therefore it may be reasoned that if sticks are included with the cotton at time of harvest, they must be eliminated before agitation of the harvested material causes the bark to strip off and contaminate the lint.

The function of a cotton gin is to convert harvested seed cotton into salable products of lint and seed, preserve the inherent qualities of the cotton and return to the customer his due products. Profit to the customer and recurring business to the ginner depends on how well the inherent qualities of the fibers are preserved. To preserve these qualities certain operations must be performed on the harvested material before separation of seed and lint else the end products not conform to the expectancy of standards determined by varietal characteristics and environmental conditions. The pre-ginning operations include drying to lower the level of moisture content, extracting to remove the cotton from the hull and cleaning to remove leaf trash, dirt, sand and other fine material. Machinery has been developed to perform each of these operations and though one unit of equipment may perform all three functions, it is generally more effective if one unit of different design is used for each operation. This situation has resulted in large outlays of gin equipment and machinery to handle the mechanically stripped cotton. Even with the large outlays no one machine or combination of machinery has proved to be successful in removing sticks from seed cotton.

Engineers of both public and private agencies have expended much effort to design a unit which would remove sticks from seed cotton. The first criterion was of course the removal of the sticks. Other factors to be considered for a stick removing machine included:

1. How much cotton was wasted?
2. Did the machine perserve the inherent qualities of the cotton?
3. Could the machine replace some other piece of equipment?
4. Did the machine have ample capacity to balance costs of installation, maintenance and operation commensurate with volume of production?

Various designs and principals were employed in the attempts to perfect a machine which would satisfy the above factors. In the spring of 1953 a 10-inch pilot unit was designed and constructed by engineers at the Cotton Ginning Research Laboratory, Stoneville, Mississippi. Preliminary tests showed such promise that the unit was shipped to Chickasha, Oklahoma, for tests on the types of cotton for which it was most urgently needed. Results from tests with Oklahoma cotton indicated that the basic principles of operation were sound and the construction of a larger unit was justified. The pilot model was returned to the Stoneville Laboratory and construction started there on a unit 60 inches in length. The large unit was shipped to Chickasha in November, 1953, and installed in such manner that it could be compared with a standard model master bur extractor. Most desirable operational characteristics were also to be determined.

II. OBJECT

The object of the study was to determine the performance under field conditions of an experimental seed cotton cleaning and stick removing machine on hand snapped and machine stripped cotton. The study was divided into two parts.

A. Determination of:

1. Rate of feed of material to the unit.
2. Speed of the extractor saw cylinder.
3. Spacing of the grid bars through which trash is discharged.

B. Comparison of the stick remover to a 14 foot master bur extractor.

Basis for evaluation of each variable and the performance of the stick remover as a unit included the following measurements:

1. Weight of waste discharged by the stick remover or comparative machine.

2. Weight of waste discharged by unit extractor-feeder-cleaner following stick remover or comparative machine.

3. Weight of waste discharged by huller-front of gin stand following stick remover or comparative machine.

4. Weight of waste discharged by moting system of gin stand following stick remover or comparative machine.

5. Weight of lint produced from a given amount of harvested material when using the stick remover or comparative machine.

6. Percentage waste in lint produced from harvested material when using stick remover or comparative machine.

7. Grade index of lint produced from harvested material when using stick remover or comparative machine.

8. Percent by weight of total trash removed when using stick remover or comparative machine.

9. Percent by weight of sticks removed when using stick remover or comparative machine.

10. Weight of clean seed cotton discharged in waste by stick remover or comparative machine from a given amount of harvested material.

In those tests with hand snapped cotton the percent of hulls removed was substituted for percent of sticks removed since snapped cotton contains very few sticks. The substitution gave a comparison of effectiveness of the stick remover as a hull extractor.

Calculated value of lint produced from a given amount of harvested material was used in the final comparison of stick remover versus master bur extractor. These figures substituted for weight of seed cotton in waste give an indication of the desirability of eliminating certain portions of the harvested material.

III. PROCEDURE AND TECHNIQUES OF EVALUATION

Harvested cotton of the representative type desired was obtained in sufficient quantities to provide test lots for all the gin arrangements in each series of tests. Previous experience in ginning research at the Oklahoma Cotton Research Station had shown that by using original lots of uniform harvested material weighing 200 pounds or more, two or more repetitions of each treatment were required to obtain accuracy of measurements. The former research indicated that as lot weights were increased the number of repetitions of each treatment could be decreased with the most reliable data obtained when using 400 pound lots repeated three times with each gin arrangement.

The standard procedure for gin tests was as follows:

1. Weighed to the nearest pound the required quantity of harvested material.

2. Run the lot through the machinery in the proper sequence, catching and weighing all waste discharged from each unit and weighing the lint and seed produced. The necessary samples for laboratory analysis were taken during the test run.

3. Convert by simple ratio all weights obtained in step 2 above to a 2000 pounds original lot basis for hand-snapped or 2400 pounds original lot basis for machine stripped cotton. The conversion was accomplished in the following manner.

a. $$\frac{\text{2000\# for hand snapped or 2400\# for mechanically stripped}}{\text{(Test lot weight - Weight of samples taken)}} = \text{Multiplier}$$

b. Multiplier X Individual Recorded Weights = Bale Weight Basis

Figures obtained for each measurement from each repetition were added and the mean extracted for use in the final comparisons of treatments.

The techniques for obtaining laboratory measurements are described in general in the following paragraphs. Techniques employed were similar to those used by other research workers in cotton production, harvesting, ginning, marketing and utilization. Sufficient observations were made on each measure to obtain reproducibility of results consistent with variations in the component measured.

The pneumatic fractionation procedure was used to determine the foreign matter content of the seed cotton. In this technique all hulls and sticks were picked by hand from a 300 gram original sample and the remaining material placed in a closed container to be agitated by compressed air. The centrifuge action of the fractionator allowed the motes and leaf trash to be screened off during the agitation. Each component of trash was collected and weighed separately. Simple calculations gave the percentage of each component in the original sample.

Percent of trash removed by a machine or combination of machinery was calculated from the fractionation data as follows:

$$\frac{\text{\% Trash in material input} - \text{\% Trash in material output} \times 100}{\text{\% Trash in material input}} = \text{Percent Trash Removed}$$

Grade and staple length of the lint was determined by comparison to official standards by United States Department of Agriculture Cotton Classers.

Waste in the lint was determined by the Shirley Analyzer method. One-hundred grams of lint was processed through the machine and the cleaned lint and visible waste caught and weighed. The weight of cleaned lint equaled percent cleaned lint and the weight of visible waste

caught equaled percent visible waste. One-hundred percent minus percent of cleaned lint equaled total waste. Invisible waste was the difference between total waste and visible waste.

Grade index of the lint was determined in the following manner. Basis sheets for premiums and discounts issued by a local cotton buyer were averaged for the four year period 1951 through 1954. Middling grade with 15/16th inch staple was chosen as base and given an index value of 100.0 and a base price of $.35 per pound assigned to it. Premiums or discounts for all grades in the 15/16th inch staple length range were added to the Oklahoma quotation for Middling to obtain relative values. Formula for the conversion to index was as follows:

$$\frac{3500 - \text{Discount or premium for grade} \times 100}{3500 - \text{Discount for Middling}} = \text{Grade Index}$$

Classer's designation of grade was assigned the index number for that grade and the average index number was then calculated for each treatment. Some examples of indexes for grade are: Middling = 100.0; Low Middling = 84.4; Low Middling Spot (Light) = 73.7.

Value of baled lint was calculated by multiplying weight of lint produced by the average per pound price of the lint based on premiums and discounts for grade and staple length.

IV. DESCRIPTION OF MACHINE TESTED

The pilot model of the stick remover shown in Figure 1 was used in the preliminary trials in August, 1953 to ascertain the desirability of constructing a larger unit which could be placed in line with standard gin machinery at the Oklahoma Cotton Research Station. Conventional extractor saw cylinders seven inches in diameter were used to hold and convey the cotton past a grid bar arrangement. The grid bars were 3/8 inch in diameter and set in a circle with a radius of 4 1/2 inches concentric with the saw cylinder. The bars were aligned parallel to the axis of the saw cylinders and were so spaced to allow trash to be expelled through the openings. Four cylinders were placed in series one above the other in order that the harvested material might be exposed to the expelling force four different times.

From the top of the unit cotton is fed into the machine at a uniformly controlled rate and falls onto a directional kicker roll cylinder. This cylinder loosens the cotton and directs it onto the first extractor cylinder. The saw teeth engage the lint and pull the material past the grid bar arrangement. The circular arrangement of the grid assembly set one inch away from the saws serves to hold the cotton on the saw tooth while at the same time allowing the foreign matter to be expelled between the bars. Trash expelled falls by gravity to the bottom of the unit. Rotation of the cylinder carries the cotton under and to the rear where it is doffed by brushes. A directional hood guides the cotton thrown by

the brush around and down onto the next cylinder. The same process is repeated on each of the four cylinders.

The preliminary tests indicated an expected capacity of approximately two pounds of material per minute per inch of initial saw cylinder.

The first model of the full sized unit as installed at Chickasha is shown in Figure 2. The picture was taken from the left rear of the machine and shows the feed control adjustment, trash discharge drive and endless belt used to drive the four extractor cylinders and brushes from the cotton directional kicker roll. Also shown is an end view of the 14 foot master bur extractor to which the stick remover was compared.

The view in Figure 3 illustrates the right end of the stick remover. The flat belt from the cotton directional kicker roll is connected to a variable speed drive powered by an electric motor and used to change the speeds of the kicker roll and consequently the extractor cylinders.

A closer view of the grid bars and their arrangement around the extractor cylinders is shown in Figure 4. This view also shows the 40 percent of a circle employed for extracting of foreign matter.

The stripped cotton shown in Figure 5 is typical of material gathered by machine strippers. The stick remover was designed to remove the lengthy portions of the cotton plant embedded with the harvested material.

Results from the 1953 tests indicated a reclaimer was necessary to remove the cotton thrown out with the trash. Grid bars were removed from the bottom cylinder and the cotton and trash guides modified so the cylinder could be used as the reclaimer. Cotton from the third cylinder was directed away from the bottom one and all trash was directed onto the bottom cylinder. A wire brush was used to hold the trash against the face of the cylinder until the saw teeth engaged the lint and carried the

cotton away from the trash. This action forced the trash through the brush from whence it fell by gravity to the trash discharge. The cotton was doffed by brushes from the saw and re-entered the stream of cleaned cotton. Shown in Figure 6 is the installation as used in 1954. The illustration in Figure 7 gives a closer view of the by-pass valve arrangement used to direct the cotton into or past the stick remover.

Fig. 1 - Pilot model of the stick remover.

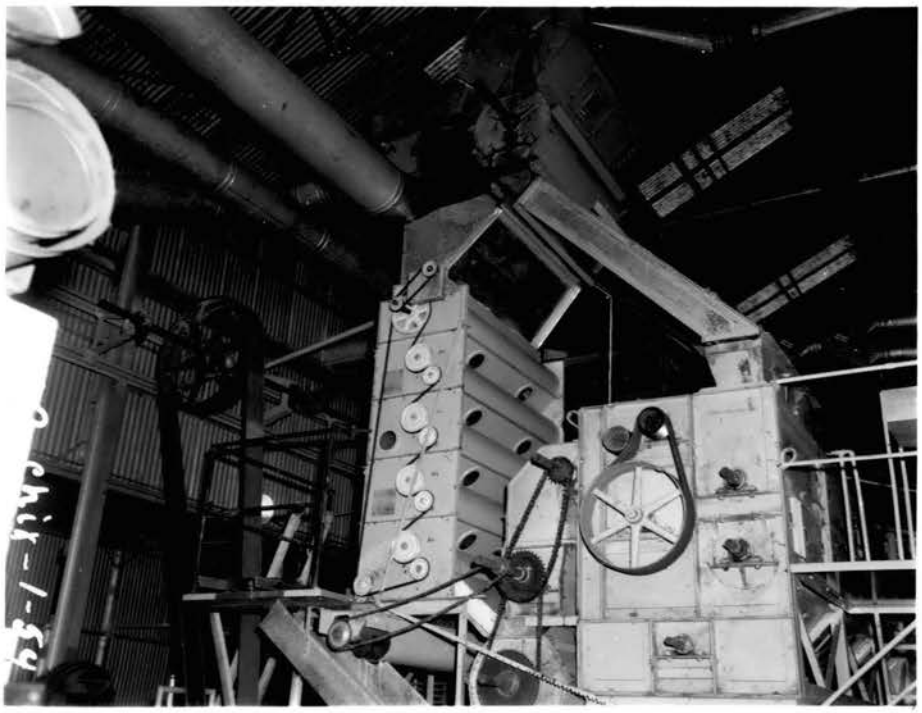

Fig. 2 - Full size stick remover (machine on left) as installed in 1953. Master extractor in lower right corner of picture.

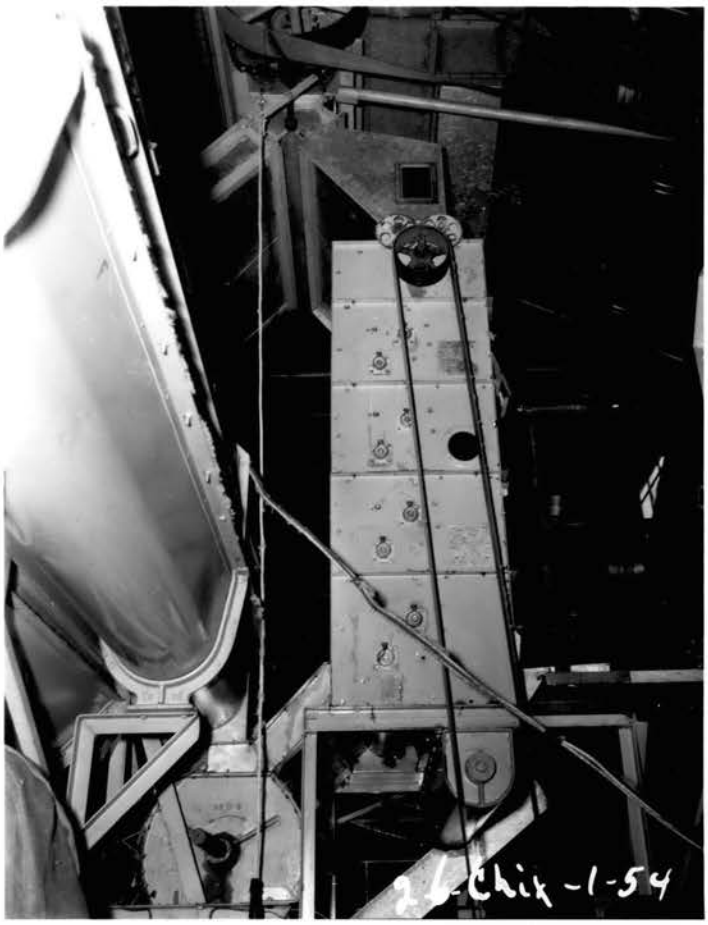

Fig. 3 - Right end view of stick remover as installed in 1953.

Fig. 4 - Close-up view of grid bar assembly and its placement relative to the extractor saw cylinder.

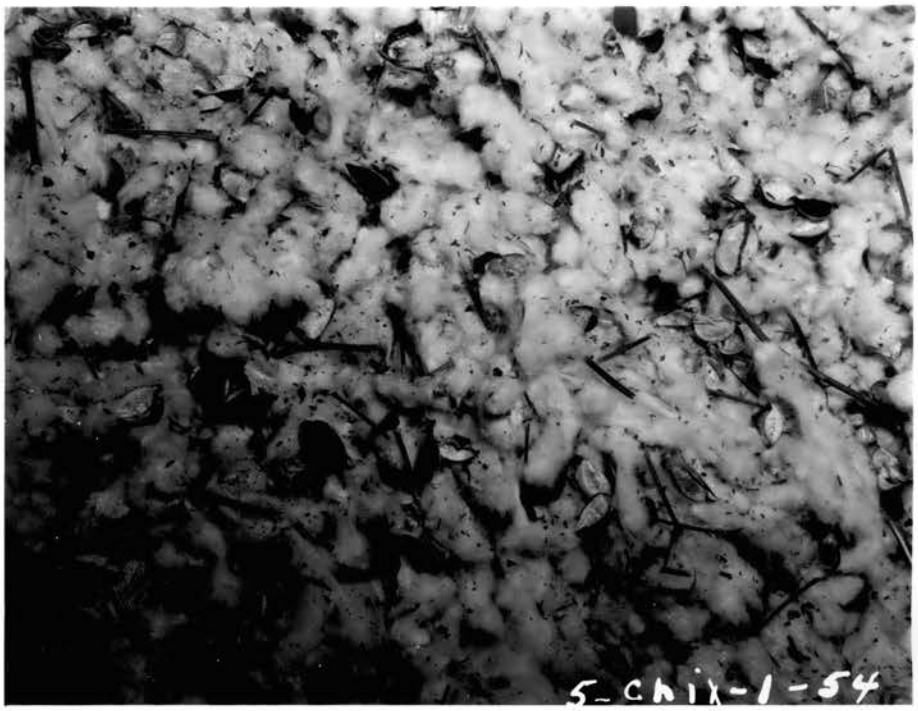

Fig. 5 - Typical mechanically stripped cotton showing hulls, leaf trash and sticks.

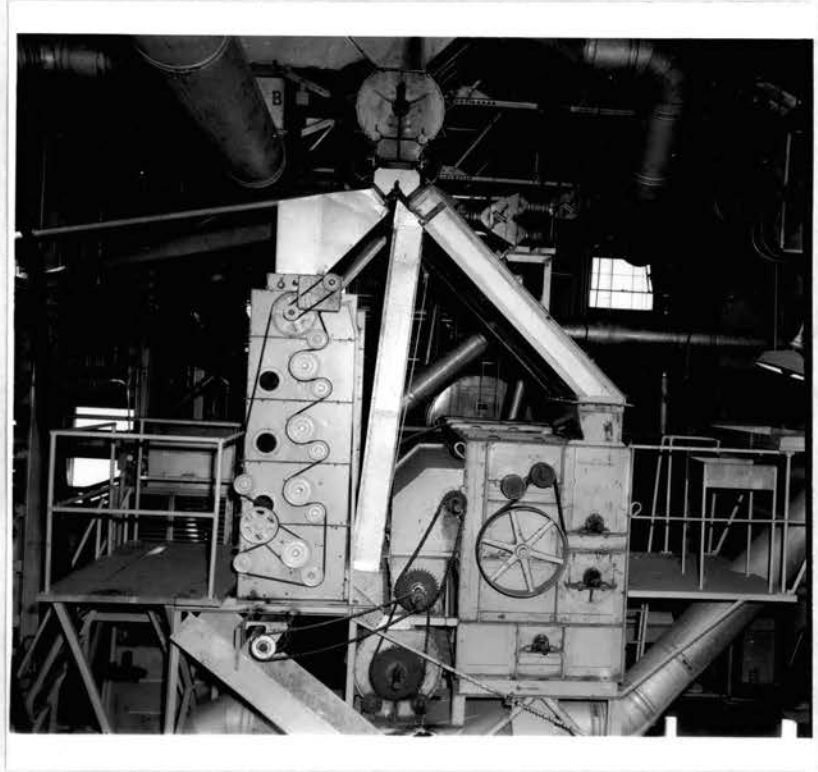

Fig. 6 - Stick remover as installed in 1954.

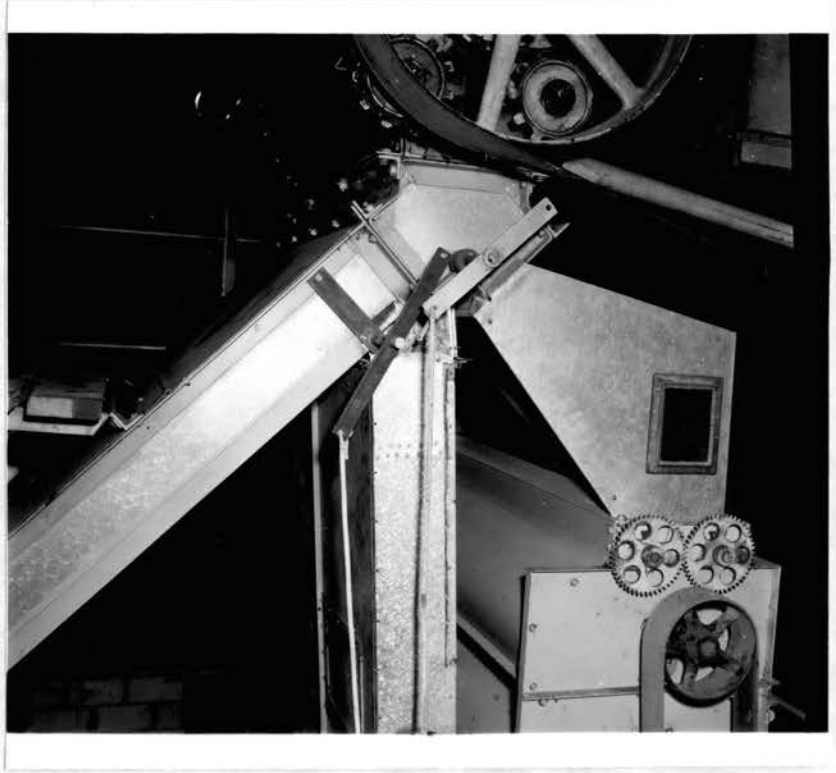

Fig. 7 - Valve arrangement to route cotton into or past the stick remover.

V. DESCRIPTION OF TESTS AND RESULTS

The tests used in seeking the objectives listed in Chapter II are described in the following paragraphs. Many of the tests were multi-purpose and the 1954 tests were extensions with modifications of the 1953 tests.

A. Determination of Rate of Feed, Extractor Saw Speed and Grid Bar Spacing

(1) 1953 Tests.

The tests used in the first year's study were designed to compare three rates of feed combined with three extractor saw cylinder speeds and two grid bar spacings. Lankart 57 cotton grown on the Cotton Research Station farm was stripped after frost for use in these tests. Total foreign matter content of the harvested material was 34.80 percent. In 2400 pounds of material there was calculated to be 576 pounds of hulls, 167 pounds of sticks and 92 pounds of motes and leaf trash.

Rates of feed into the stick remover were 72, 93 and 119 pounds of material per minute. Extractor saw cylinders were operated at 616 rpm, 770 rpm and 924 rpm. Grid bar spacings were 1 inch and 1 1/4 inches on center to give clearances of 5/8 inch and 7/8 inch respectively for the narrow and wide grid bars. Three repetitions of each of the nine combinations were used on the one inch grid assembly and two repetitions were used on the 1 1/4 inch grid assembly.

The overhead arrangement included a reel type cleaner-drier followed by the stick remover and a unit extractor-feeder-cleaner over an 80-saw standard moting huller-front air blast gin stand. Samples of material (for determination of trash content) were taken before entering the reel drier, between the stick remover and unit extractor and after the unit extractors just before entering the huller-front of the gin stand. Lint samples were taken after ginning for ascertaining classer's grade and staple length and content of foreign matter. Results of the 1953 tests are given in Table I through X.

Table I

Effects of rate of feed, extractor saw cylinder speed and grid bar spacing on pounds of waste discharged from 2400 pounds of stripped material by stick remover - 1953 tests.

Rate of Feed in pounds per minute	Extractor saw cylinder speed in rpm					
	616		770		924	
	1"	1 1/4"	1"	1 1/4"	1"	1 1/4"
72	186	512	201	545	248	608
93	201	514	192	546	239	601
119	182	510	195	537	227	588

Table II

Effects of rate of feed, extractor saw cylinder speed and grid bar spacing on pounds of waste discharged by unit extractor-feeder-cleaner following stick remover - 1953 tests.

Rate of Feed in pounds per minute	Extractor saw cylinder speed in rpm					
	616		770		924	
	1"	1 1/4"	1"	1 1/4"	1"	1 1/4"
72	388	204	345	174	333	159
93	380	209	352	188	351	175
119	382	223	360	201	347	187

Table III

Effects of rate of feed, extractor saw cylinder speed and grid bar spacing on pounds of waste discharged by huller-front of gin stand following stick remover and unit extractor - 1953 tests.

Rate of Feed in pounds per minute	Extractor saw cylinder speed in rpm					
	616		770		924	
	1"	1 1/4"	1"	1 1/4"	1"	1 1/4"
72	119	82	119	76	129	76
93	123	81	129	77	130	78
119	123	80	145	86	134	90

Table IV

Effects of rate of feed, extractor saw cylinder speed and grid bar spacing on pounds of waste discharged by moting system of 80-saw gin stand following stick remover and unit extractor - 1953 tests.

Rate of Feed in pounds per minute	Extractor saw cylinder speed in rpm					
	616		770		924	
	1"	1 1/4"	1"	1 1/4"	1"	1 1/4"
72	17.8	13.8	18.2	12.7	19.3	14.6
93	18.6	14.0	18.5	15.0	23.1	15.3
119	19.1	13.8	23.1	15.3	21.8	14.8

Table V

Effects of rate of speed, extractor saw cylinder speed and grid bar spacing on pounds of lint produced from 2400 pounds of stripped material - 1953 tests.

Rate of Feed in pounds per minute	Extractor saw cylinder speed in rpm					
	616		770		924	
	1"	1 1/4"	1"	1 1/4"	1"	1 1/4"
72	523	514	517	480	532	476
93	524	495	533	487	519	481
119	528	494	544	495	538	474

Table VI

Effects of rate of feed, extractor saw cylinder speed and grid bar spacing on percentage waste in lint as determined by Shirley Analyzer - 1953 tests.

Rate of Feed in pounds per minute	Extractor saw cylinder speed in rpm					
	616		770		924	
	1"	1 1/4"	1"	1 1/4"	1"	1 1/4"
72	10.79	9.39	10.68	9.25	11.43	9.02
93	10.78	9.54	12.51	9.90	11.36	9.93
119	10.94	10.33	11.59	10.83	11.96	10.17

Table VII

Effects of rate of feed, extractor saw cylinder speed and grid bar spacing on grade index of lint - 1953 tests.

Rate of Feed in pounds per minute	Extractor saw cylinder speed in rpm					
	616		770		924	
	1"	1 1/4"	1"	1 1/4"	1"	1 1/4"
72	71.4	71.1	72.0	72.0	70.8	71.1
93	71.4	72.8	70.8	71.1	70.8	70.3
119	71.4	70.3	70.3	71.1	71.4	72.0

Table VIII

Effects of rate of feed, extractor saw cylinder speed and grid bar spacing on percent total trash removed by reel drier and stick remover combination as determined by fractionation analysis for trash content of seed cotton - 1953 tests.

Rate of Feed in pounds per minute	Extractor saw cylinder speed in rpm					
	616		770		924	
	1"	1 1/4"	1"	1 1/4"	1"	1 1/4"
72	25.95	47.96	27.33	47.42	31.08	50.72
93	20.50	48.12	26.29	43.59	27.60	46.71
119	16.06	42.30	26.80	40.90	28.09	41.56

Table IX

Effects of rate of feed, extractor saw cylinder speed and grid bar spacing in stick remover on percent sticks removed by reel drier and stick remover combination as determined by fractionation analysis for trash content of seed cotton - 1953 tests.

Rate of Feed in pounds per minute	Extractor saw cylinder speed in rpm					
	616		770		924	
	1"	1 1/4"	1"	1 1/4"	1"	1 1/4"
72	48.35	67.06	52.99	62.84	61.67	68.72
93	50.48	57.55	41.83	66.21	43.90	63.98
119	41.80	45.59	46.42	58.26	55.01	60.57

Table X

Effects of rate of feed, extractor saw cylinder speed and grid bar spacing on pounds of seed cotton in waste discharged by stick remover from 2400 pounds of stripped material - 1953 tests.

Rate of Feed in pounds per minute	Extractor saw cylinder speed in rpm					
	616		770		924	
	1"	1 1/4"	1"	1 1/4"	1"	1 1/4"
72	8.0	66.6	10.0	101.3	14.2	138.9
93	12.2	88.8	11.6	104.2	15.4	135.2
119	11.5	103.2	13.8	108.5	17.9	143.7

(2) 1954 Tests.

It was apparent from the 1953 tests that much seed cotton was being thrown out with the trash by the stick remover when using the wider spaced grid bars. A reclaiming attachment was built at the Stoneville Laboratory and installed in the machine at Chickasha prior to the 1954 ginning season.

Observations made during the 1953 season indicated that vibrations were set up in the extractor saw cylinder when operated at the higher speeds. Another fault at high speed operation was that the cotton was not being doffed from the extractor saw teeth and consequently was carried around and into the raw material. This reduced the capacity since the teeth were full and could not gain another load when passing the exposed cotton. Chokages also occurred. When all considerations were weighed a speed of 705 rpm was selected for operation of the extractor saw cylinders.

The 1954 tests were designed to compare three grid bar spacings in combination with four rates of feed. The 1953 tests had shown the 1 inch on center grid bar spacings to be definitely inferior to the 1 1/4 inches on center grid bar spacings; however, the wider spaced grids had not proven entirely satisfactory. Grid bar spacings studied in 1954 were 1 1/4 inches on center, 1 3/4 inches on center, and 2 inches on center to give effective clearances between grid bars of 7/8 inch, 1 3/8 inches and 1 5/8 inches. These spacings were combined with rates of feed of 33 pounds per minute, 67 pounds per minute, 100 pounds per minute and 133 pounds per minute to simulate 1 bale per hour, 2 bales per hour, 3 bales per hour and 4 bales per hour operation. Each combination was repeated three times to give a total of 36 lots for the series.

Cotton used in the series was Stormproof # 1 grown under irrigation at the Oklahoma Irrigation Experiment Station, Altus, Oklahoma. Yield of the cotton was between 1 1/2 and 2 bales per acre at the time of stripping after frost. Total trash content of the harvested material was 25.04 percent. In 2400 pounds of material there was calculated to be 428 pounds of hulls, 66 pounds of sticks and 107 pounds of motes and leaf trash.

The only overhead treatment employed was the stick remover at the different conditions. It was followed by the unit extractor-feeder-cleaner over the 80-saw standard moting huller-front gin stand.

Samples of material (for determination of content of trash) were taken before entering the stick remover, between the stick remover and unit extractor, and after the unit extractor prior to entering the huller front of the gin stand. Lint samples were taken after ginning to ascertain classer's grade and staple length and content of foreign matter. Results of the 1954 tests are shown in Table XI through XX.

Table XI

Effect of rate of feed and grid bar spacing on pounds of waste discharged by stick remover from 2400 pounds stripped material - 1954 tests.

Rate of feed in pounds per minute	Spacing of grid bars-inches on center		
	1 1/4"	1 3/4"	2"
33	364	517	564
67	330	524	522
100	335	516	554
133	339	523	561

Table XII

Effects of rate of feed and grid bar spacing in stick remover on pounds of waste discharged by unit extractor - 1954 tests.

Rate of feed in pounds per minute	Grid bar spacing-inches on center		
	1 1/4"	1 3/4"	2"
33	196	87	95
67	236	101	100
100	249	110	106
133	237	114	114

Table XIII

Effects of rate of feed and grid bar spacing in stick remover on pounds of waste discharged by huller-front of gin stand - 1954 tests.

Rate of feed in pounds per minute	Spacing of grid bars-inches on center		
	1 1/4"	1 3/4"	2"
33	28	17	20
67	34	18	21
100	36	18	21
133	34	19	22

Table XIV

Effects of rate of feed and grid bar spacing in stick remover on pounds of waste discharged by moting system of 80-saw gin stand - 1954 tests.

Rate of feed in pounds per minute	Grid bar spacing-inches on center		
	1 1/4"	1 3/4"	2"
33	12	10	11
67	12	10	11
100	14	10	11
133	13	9	12

Table XV

Effects of rate of feed and grid bar spacing in stick remover on pounds of lint produced from 2400 pounds of stripped material - 1954 tests.

Rate of feed in pounds per minute	Grid bar spacing-inches on center		
	1 1/4"	1 3/4"	2"
33	657	659	635
67	653	653	645
100	652	624	635
133	656	630	632

Table XVI

Effects of rate of feed and grid bar spacing in stick remover on percentage waste in lint as determined by Shirley Analyzer - 1954 tests.

Rate of feed in pounds per minute	Grid bar spacing-inches on center		
	1 1/4"	1 3/4"	2"
33	8.42	7.65	8.10
67	8.33	7.95	7.84
100	8.44	7.72	8.38
133	8.97	7.46	7.97

Table XVII

Effects of rate of feed and grid bar spacing in stick remover on grade index of lint - 1954 tests.

Rate of feed in pounds per minute	Grid bar spacing-inches on center		
	1 1/4"	1 3/4"	2"
33	83.5	91.1	84.7
67	84.2	87.2	85.3
100	84.2	90.5	84.7
133	84.6	87.9	84.4

Table XVIII

Effects of rate of feed and grid bar spacing in stick remover on percent of total trash removed by the unit as determined by fractionation analysis for trash content of seed cotton - 1954 tests.

Rate of feed in pounds per minute	Grid bar spacing-inches on center		
	1 1/4"	1 3/4"	2"
33	49.0	75.5	70.2
67	46.4	71.1	65.4
100	37.1	63.3	68.0
133	36.5	67.8	64.2

Table XIX

Effects of rate of feed and grid bar spacing in stick remover on percent sticks removed by unit as determined by fractionation analysis for trash content of seed cotton - 1954 tests.

Rate of feed in pounds per minute	Grid bar spacing-inches on center		
	1 1/4"	1 3/4"	2"
33	49.9	69.4	56.9
67	62.1	67.1	47.8
100	37.4	62.6	64.1
133	38.1	54.4	54.0

Table XX

Effects of rate of feed and grid bar spacing in stick remover on pounds of seed cotton in waste discharged by the unit - 1954 tests.

Rate of feed in pounds per minute	Grid bar spacing-inches on center		
	1 1/4"	1 3/4"	2"
33	10	23	41
67	9	31	53
100	10	38	54
133	15	45	72

B. Comparison of the Stick Remover to a 14 foot Master Extractor

(1) 1953 Tests.

The stick remover with two grid bar spacings was used with two combinations of overhead machinery in 1953 to determine its performance as compared to the 14 foot master bur extractor in one of the overhead arrangements. Grid bar spacings in the stick remover were 1 inch on center and 1 1/4 inches on center. Each of the five combinations was repeated three times in each series and three series were run using different cottons.

Series I was run with Stoneville 62 cotton, hand snapped at early season. In 2000 pounds of snapped material there was calculated to be 499 pounds of total trash or 442 pounds of hulls and 57 pounds of motes and leaf trash.

The cotton used in Series II was the first harvest of Lankart 57 hand snapped after frost. Calculated total trash in 2000 pounds of material was 600 pounds or 510 pounds of hulls and 90 pounds of motes and leaf trash.

The second harvest of Stoneville 62 hand snapped after frost was used in Series III. Total trash in 2000 pounds of material was calculated to be 536 pounds or 441 pounds of hulls and 95 pounds of motes and leaf trash. All cottons were grown on the Cotton Research Station farm.

The simple overhead arrangement consisted of the reel type cleaner-drier and stick remover before the unit extractor over the 80-saw standard moting gin. In the elaborate overhead arrangement a 4-cylinder 52 inch width airline cleaner was added before the reel drier and a 7-cylinder 52 inch width inclined cleaner added between the stick remover and unit extractor over the 80-saw standard moting gin. The master bur

extractor was substituted for the stick remover in the elaborate set up for a check lot. In Series I the extractor saw cylinders were operated at 616 rpm while on Series II and III the speed was 770 rpm. Rate of feed through the overhead was 119 pounds of material per minute entering the first unit.

Samples of material (for determination of content of trash) were taken prior to entry into the overhead, immediately after stick remover or master bur extractor and after the unit extractor just before entering the huller-front of the gin stand. Lint samples were taken after ginning to ascertain classer's grade and staple length and content of foreign matter. Results of the 1953 tests are shown in Tables XXI through XXX.

Table XXI

Effects of combinations of different overhead machinery with stick remover or master extractor on total pounds of waste discharged by combination from 2000 pounds of hand snapped material - 1953 tests.

Series	Simple Overhead		Elaborate Overhead		
	1"	1 1/4"	1"	1 1/4"	Check
I	503	582	521	616	527
II	465	569	495	608	599
III	475	606	499	637	538

Table XXII

Effects of combinations of different overhead machinery with stick remover or master extractor on pounds of waste discharged by unit extractor - 1953 tests.

Series	Simple Overhead		Elaborate Overhead		
	1"	1 1/4"	1"	1 1/4"	Check
I	333	145	321	162	118
II	266	125	253	122	112
III	266	193	251	177	75

Table XXIII

Effects of combinations of different overhead machinery with stick remover or master extractor on pounds of waste discharged by huller-front of gin stand - 1953 tests.

Series	Simple Overhead		Elaborate Overhead		
	1"	1 1/4"	1"	1 1/4"	Check
I	28	21	27	25	11
II	56	33	56	30	24
III	83	61	83	57	24

Table XXIV

Effects of combinations of different overhead machinery with stick remover or master extractor on pounds of waste discharged by moting system of 80-saw gin - 1953 tests.

Series	Simple Overhead		Elaborate Overhead		
	1"	1 1/4"	1"	1 1/4"	Check
I	6	5	5	6	4
II	10	6	9	6	5
III	13	10	13	10	6

Table XXV

Effects of combinations of different overhead machinery with stick remover or master extractor on pounds of lint produced from 2000 pounds of snapped material - 1953 tests.

Series	Simple Overhead		Elaborate Overhead		
	1"	1 1/4"	1"	1 1/4"	Check
I	502	478	495	465	473
II	517	486	501	476	490
III	489	448	483	450	455

Table XXVI

Effects of combinations of different overhead machinery with stick remover or master extractor on percentage waste in lint as determined by Shirley Analyzer - 1953 tests.

Series	Simple Overhead		Elaborate Overhead		
	1"	1 1/4"	1"	1 1/4"	Check
I	4.74	4.34	4.35	4.57	4.12
II	7.77	6.56	6.83	5.75	6.40
III	8.19	7.29	8.04	7.54	5.72

Table XXVII

Effects of combination of different overhead machinery with stick remover or master extractor on grade index of lint - 1953 tests.

Series	Simple Overhead		Elaborate Overhead		
	1"	1 1/4"	1"	1 1/4"	Check
I	96.4	95.5	96.2	94.0	96.0
II	74.4	74.5	75.8	76.5	75.8
III	79.7	84.4	86.1	84.4	80.4

Table XXVIII

Effects of combinations of different overhead machinery with stick remover or master extractor on percent of total trash removed up to point of discharge from each unit as determined by fractionation analysis for trash content of seed cotton - 1953 tests.

Series	Simple Overhead		Elaborate Overhead		
	1"	1 1/4"	1"	1 1/4"	Check
I	20.7	57.7	24.4	51.8	67.1
II	22.5	55.2	26.5	52.9	66.6
III	19.4	37.6	19.7	42.4	71.0

Table XXIX

Effects of combinations of overhead machinery with stick remover or bur machine on percent hulls removed to point of discharge from each unit as determined by fractionation analysis for trash content of seed cotton - 1953 tests.

Series	Simple Overhead		Elaborate Overhead		
	1"	1 1/4"	1"	1 1/4"	Check
I	15.5	55.7	16.7	47.4	65.5
II	13.6	48.4	16.7	48.1	65.4
III	13.7	34.2	13.4	39.4	71.1

Table XXX

Effects of combinations of overhead machinery with stick remover or bur machine on pounds of seed cotton in waste discharged by each unit - 1953 tests.

Series	Simple Overhead		Elaborate Overhead		
	1"	1 1/4"	1"	1 1/4"	Check
I	5.7	77.9	6.8	83.9	3.3
II	6.9	85.6	7.6	86.5	7.9
III	9.3	98.0	9.1	95.2	5.1

(2) 1954 Tests.

The stick remover was compared directly to the bur machine with both units operating under the same conditions in the 1954 tests. Cotton used in the comparison was the same as that used in tests to determine rate of feed and grid bar spacing. It was described previously as being grown at Altus, Oklahoma.

Four overhead treatments were employed with the two types of extractors. Two machinery arrangements, simple and elaborate, were run without and with drying to give the four combinations. Each of the eight combinations was repeated three times.

The simple overhead arrangement consisted of stick remover or master extractor followed by a 7-cylinder 52 inch width inclined cleaner. The elaborate overhead arrangement consisted of a 4-cylinder 52 inch width airline cleaner, 7-cylinder 52 inch width inclined cleaner, stick remover or master extractor, 7-cylinder 52 inch width inclined cleaner and 7-cylinder 52 inch width inclined cleaner. A shelf type drier with hot air temperature of 200°F was used for drying. Rate of feed through all overhead machinery excepting the stick remover was at the rate of four bales per hour. The rate of feed through the stick remover was two bales per hour. Grid spacing in the stick remover was 1 3/4 inches on center and the saw cylinders were operated at 705 rpm. All arrangements were followed by a unit extractor-feeder-cleaner above the 80-saw standard moting huller-front gin.

Samples of material (for determination of content of trash) were taken before and after the stick remover or master extractor and after the unit extractor prior to entering huller-front of gin stands. Lint samples were taken after ginning to ascertain classer's grade and staple length and content of foreign matter. Results of the 1954 tests are shown in Table XXXI through XXXX.

Table XXXI

Comparison of pounds of waste discharged from 2400 pounds of stripped material by stick remover or master extractor operating under like conditions - 1954 tests.

	Simple Overhead		Elaborate Overhead	
	Without Drying	With Drying	Without Drying	With Drying
Stick Remover	524	496	410	413
Master Extractor	427	374	297	278

Table XXXII

Comparison of pounds of waste discharged by unit extractor following stick remover or master extractor operating under like conditions - 1954 tests.

	Simple Overhead		Elaborate Overhead	
	Without Drying	With Drying	Without Drying	With Drying
Stick Remover	84	79	71	60
Master Extractor	160	156	151	153

Table XXXIII

Comparison of pounds of waste discharged by huller-front of gin stand following stick remover or master extractor operating under like conditions - 1954 tests.

	Simple Overhead		Elaborate Overhead	
	Without Drying	With Drying	Without Drying	With Drying
Stick Remover	16	12	16	14
Master Extractor	21	17	23	21

Table XXXIV

Comparison of pounds of waste discharged by moting system of 80-saw gin following stick remover or master extractor operating under like conditions - 1954 tests.

	Simple Overhead		Elaborate Overhead	
	Without Drying	With Drying	Without Drying	With Drying
Stick Remover	9	7	10	9
Master Extractor	12	9	10	10

Table XXXV

Comparison of pounds of lint produced from 2400 pounds of stripped material from arrangements using stick remover or master extractor operating under like conditions - 1954 tests.

	Simple Overhead		Elaborate Overhead	
	Without Drying	With Drying	Without Drying	With Drying
Stick Remover	638	633	635	622
Master Extractor	661	639	624	624

Table XXXVI

Comparison of percentage waste as determined by Shirley Analyzer in lint following stick remover or master extractor operating under like conditions - 1954 tests.

	Simple Overhead		Elaborate Overhead	
	Without Drying	With Drying	Without Drying	With Drying
Stick Remover	6.02	5.46	6.10	5.35
Master Extractor	8.65	7.24	7.62	7.45

Table XXXVII

Comparison of grade index of lint following stick remover or master extractor operating under like conditions - 1954 tests.

	Simple Overhead		Elaborate Overhead	
	Without Drying	With Drying	Without Drying	With Drying
Stick Remover	82.9	87.5	85.2	88.7
Master Extractor	84.2	84.0	83.0	82.9

Table XXXVIII

Comparison of percent total trash removed to point of discharge of stick remover or master extractor operating under like conditions as determined by fractionation analysis for trash content of seed cotton - 1954 tests.

	Simple Overhead		Elaborate Overhead	
	Without Drying	With Drying	Without Drying	With Drying
Stick Remover	73.8	76.0	69.9	81.7
Master Extractor	59.2	51.0	54.7	56.2

Table XXXIX

Comparison of percent sticks removed to point of discharge from stick remover or master extractor operating under like conditions as determined by fractionation analysis for trash content of seed cotton - 1954 tests.

	Simple Overhead		Elaborate Overhead	
	Without Drying	With Drying	Without Drying	With Drying
Stick Remover	73.9	65.7	76.7	76.1
Master Extractor	35.2	13.6	32.9	17.6

Table XXXX

Comparison of dollar value of lint produced from 2400 pounds of stripped material by stick remover or master extractor operating under like conditions - 1954 tests.

	Simple Overhead		Elaborate Overhead	
	Without Drying	With Drying	Without Drying	With Drying
Stick Remover	162	171	166	170
Master Extractor	171	165	159	159

VI. DISCUSSION OF RESULTS

A. Determination of Rate of Feed, Extractor Saw Cylinder Speed and Grid Bar Spacing.

(1) 1953 Tests.

Principal results of the 1953 tests used to determine rate of feed, extractor saw cylinder speed and grid bar spacing are given in Table XXXXI and Figures 8 through 17. Numbers in parenthesis in Table XXXXI indicate the figure in which the data are plotted.

Measurements obtained from the 1953 tests show that there were large differences in the performance of the stick remover when using the two grid bar spacings. The closer spaced bars did not allow the trash to be discharged through the openings. If the trash was not separated from the seed cotton in the stick remover, a greater load was left for the units following. This conclusion is evidenced by the curves of trash weights in Figures 8 through 11. The curves also show the influence of greater centrifugal force at the higher speeds. As the speed of the cylinders was increased there was a stronger force causing the heavier matter to proceed with greater momentum as it was projected from the extractor cylinder. Crushing of the hulls occurred when under accelerated propulsion they came in contact with the stationary grid bars through which they could not escape because of limited clearance. Result of the action was to grind the trash into a finer state with little cleaning and extracting being performed in the stick remover. Evidence of this conclusion is found in the weight of motes (Fig. 11), weight of lint (Fig. 12) and percentage waste in lint (Fig. 13).

Table XXXXI - Principal Results of 1953 Tests to Determine Rate of Feed, Extractor Saw Cylinder Speed and Grid Bar Spacing for Stick Remover.

Measure for Evaluation	Rate of Feed	Saw Cylinder Speed	Grid Bar Spacing
(8) Total Waste Discharged by Stick Remover	Decreased with Increased Rate of Feed	Increased with Increased Speed	Increased with Increased Spacing
(9) Waste Discharged by Unit Extractor	Increased with Increased Rate of Feed	Decreased with Increased Speed	Decreased with Increased Spacing
(10) Waste Discharged by Huller-front	Increased with Increased Rate of Feed	Increased with Increased Speed	Decreased with Increased Spacing
(11) Waste Discharged by by Moting System	Increased with Increased Rate of Feed	Increased with Increased Speed	Decreased with Increased Spacing
(12) Weight of Lint Produced	Increased with Increased Rate of Feed	Decreased with Increased Speed	Decreased with Increased Spacing
(13) Percentage Waste in Lint	Increased with Increased Rate of Feed	Increased with Increased Speed	Decreased with Increased Spacing
(14) Grade Index of Lint	Slight Decrease with Increase Rate of Feed	Slight decrease with Increased Speed	Slight Increase with Increased Spacing
(15) Percent Total Trash Removed	Decreased with Increased Rate of Feed	Increased with Increased Speed	Increased with Increased Spacing
(16) Percent of Stick Removed	Decreased with Increased Rate of Feed	Increased with Increased Speed	Increased with Increased Spacing
(17) Seed Cotton Discharged with Waste	Increased with Increased Rate of Feed	Increased with Increased Speed	Increased with Increased Spacing

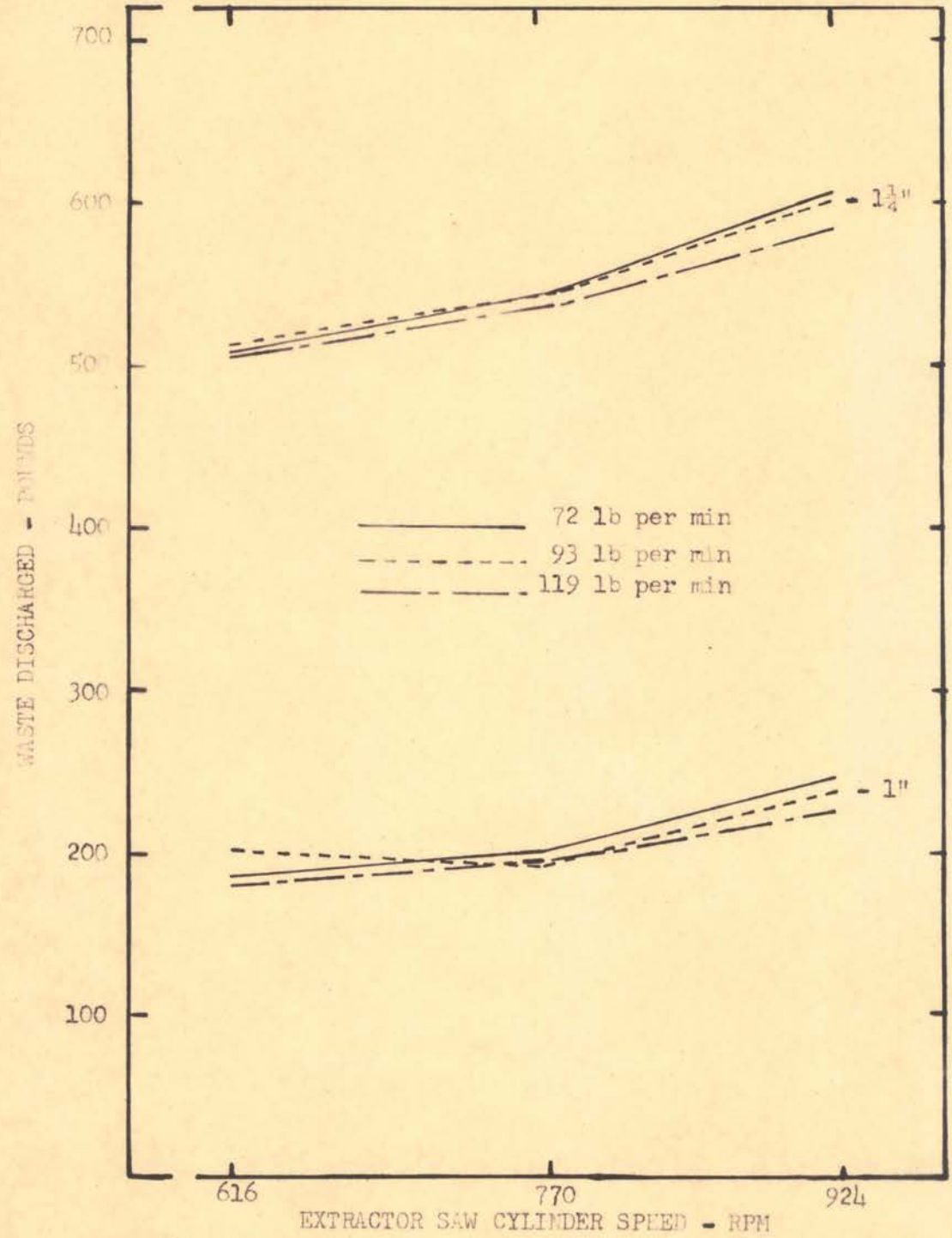

Fig. 8 - The effects of rate of feed, extractor saw cylinder speed and grid bar spacing on pounds of waste discharged from stick remover using 2400 pounds of stripped material - 1953 tests.

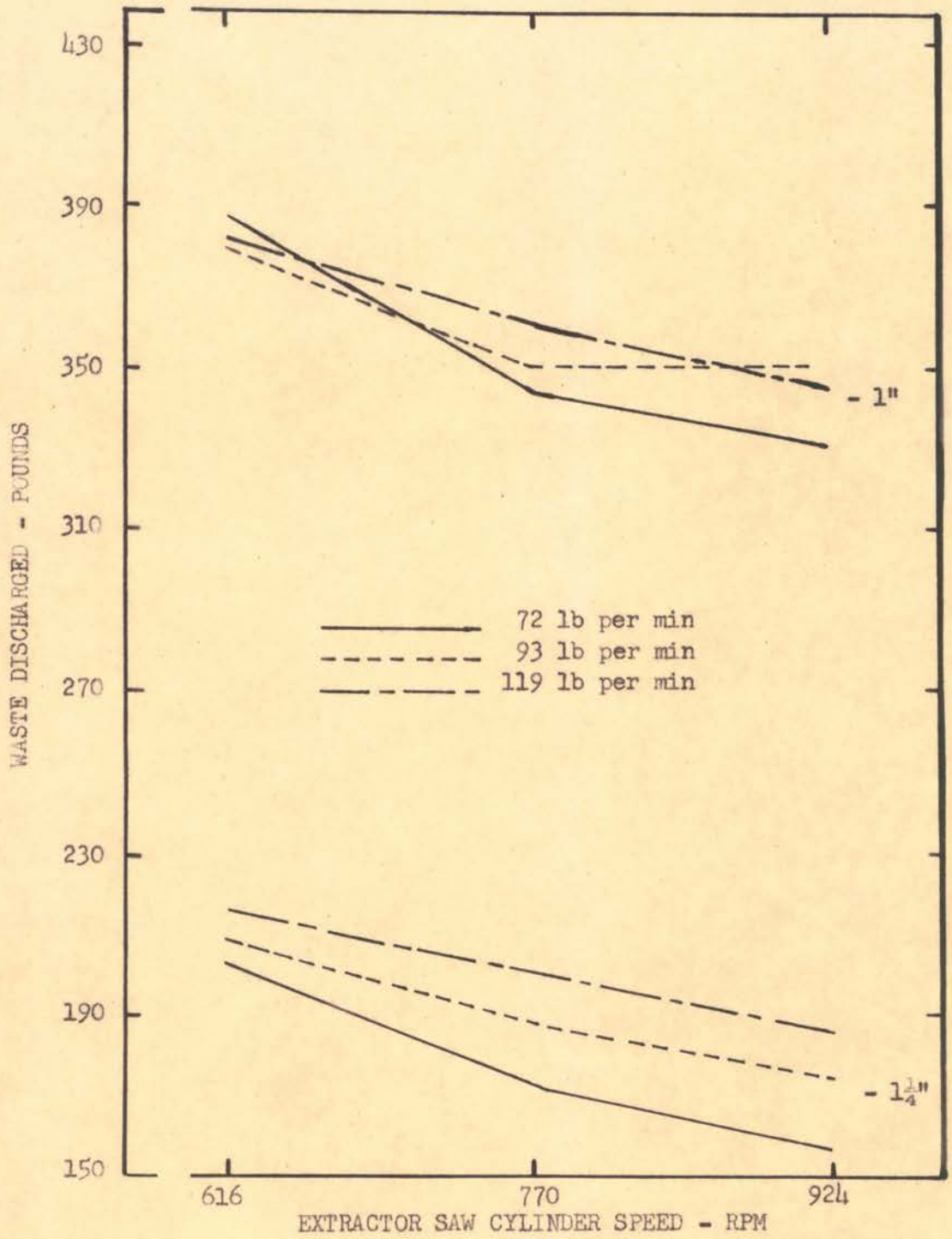

Fig. 9 - The effects of rate of feed, extractor saw cylinder speed and grid bar spacing on pounds of waste discharged by extractor-feeder-cleaner following stick remover using 2400 pounds of stripped material - 1953 tests.

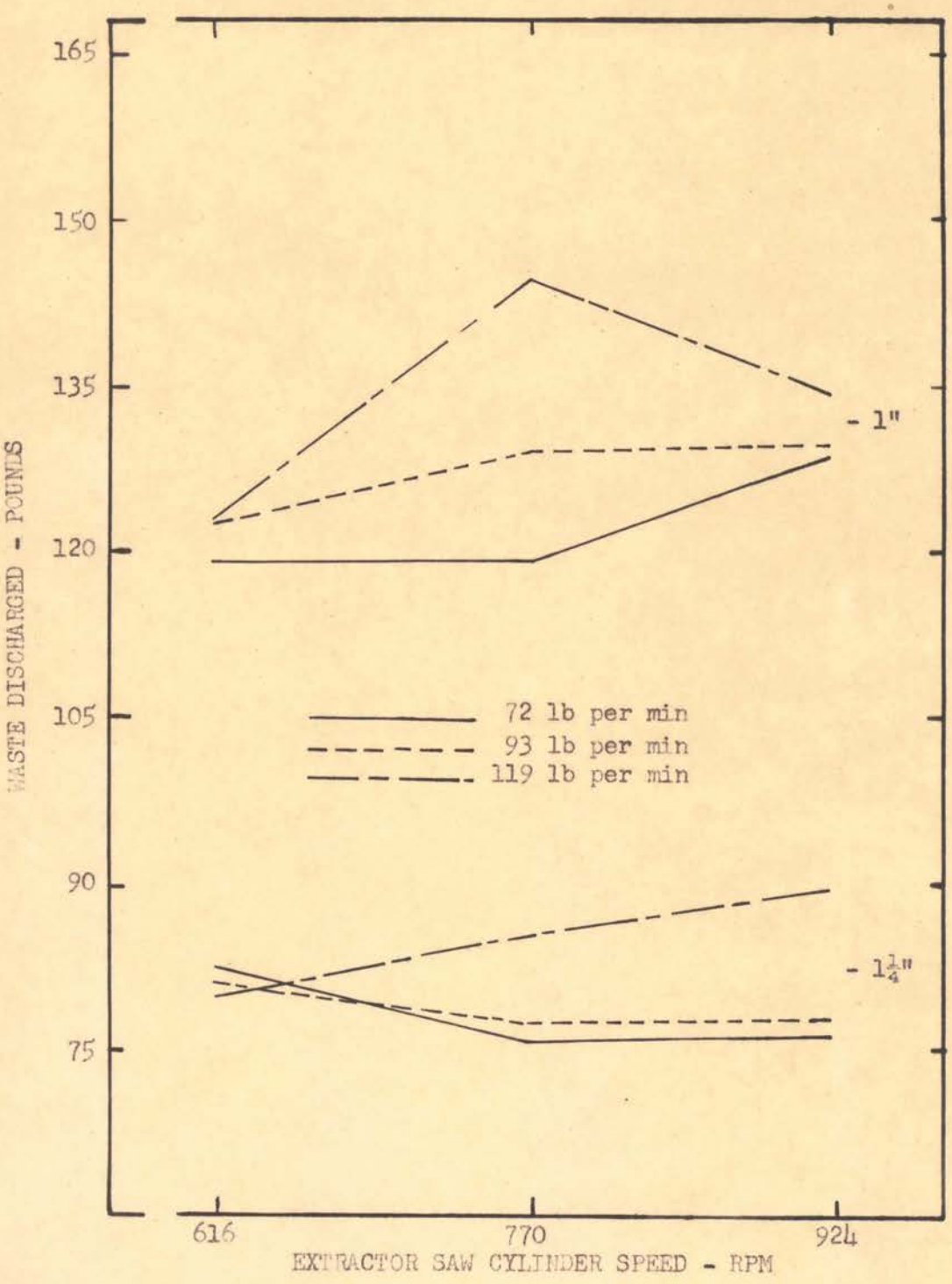

Fig. 10 - The effects of rate of feed, extractor saw cylinder speed and grid bar spacing on pounds of waste discharged by huller-front of gin stand following stick remover using 2400 pounds of stripped material - 1953 tests.

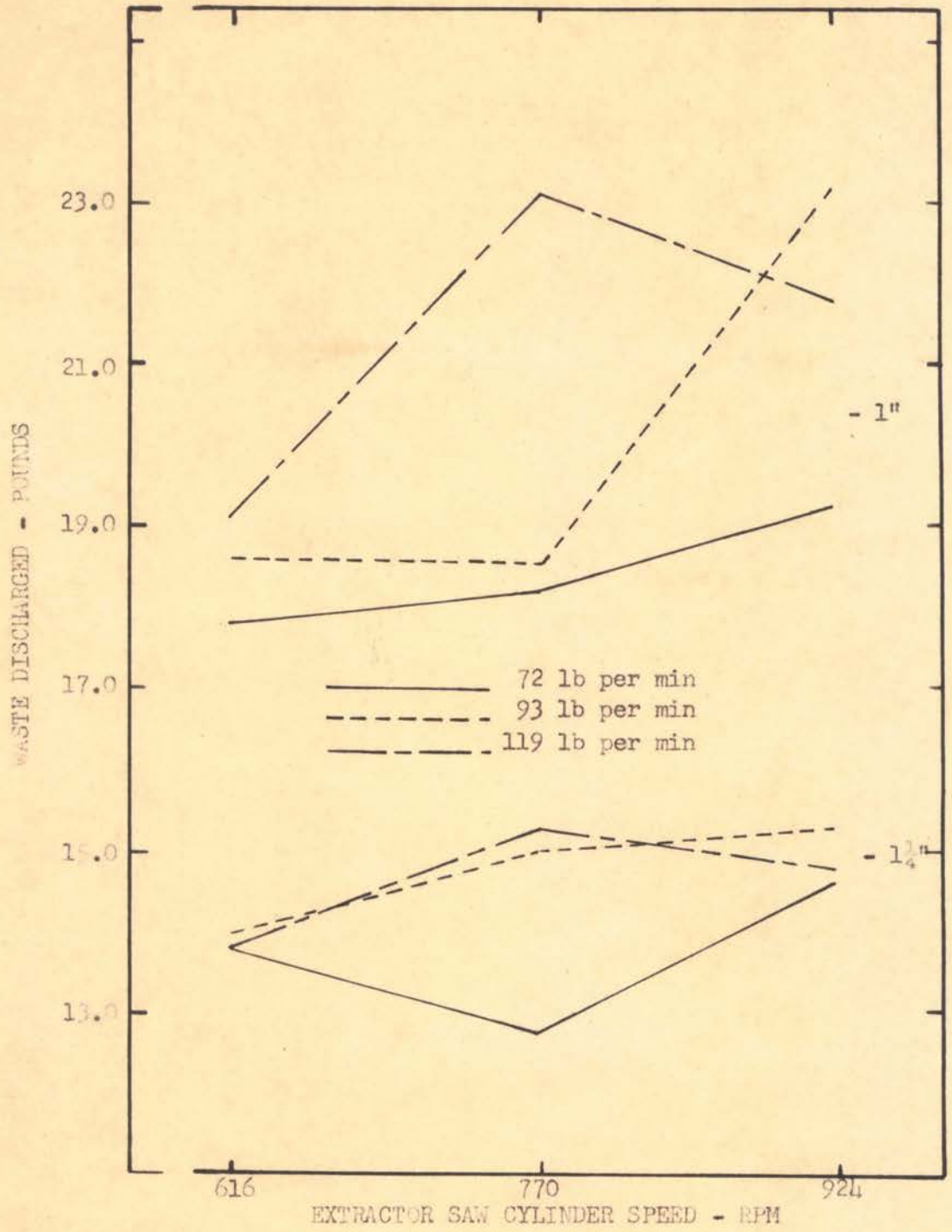

Fig. 11 - The effects of rate of feed, extractor saw cylinder speed and grid bar spacing on pounds of waste discharged by moting system of pin stand following the stick remover using 2400 pounds of stripped material-1953 tests.

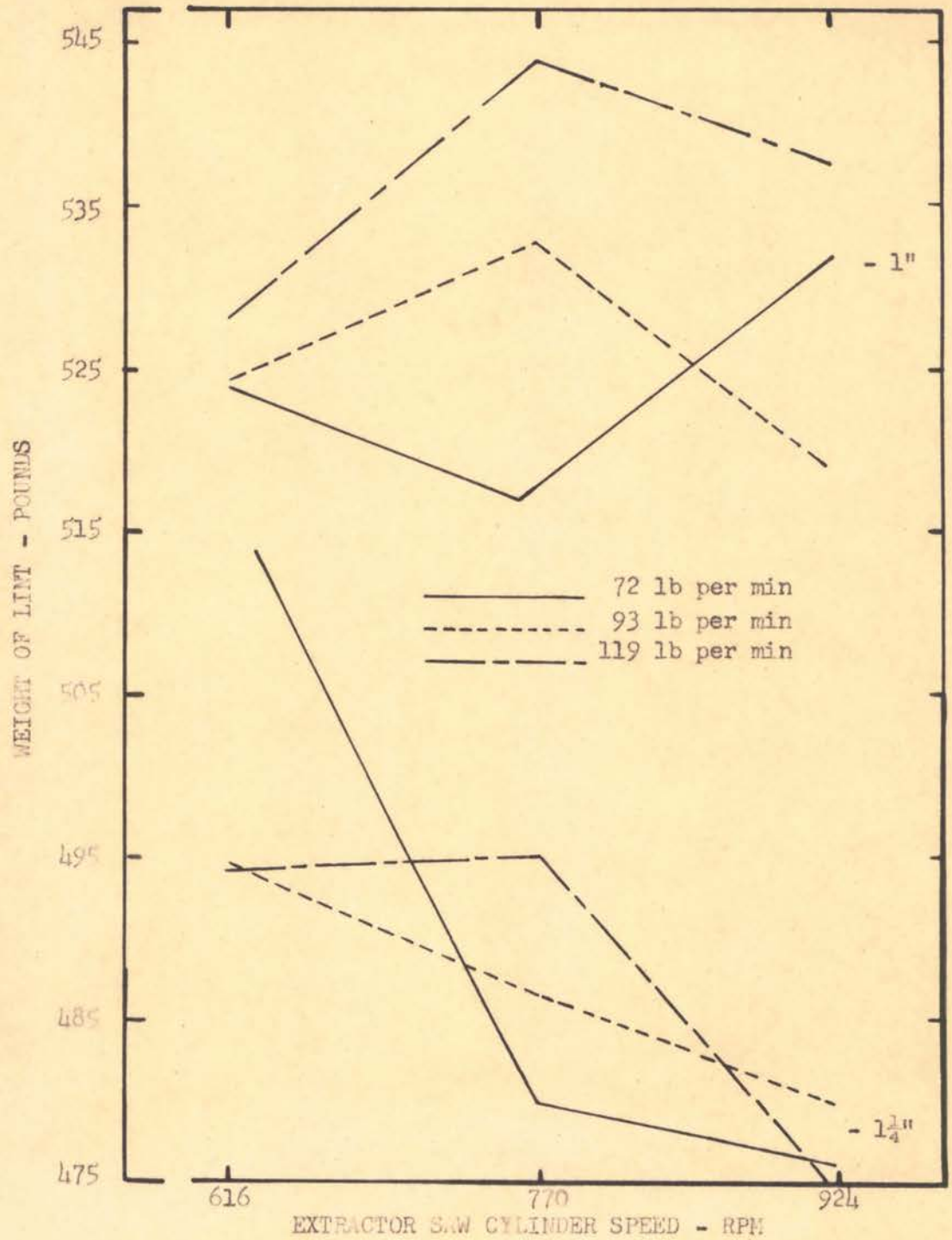

Fig. 12 - The effects of rate of feed, extractor saw cylinder speed and grid bar spacing on weight of lint produced from 2400 pounds of stripped material when using the stick remover - 1953 tests.

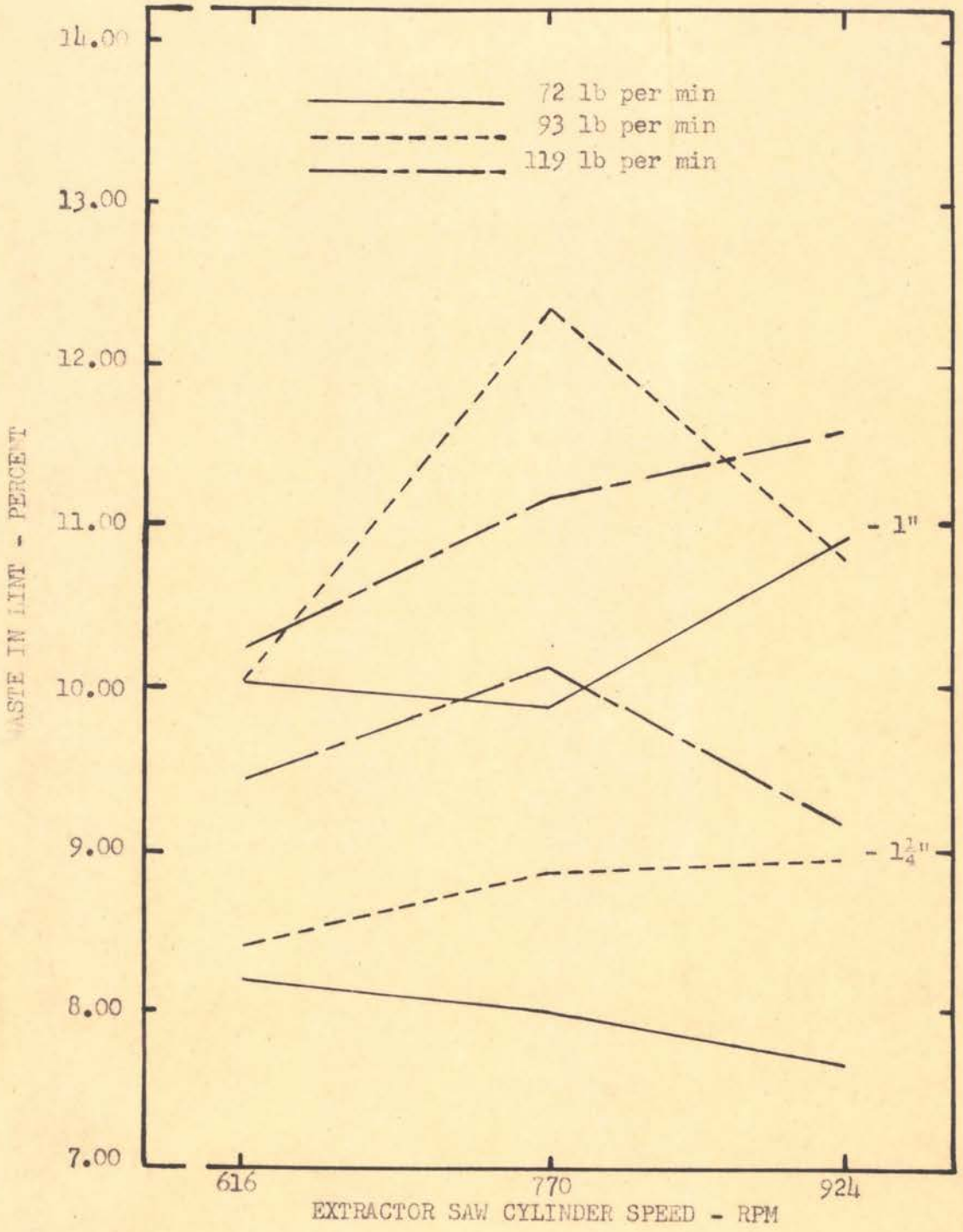

Fig. 13 - The effects of rate of feed, extractor saw cylinder speed and grid bar spacing on percentage waste in lint ginned after the stick remover - 1953 tests.

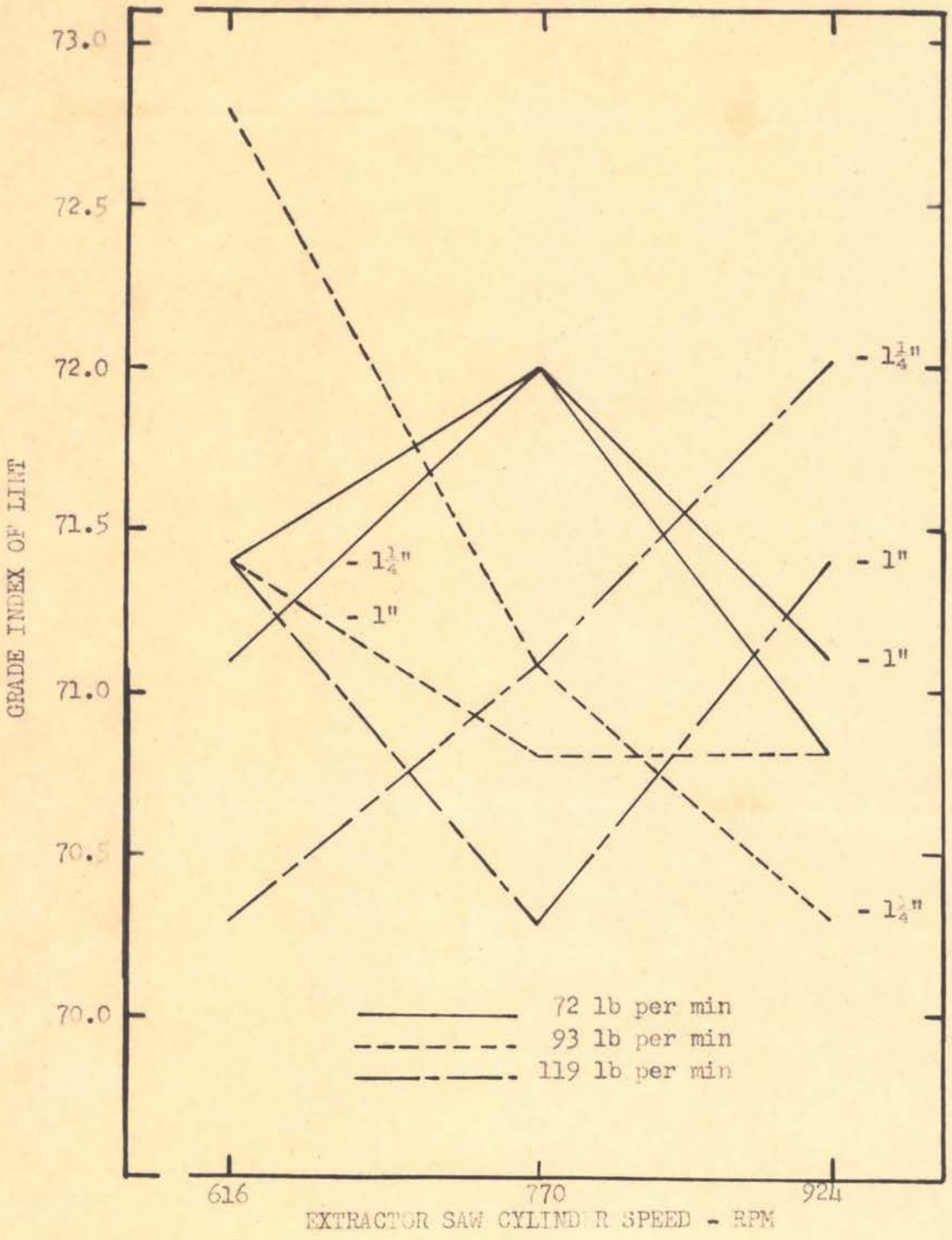

Fig. 14 - The effects of rate of feed, extractor saw cylinder speed and grid bar spacing on grade index of lint ginned after stick remover - 1953 tests.

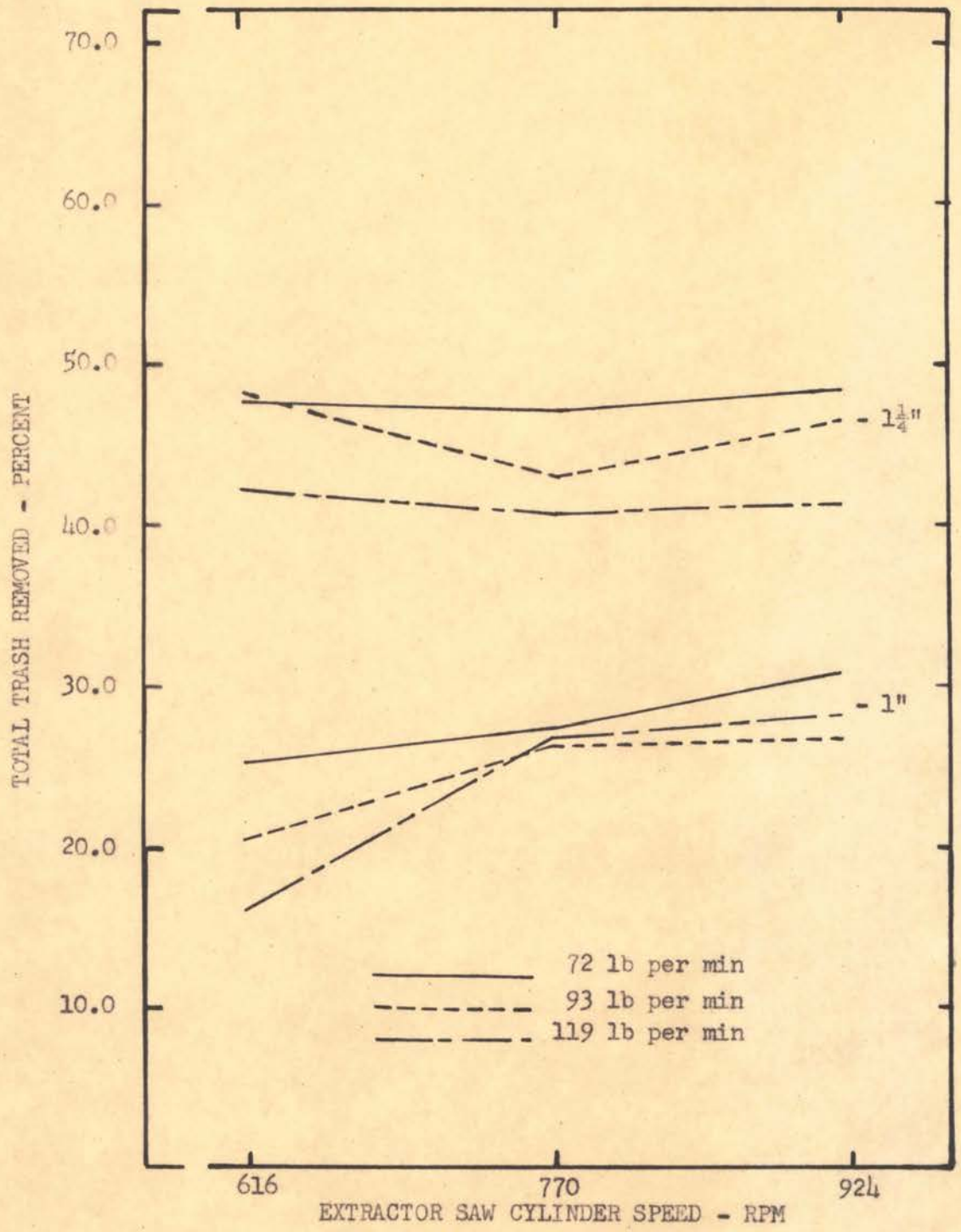

Fig. 15 - The effects of rate of feed, extractor saw cylinder speed and grid bar spacing on percent of total trash removed by reel drier and stick remover combination - 1953 tests.

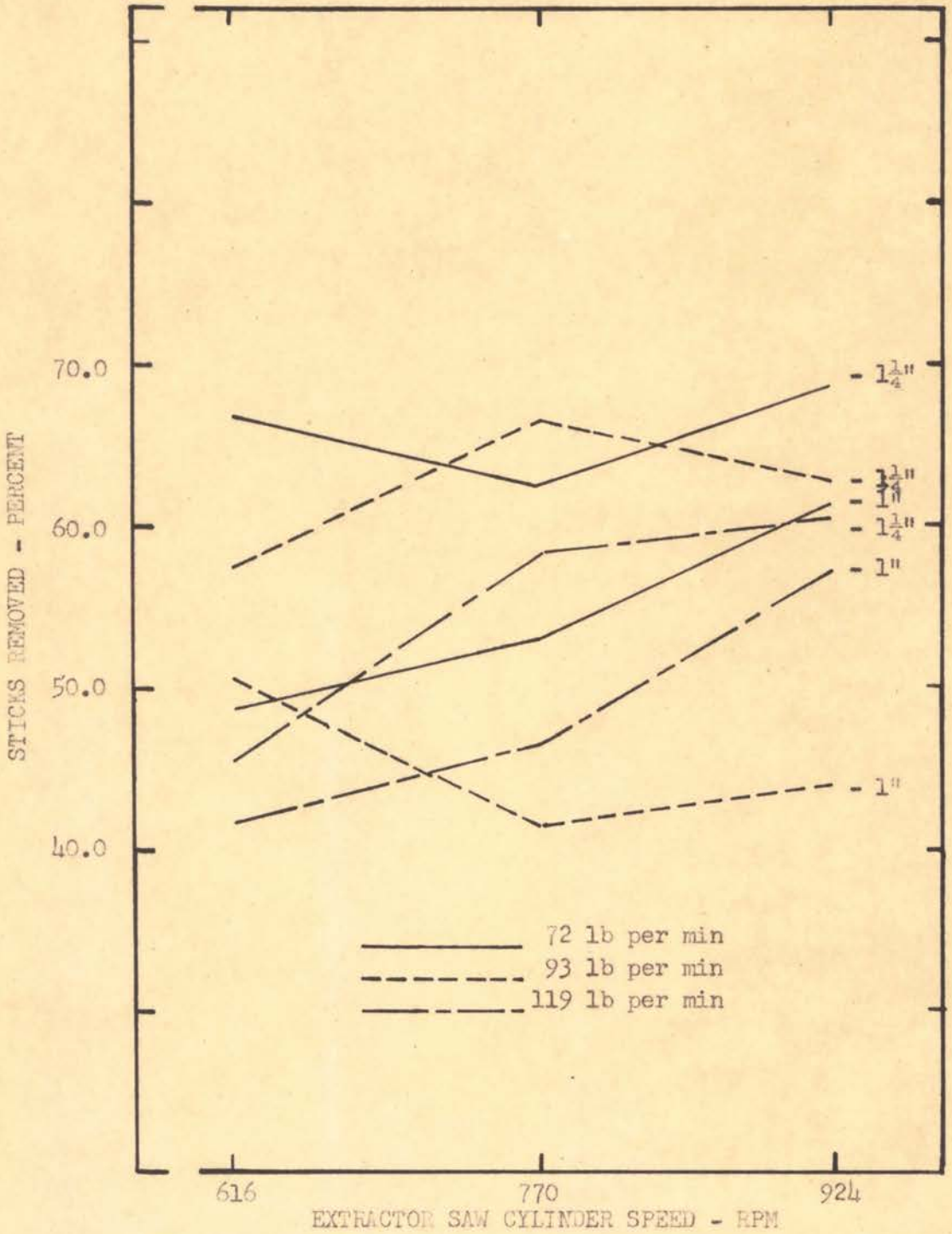

Fig. 16 - The effects of rate of feed, extractor saw cylinder speed and grid bar spacing on percent of sticks removed by reel drier and stick remover combination - 1953 tests.

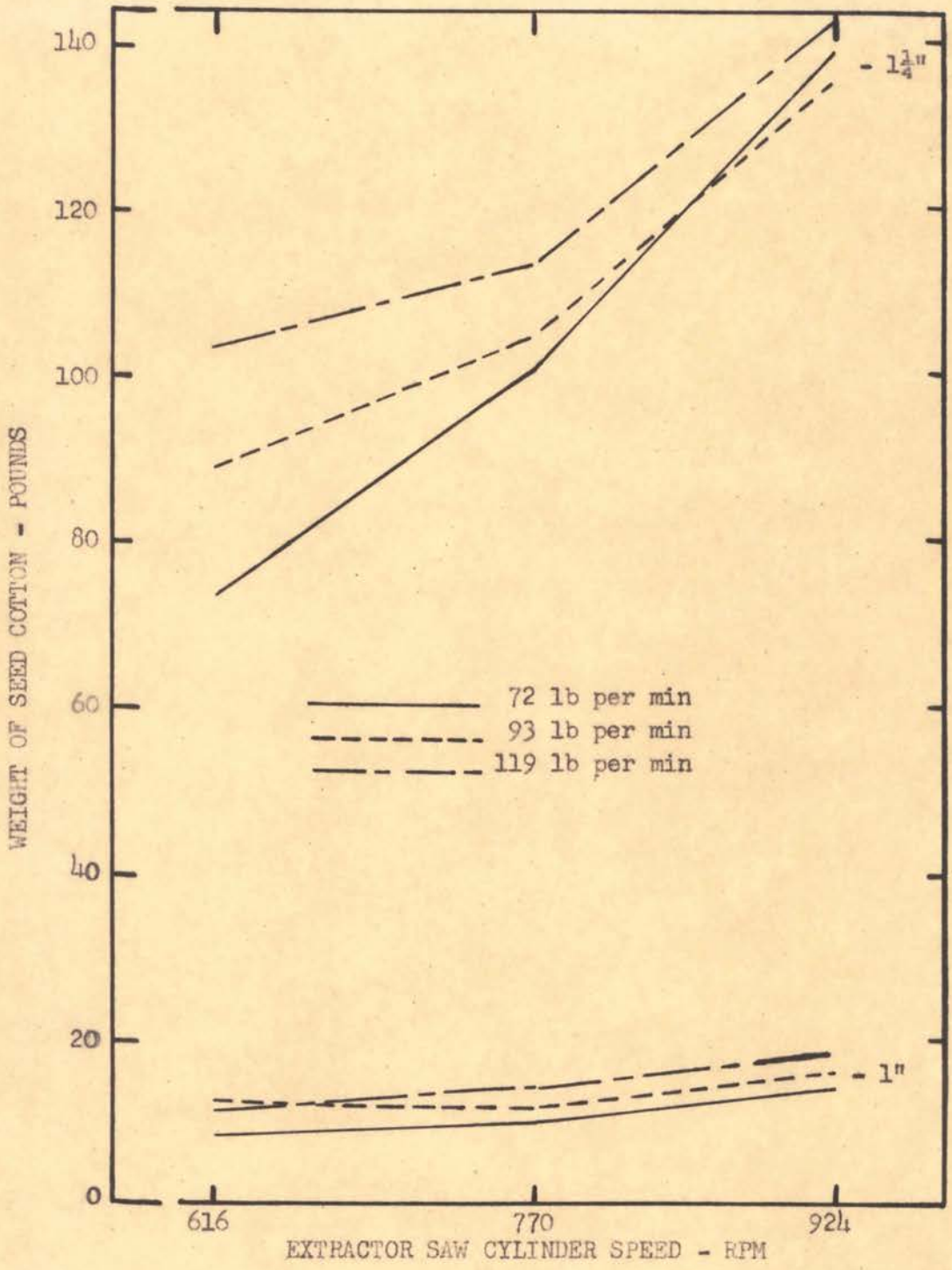

Fig 17 - The effects of rate of feed, extractor saw cylinder speed and grid bar spacing on amount of seed cotton discharged with waste from stick remover from 2400 pounds of stripped material - 1953 tests.

As the rate of feed to the stick remover was increased a larger bat or thickness of layer of material was placed on the extractor cylinder. Only the trash on the outer periphery of the circular bat could be expelled, therefore resulting in lower effectiveness in cleaning and extracting.

Those forces which contributed to better cleaning and extracting also contributed to greater loss of seed cotton through the grid bar openings. Thus when the greatest amount of waste was removed by the stick remover (Figs. 8 and 15) the greatest loss of cotton occurred (Fig. 17).

Differences in grade index of the lint samples from the combinations were very slight and were attributable to the inherent color of the cotton rather than to any action of the stick remover (Fig. 24).

All factors considered it was concluded that the grid bar spacings of one inch on center were not useful with cotton harvested in the hull. It was further concluded that because of danger in operation, difficulty in doffing the cotton from the saw teeth and tendency to grind the trash at the highest speeds that the best speed of operation for the extractor saw cylinder would be approximately 700 rpm.

(2) 1954 Tests.

Principal results of the 1954 tests to determine rate of feed and grid bar spacing are given in Table XXXXII and Figures 18 through 27. Numbers in parenthesis in Table XXXXII refer to the figures in which data for that measurement are plotted.

Measurements obtained in the 1954 tests substantiate the findings of 1953 in that as grid bar spacings were increased the stick remover was more effective in removing the trash from the seed cotton. A limit however, was encountered between 1 3/4 inches on center and 2 inches on center

Table XXXXII - Principal Results of 1954 Tests to Determine Rate of Feed and Grid Bar Spacing

Measure for Evaluation		Rate of Feed	Grid Bar Spacing
(18)	Total Waste Discharged by Stick Remover	High at 33 lb per min, Low at 67 lb per min with Increase to 133 lb per min	Increased with Increased Spacing
(19)	Waste Discharged by Unit Extractor	Increased with Increased Rate of Feed	Decreased with Increased Spacing
(20)	Waste Discharged by Huller-Front	Increased with Increased Rate of Feed	High with 1 1/4", Low with 1 3/4" Spacing
(21)	Waste Discharged by Moting System	Slight Increase with Increased Rate of Feed	High with 1 1/4", Low with 1 3/4" Spacing
(22)	Weight of Lint Produced	Decreased with Increased Rate of Feed	Decreased with Increased Spacing
(23)	Percentage Waste in Lint	No Discernible Effect	High with 1 1/4", Low with 1 3/4" Spacing
(24)	Grade Index of Lint Produced	No Discernible Effect	High with 1 3/4", Low with 1 1/4" Spacing
(25)	Percent Total Trash Removed	Decreased with Increased Rate of Feed	Lowest with 1 1/4" Spacing
(26)	Percent Sticks Removed	Decreased with Increased Rate of Feed	Highest with 1 3/4" Spacing
(27)	Seed Cotton in Trash from Stick Remover	Increased with Increased Rate of Feed	Increased with Increased Spacing

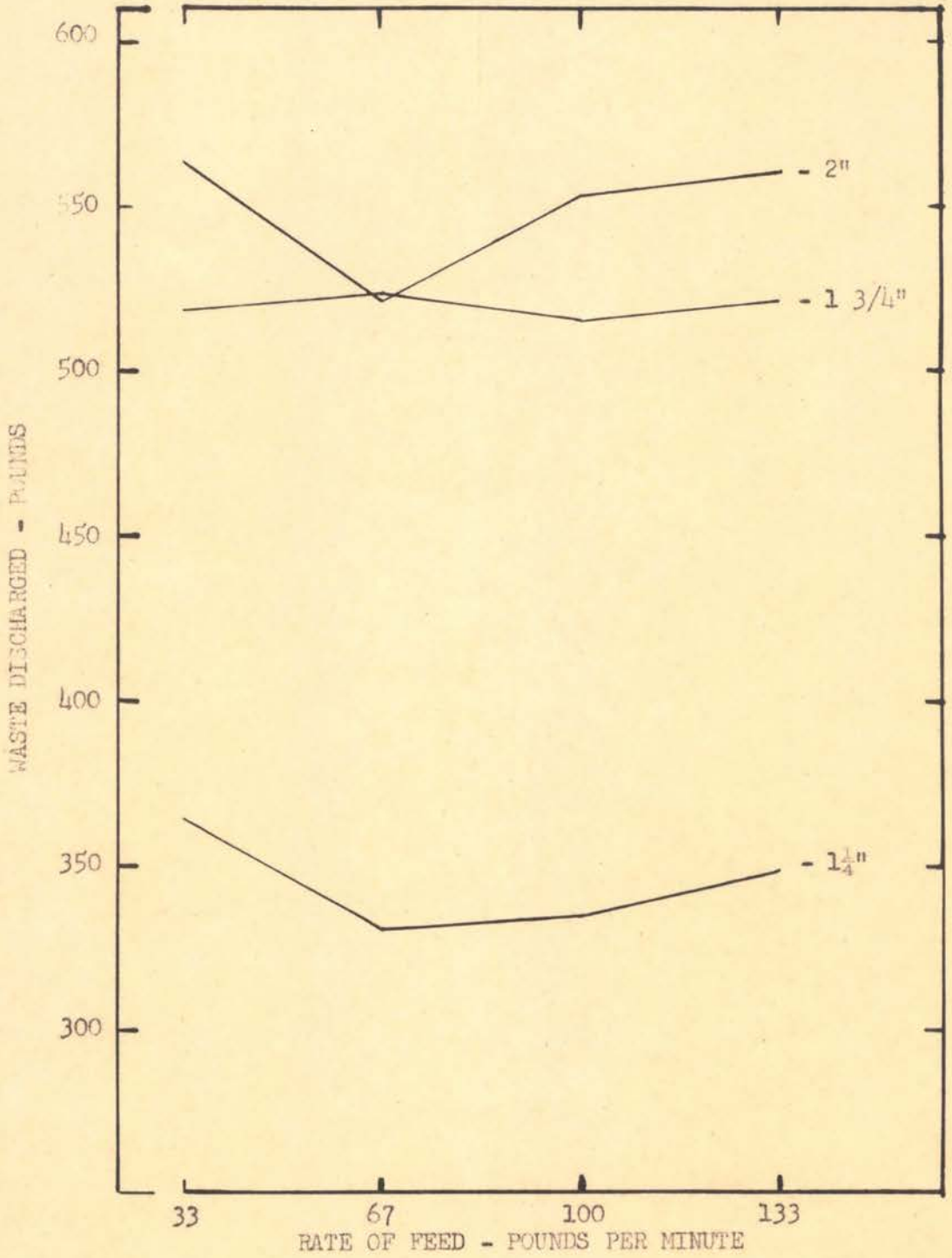

Fig. 18 - The effects of rate of feed and grid bar spacing on pounds of waste discharged from stick remover using 2400 pounds of stripped material - 1954 tests.

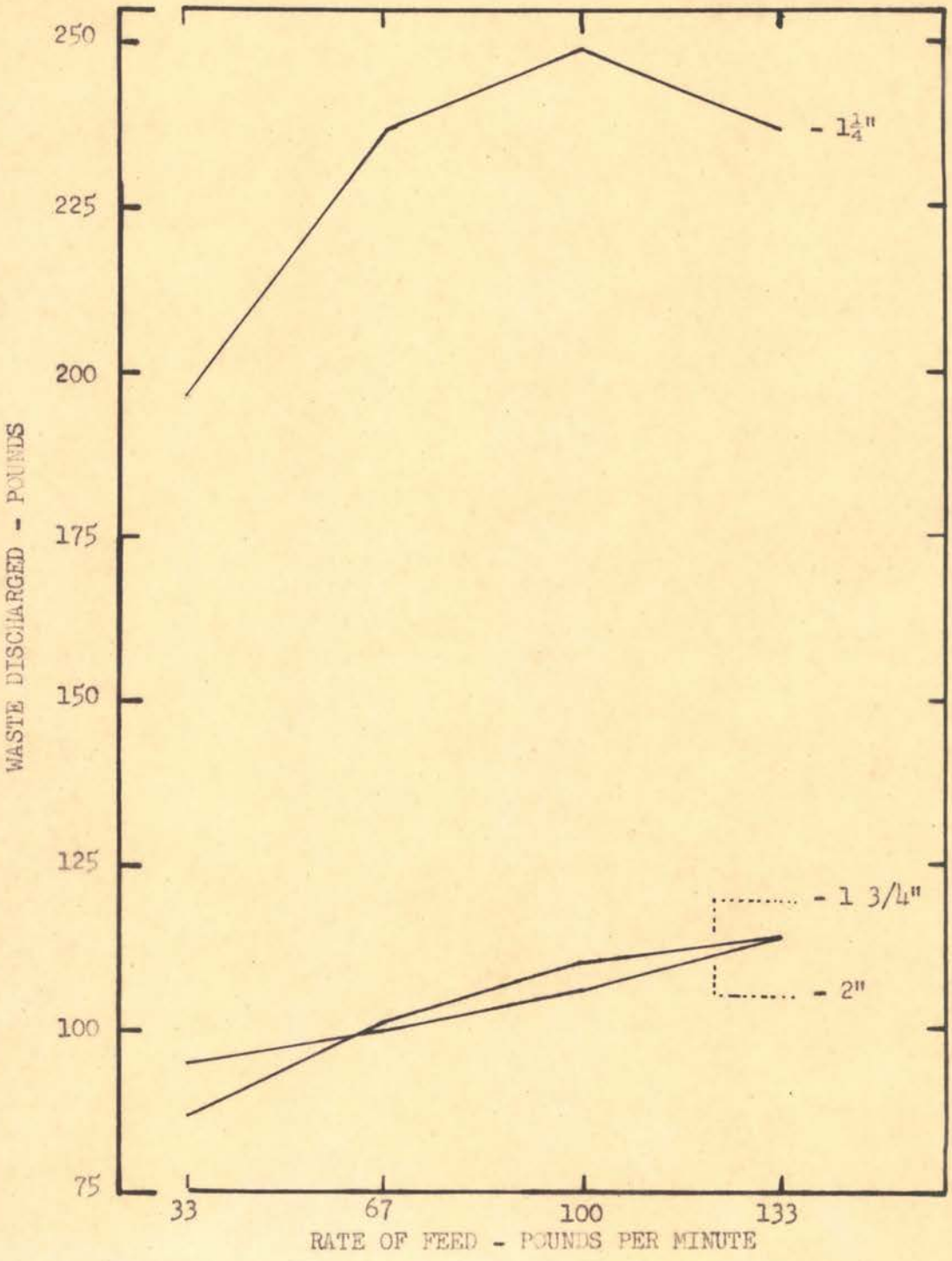

Fig. 19 - The effects of rate of feed and grid bar spacing on pounds of waste discharge by extractor-feeder-cleaner following stick remover using 2400 pounds of stripped material - 1954 tests.

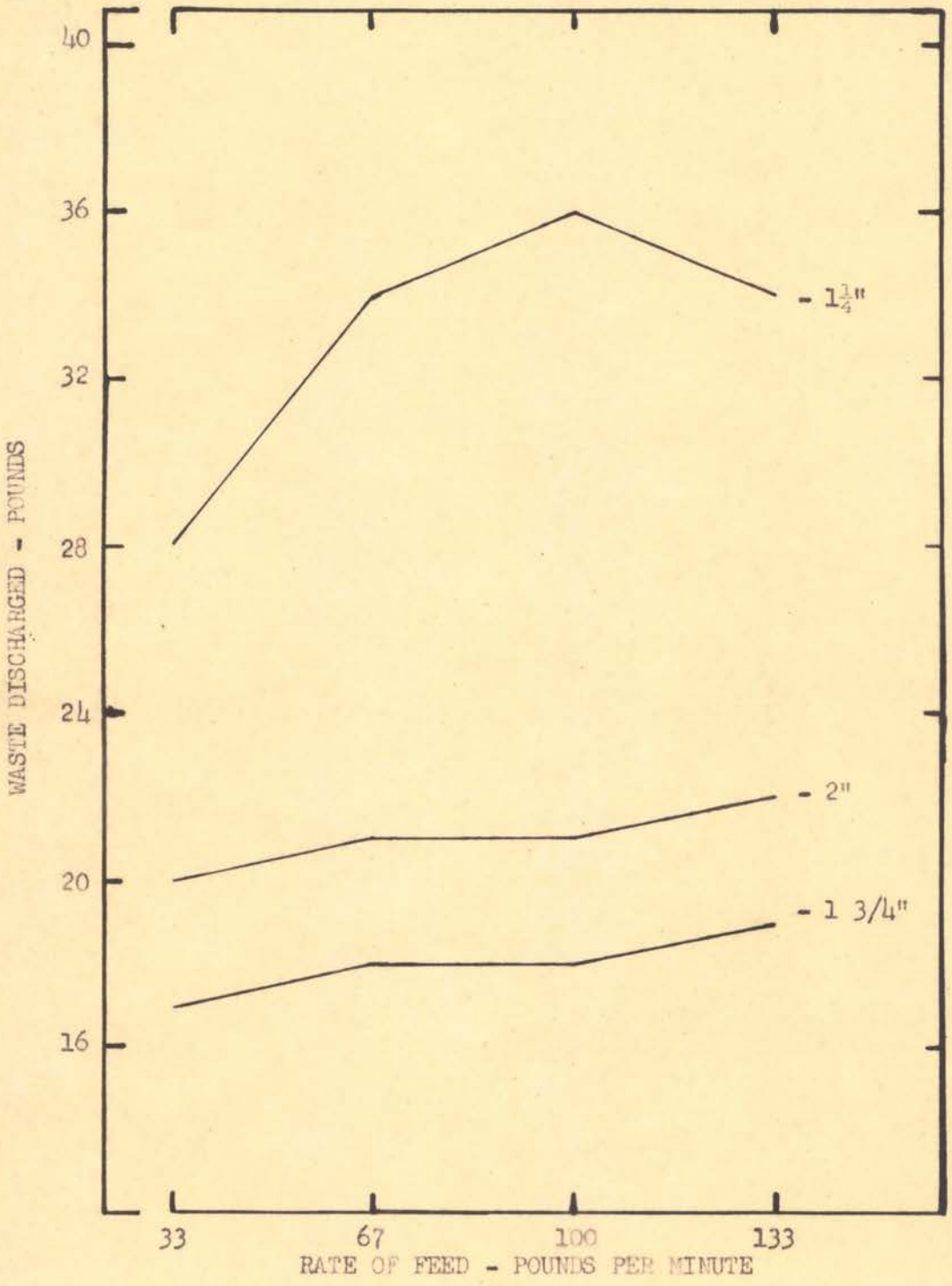

Fig. 20 - The effects of rate of feed and grid bar spacing on pounds of waste discharged by huller-front of gin stand following stick remover using 2400 pounds of stripped material - 1954 tests.

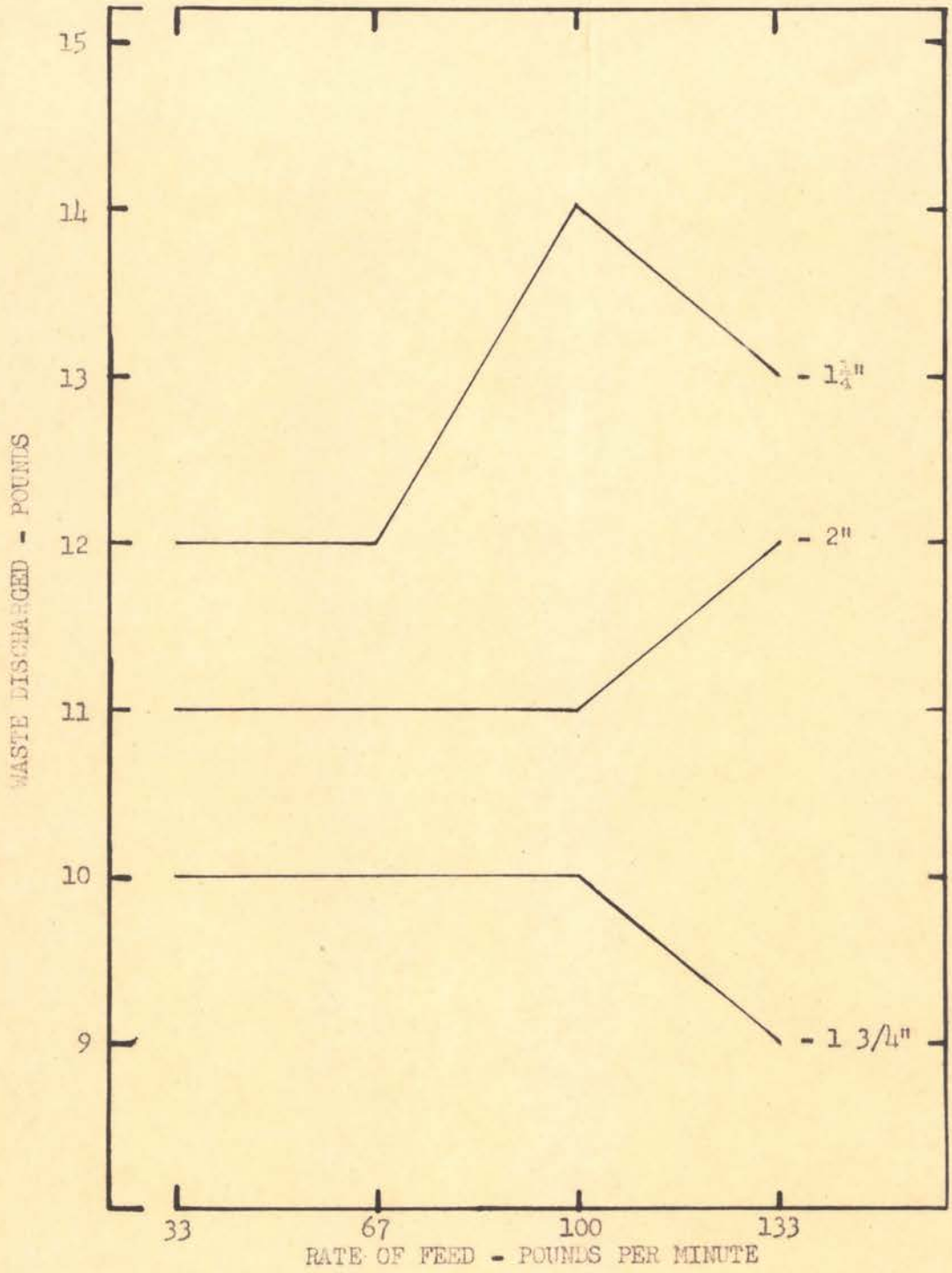

Fig. 21 - The effects of rate of feed and grid bar spacing on pounds of waste discharged by moting system of gin stand following the stick remover using 2400 pounds of stripped material - 1954 tests.

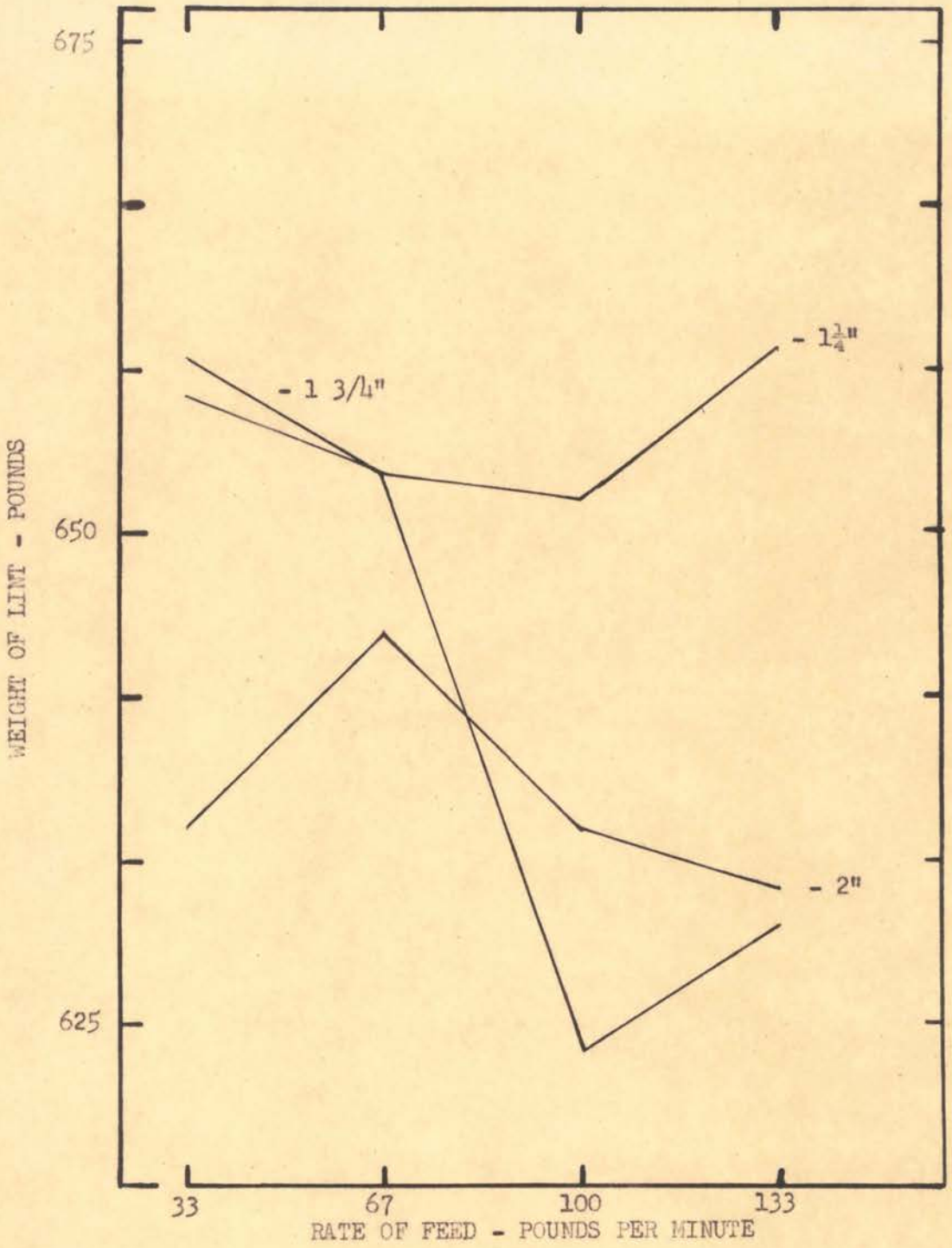

Fig. 22 - The effects of rate of feed and grid bar spacing on weight of lint produced from 2400 pounds of stripped material when using the stick remover - 1954 tests.

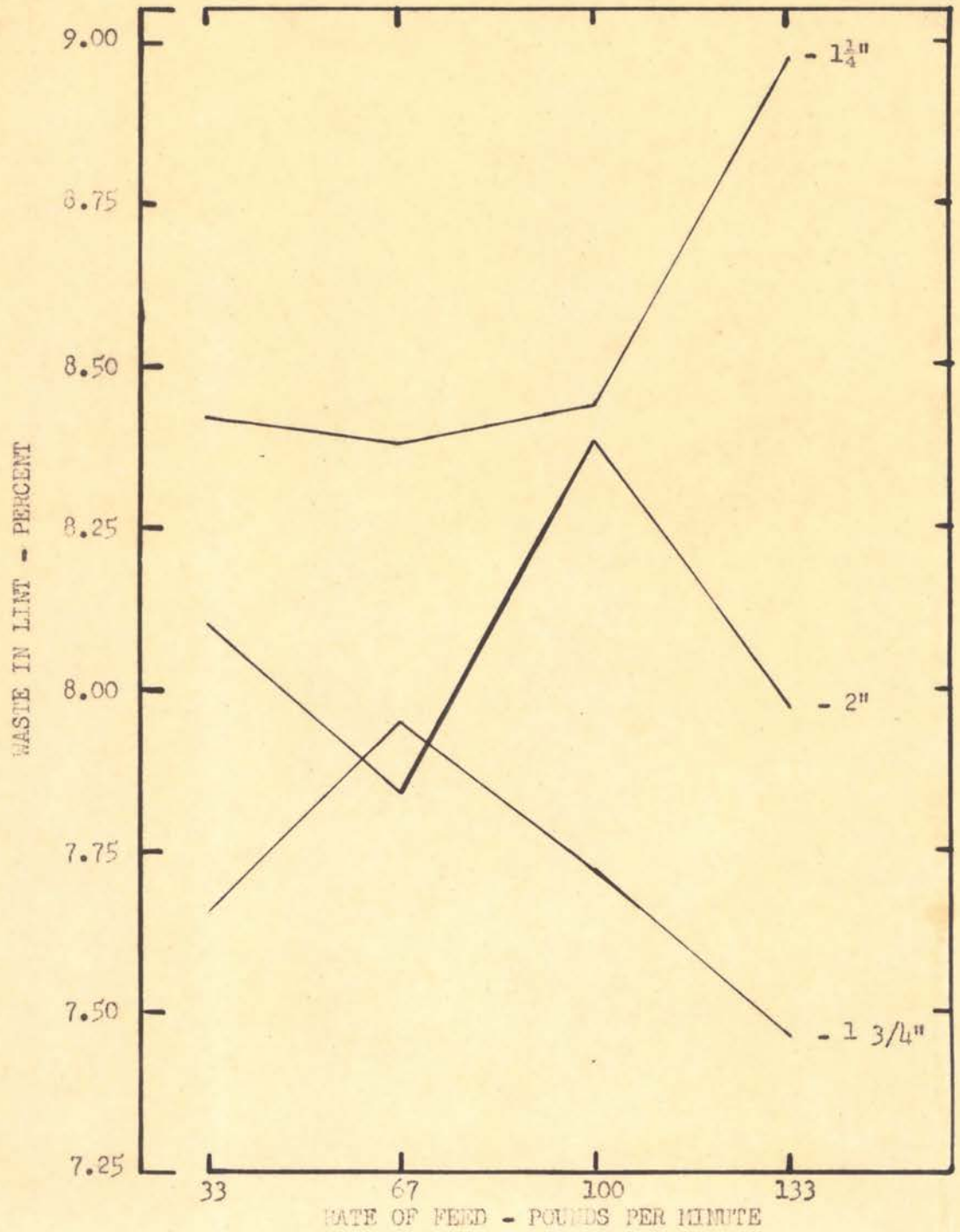

Fig. 23 - The effects of rate of feed and grid bar spacing on percentage waste in lint ginned after stick remover - 1954 tests.

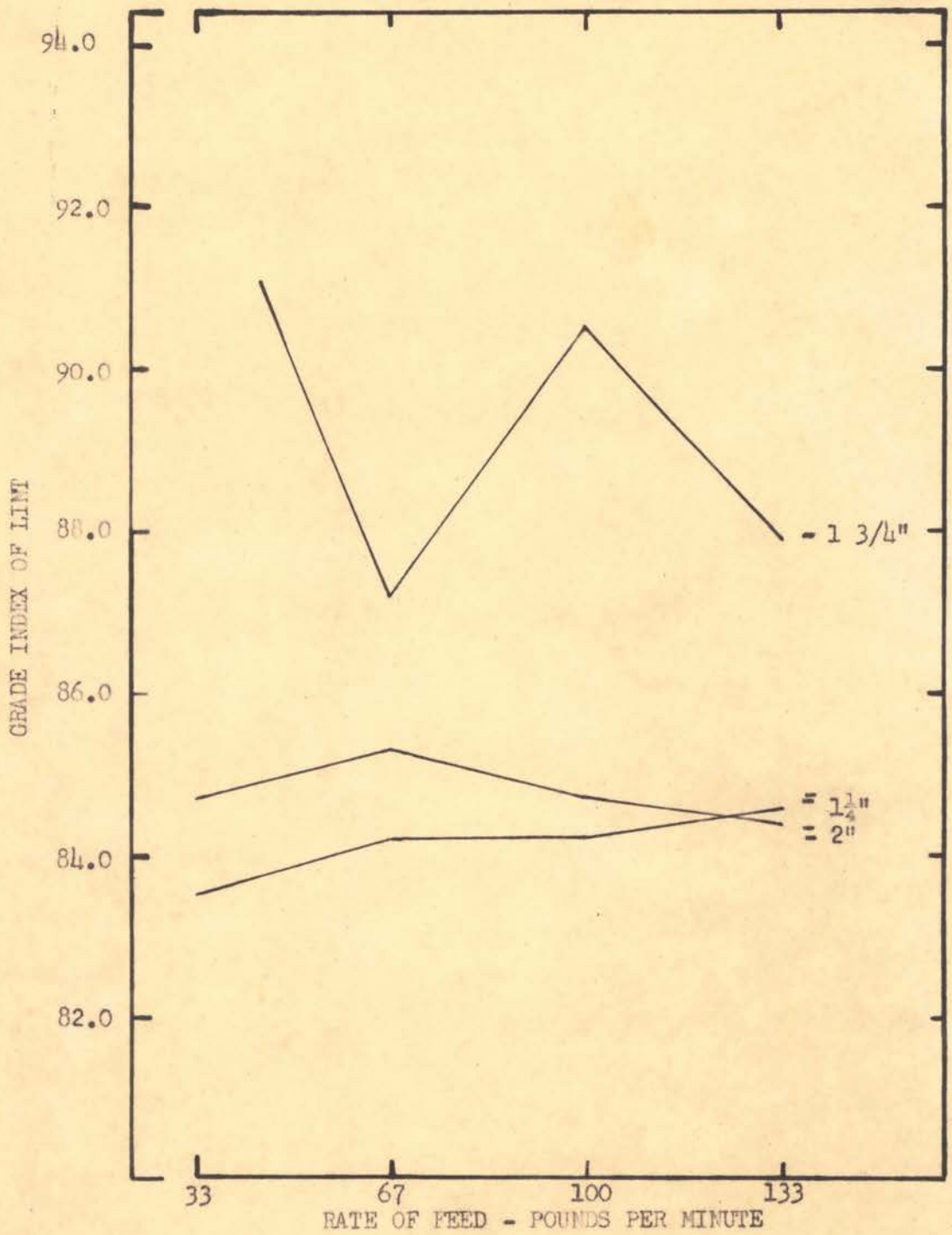

Fig. 24 - The effects of rate of feed and grid bar spacing on grade index of lint ginned after stick remover - 1953 tests.

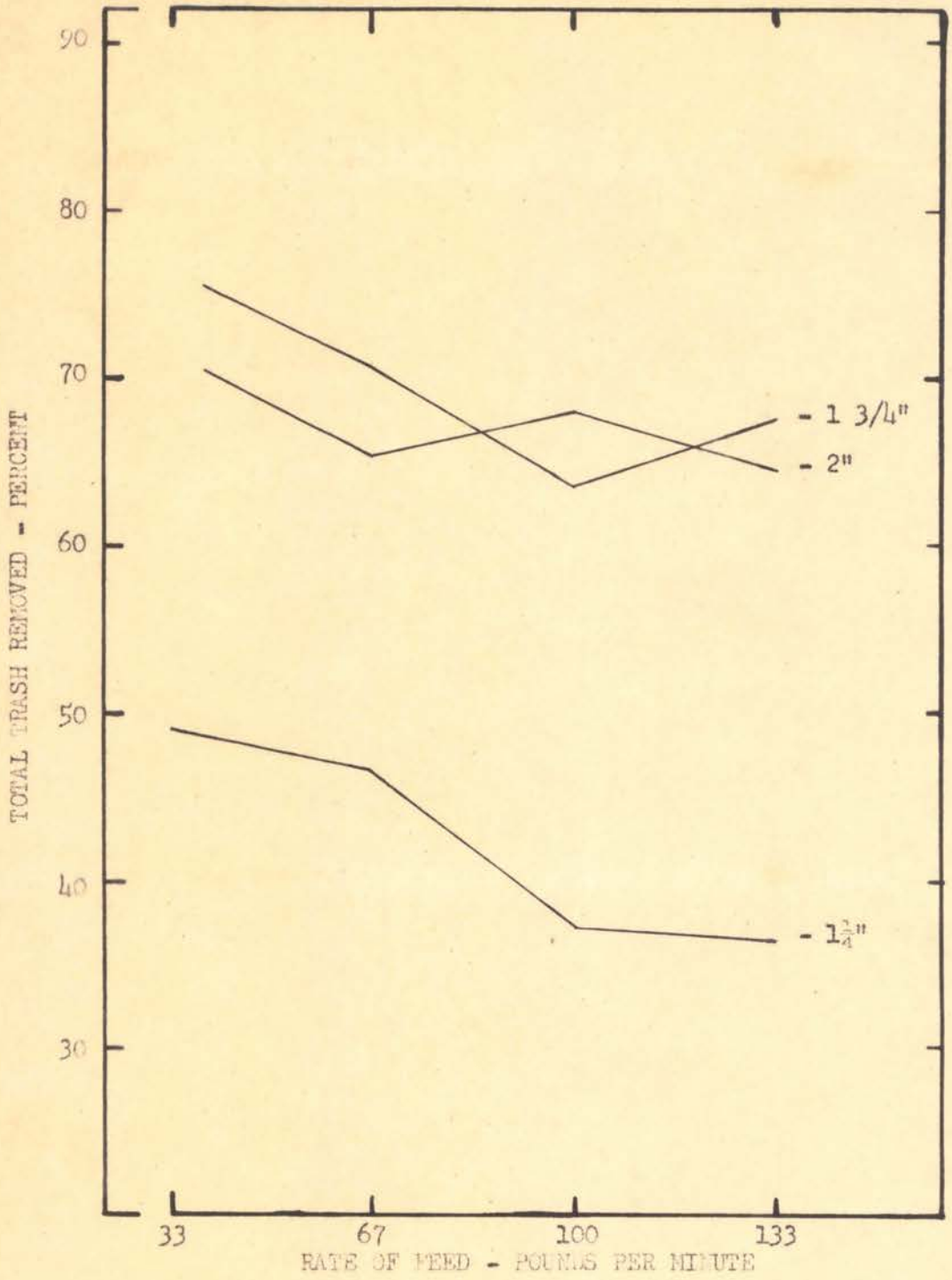

Fig. 25 - The effects of rate of feed and grid bar spacing on percent total trash removed by stick remover - 1954 tests.

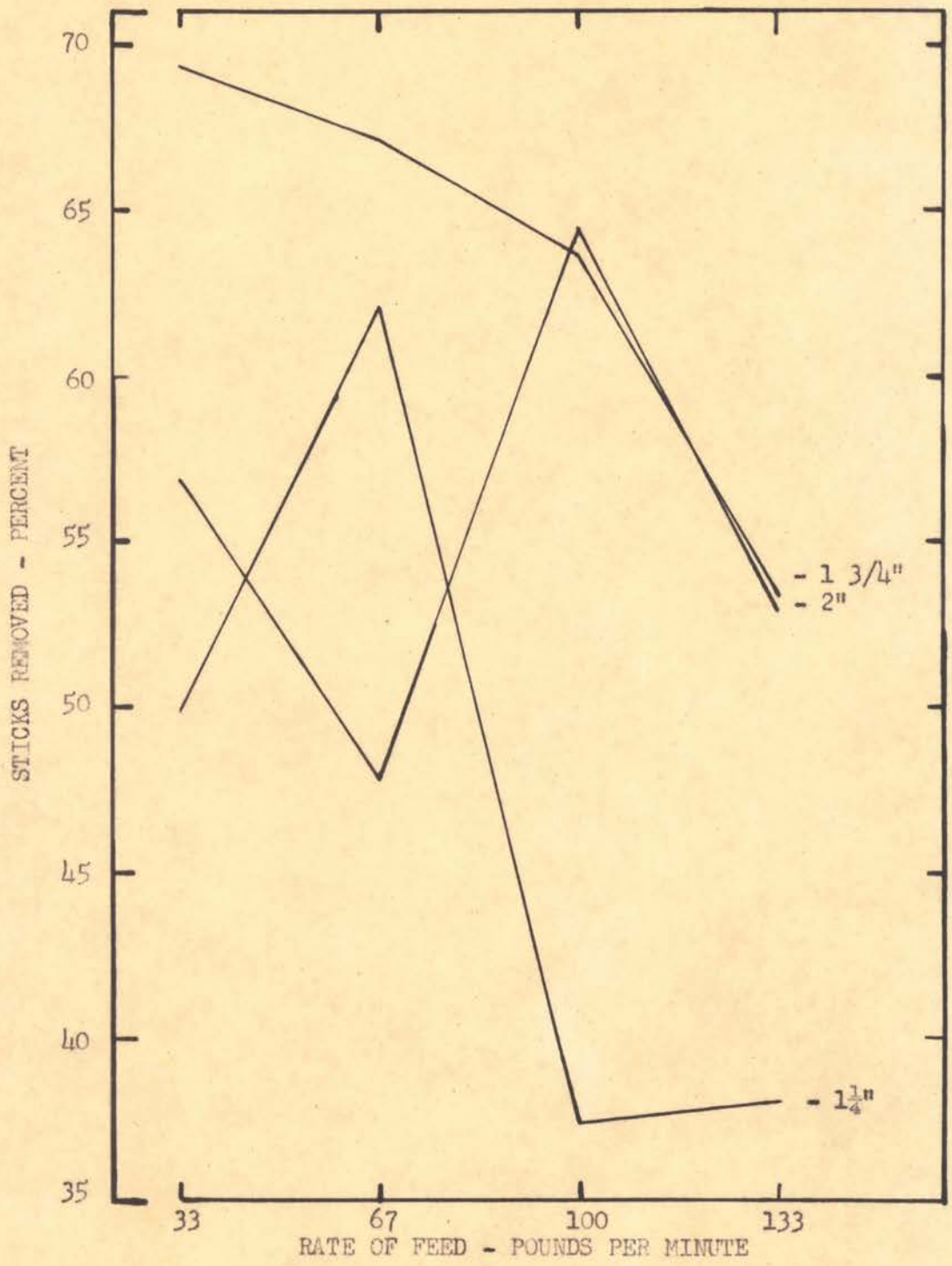

Fig. 26 - The effects of rate of feed and grid bar spacing on percent of sticks removed by stick remover - 1954 tests.

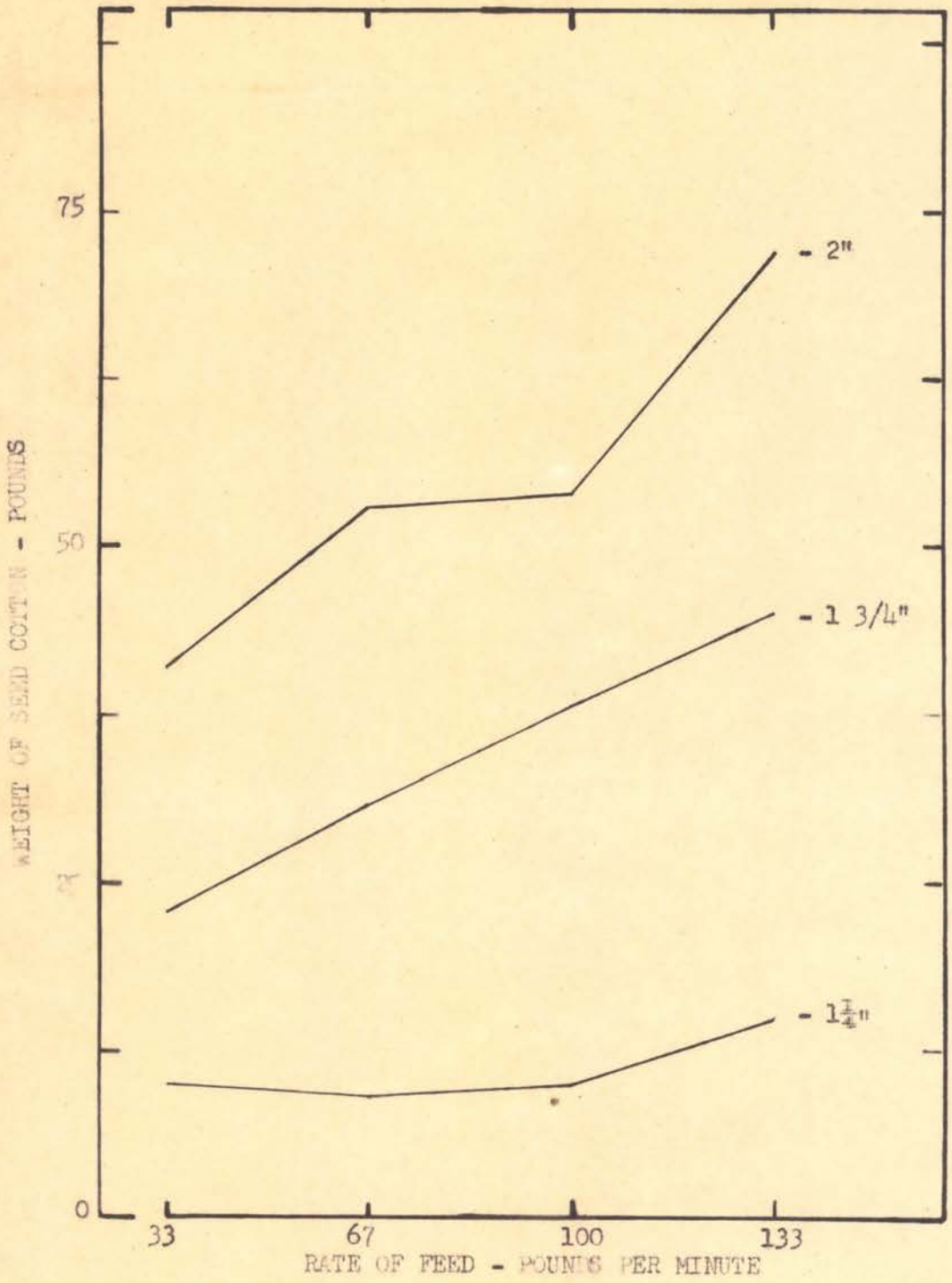

Fig. 27 - The effects of rate of feed and grid bar spacing on amount of seed cotton discharged with waste from stick remover from 2400 pounds of stripped material - 1954 tests.

(Figs. 18 through 21). Increased rates of feed reduced the effectiveness of removal of trash by the stick remover. This was attributed to the same conditions as discussed previously: i.e., a thicker bat was laid down on the extractor saw cylinder thus preventing expulsion of the trash from the under side of the circular formation.

On the type of cotton tested there appeared to be a point of diminishing effectiveness of trash removal by widening the grid bar spacing. The spacings of 2 inches on center allowed too much cotton to pass through thus overloading the reclaimer and reducing cleaning efficiency (Figs. 21 and 23). Overloading of the raclaimer caused loss of seed cotton (Fig. 27) which resulted in lowered lint turnout (Fig. 22).

Grade index of the lint was influenced by cleanliness of the sample and inherent color of the fibers. Samples from the lots following the stick remover with 1 3/4 inches on center spacing on the average had less waste than the samples following the stick remover with the other grid bar spacings (Fig. 23). In addition only 11 percent of the samples with the 1 3/4 inches spacing had color designations, while 68 percent of the lint samples with the 1 1/4 inches spacing had a color designation. None of the samples ginned following the stick remover with 2 inches on center grid bar spacings had a color designation. From this it was concluded that the wider spacings allowed more of the damaged cotton to be expelled thus preventing contamination of the better quality fibers. This conclusion warrants further study.

Conclusions from the 1954 tests were that the spacing of the grid bars in the stick remover is governed by the size of the cotton hull to be extracted and that on the type cotton used in 1954 the most effective spacing was 1 3/4 inches on center for an effective clearance of 1 3/8 inches.

Chokages occurred during tests with rates of feed of 100 and 133 pounds per minute thus establishing the rate of feed at two bales per hour for each unit 60 inches in length.

B. Comparison of the Stick Remover to a 14 foot Master Extractor.

(1) 1953 Tests.

Results of the 1953 tests comparing the stick remover with two grid bar spacings and two overhead gin arrangements to a standard model master extractor 14 feet in length give further evidence to the conclusion that the grid bar spacings must be wide enough to allow the hull to pass through without crushing.

With the one inch on center grid spacings less total trash was removed by the combination (Table XXI); the unit extractors, huller fronts and moting systems were more heavily loaded (Tables XXII, XXIII and XXIV), and the lint contained more waste (Table XXVI). The master extractor removed more trash than did the stick remover using either grid bar spacing. The greater weight of waste from the elaborate overhead system using the stick remover with 1 1/4 inches on center grid bar spacings (Table XXI) may be attributed to the greater amount of seed cotton (Table XXX) in the waste from the stick remover.

The loss of seed cotton through the stick remover accounts for the reduced bale weight for stick remover using 1 1/4 inches grid spacing (Table XXV). Excessive waste in the lint following the stick remover using one inch grids (Table XXVI) plus the fact that little seed cotton was wasted (Table XXX) caused the bale weight measure to be highest for the one inch spacing.

Variations in grade indexes of lint samples from the different combinations (Table XXVII) are attributable to color designations and not to cleanliness of the lint.

Evaluated on the basis of percent total trash removed (Table XXVIII) and percent hulls removed (Table XXIX), the master extractor removed more trash than the stick remover under any combination.

It was concluded from the 1953 tests that the stick remover did not perform as well as the master extractor but that further tests were warranted.

(2) 1954 Tests.

Data from the 1954 tests comparing the stick remover to the master extractor may be used for direct comparison.

The stick remover discharged more trash by weight under all conditions than did the master extractor (Table XXXI). The unit extractor had less trash to remove following the stick remover under all conditions than when following the master extractor (Table XXXII). This was also true for the huller-front (Table XXXIII) and moting system (Table XXXIV).

Weight of lint following the stick remover averaged less than the weight of lint following the master extractor (Table XXXV). This fact coupled with the lesser amount of waste in the lint following the stick remover (Table XXXVI) indicated greater trash removal by the stick remover as compared to the master extractor. The grade index of the lint samples also averaged higher for the stick remover (Table XXXVII) which indicated better cleaning.

Percent total trash removed by the combinations using the stick remover was much greater for the stick remover than for the master extractor (Table XXXVIII).

The combinations with the stick remover removed an average of 73.1 percent of the sticks which was approximately three times more than the amount of sticks removed by the master extractor (Table XXXIX).

Value of the lint produced from 2400 pounds of stripped material by the combinations using the stick remover averaged higher than the value of the lint produced by those combinations using the master extractor (Table XXXX). In three of the four treatments the value of the lint from the stick remover was higher than the value of the lint from the master extractor.

It was concluded from the 1954 tests that the stick remover performed as well as the master extractor and also removed a sufficient quantity of sticks to aid materially in the reduction of malfunctions in gin operation.

VII. SUMMARY AND CONCLUSIONS

The following conclusions are made after careful consideration of the information obtained in testing the stick remover.

A. Determination of Rate of Feed, Extractor Saw Cylinder Speed and Grid Bar Spacing

1. Capacity of the unit was limited to two bales per hour or less. Chokages occurred at faster rates of feed and efficiency of cleaning and extracting was reduced. The low cost of the stick remover should make possible the installation of unit gins; i.e., a stick remover and unit extractor for each gin stand.

2. The seven inch extractor saw cylinders gave optimum performance at approximately 700 rpm. Lower speeds decreased the efficiency of extraction while the higher speeds were mechanically dangerous and increased the risk of damage to the inherent properties of the cotton.

3. Spacing of the 3/8 inch diameter grid bars gave best performance with an effective clearance which allowed the hull to be discharged without crushing. Clearances will vary with the variety of cotton handled but under the conditions tested the 1 3/8 inches clearance between grid bars gave best performance.

B. Comparison of the Stick Remover to a 14 foot Master Bur Extractor.

1. On the basis of evaluation of the ten items measured the performance of the stick remover with 1 3/8 inches clearance between grid bars, extractor saw cylinders at 705 rpm and fed at the rate of

2 bales per hour was slightly better than the 14 foot master bur extractor fed at four bales per hour.

C. General

1. Although less than 100 percent effective, the stick remover did remove 60-75 percent of the sticks and the cotton was conditioned to the point whereat units following the stick remover could remove the balance of sticks remaining in the seed cotton.

2. With the reclaiming unit installed during the second year of operation, waste of seed cotton was reduced to an acceptable level. There was evidence that the small amount of waste which did occur was beneficial as it included that portion of damaged cotton which contributed to color designations in the grade of lint.

3. With the measurements employed there was no damage to the inherent qualities of the cotton when the stick remover was operated with 1 3/8 inches clearance between grid bars, extractor saw cylinders at 705 rpm and fed at the rate of 2 bales per hour.

4. Performance of the stick remover satisfies the requirement of replacing equipment already in use. It has ample capacity to balance cost of installation, maintenance and operation commensurate with volume of production.

5. The stick remover may be used satisfactorily as a hull extractor, stick remover and cleaner on Oklahoma cotton harvested by hand-snapping or mechanical stripping.

One of the major problems involved in collecting the data for the thesis was that of knowing which factors to evaluate and which to not evaluate. It is recognized that the ginning of mechanical harvested cotton is most complex and that much effort has been spent in the past

and is at the present being expended on developing techniques for measuring the effect of gin machinery operation on the inherent quality of the cotton fibers. It is recommended that this form of research be expanded in order that methods may be developed which will give the gin operator greater control of the gin plant as dictated by the variations of the cotton delivered for processing.

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The content and form have been checked and approved by the author and thesis adviser. Changes or corrections in the thesis are not made by the Graduate School office or by any committee. The copies are sent to the bindery just as they are approved by the author and faculty adviser.

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