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The Cleanliness of Rectilinear Combed Tops

Part III: The Influence of a Double Top Comb and a Burr Beater

by

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THE CLEANLINESS OF RECTILINEAR COMBED TOPS*

PART III: THE INFLUENCE OF A DOUBLE TOP COMB AND A BURR BEATER

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ABSTRACT

The combing performance of a double top comb was compared with that of a single top comb. For equal gauge settings the double top comb produced more noil but a top having fewer impurities and a longer mean fibre length than did the single top comb. The use of the burr beater resulted in only a limited improvement of the cleanliness of the top.

KEY WORDS

Rectilinear comb — wool — double top comb — single top comb — burr beater — combing performance — top cleanliness — mean fibre length — percentage noil.

INTRODUCTION

Results reported by Belin[1], and Aldrich and Kruger[2] showed that the action of the comb cylinder is exploited to its maximum in removing impurities from the fringe of the rectilinear comb. Virtually no impurities (neps and vegetable particles) are present in the fringe in front of the top comb as it is presented to the withdrawal rollers. The impurities in the combed sliver, therefore, must move through the gaps in the top comb or somehow by-pass the top comb to appear in the combed sliver. The inefficient action of the top comb in preventing the forward movement of these impurities is, therefore, mainly responsible for the presence of impurities in the combed sliver.

Wegener[3] in processing silk, investigated the combing performance of top combs with pin densities in the range of 4 to 32 pins per cm. The percentage noil showed almost no change while a decrease of 50% in the number of neps was observed for pin densities ranging from 16 to 32 pins per cm. In general there was an increase in mean fibre length, although it was small.

From a study of the distribution of vegetable particles and neps in the beard before and after withdrawal, Belin[1] concluded that the top comb acts as an

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*Part of a Ph.D-Thesis by De V. Aldrich submitted to the University of Port Elizabeth

TABLE 1

CHARACTERISTICS OF THE PRECOMBED SLIVERS USED

WOOL		A	B	C	D	E
Mean fibre length (mm)		56,0	55,8	58,8	62,0	61,8
Coefficient of Variation (%)		65,1	64,0	58,1	58,0	58,7
% Fibres shorter than 25 mm		35,0	33,2	20,9	16,7	19,7
Mean fibre diameter (microns)		22,1	22,2	22,9	21,8	19,5
Ether extractible matter (%)		0,98	0,94	0,77	0,83	0,84
Impurities per 20 grams:						
Neps		456	590	301	380	1115
Vegetable particles	> 10 mm	100	95	–	–	–
	> 3 mm < 10 mm	506	542	140	46	32
	< 3 mm	1053	895	260	124	105
Total vegetable particles		1659	1532	400	170	137
% Vegetable matter (by mass)		1,30	1,25	–	–	–

impedance to the forward movement of vegetable particles and to some extent also of neps. Depending on the size of the neps, the top comb can, however, also act as a sieve. Belin also reported that a decrease in the gap between the pins of the top comb from 140 microns to 70 microns only slightly improved the top cleanliness.

More recently Aldrich and Kruger[2] studied the influence of gap, percentage void, pin density and pin thickness on the combing performance of top combs. They found that of the four characteristics mentioned, the gap and percentage void are the controlling factors as far as the removal of impurities are concerned. Both the gap and percentage void showed optimum values which resulted in a minimum number of neps and vegetable particles in the top, but produced a maximum percentage noil.

The present paper describes an investigation of the use of a double top comb arrangement and a burr beater to improve the efficiency with which the comb removes impurities.

EXPERIMENTAL

Materials:

The experiments were carried out on Merino wools of 60^s to 64^s quality. The characteristics of the precombed slivers of the five lots used, designated alphabetical-

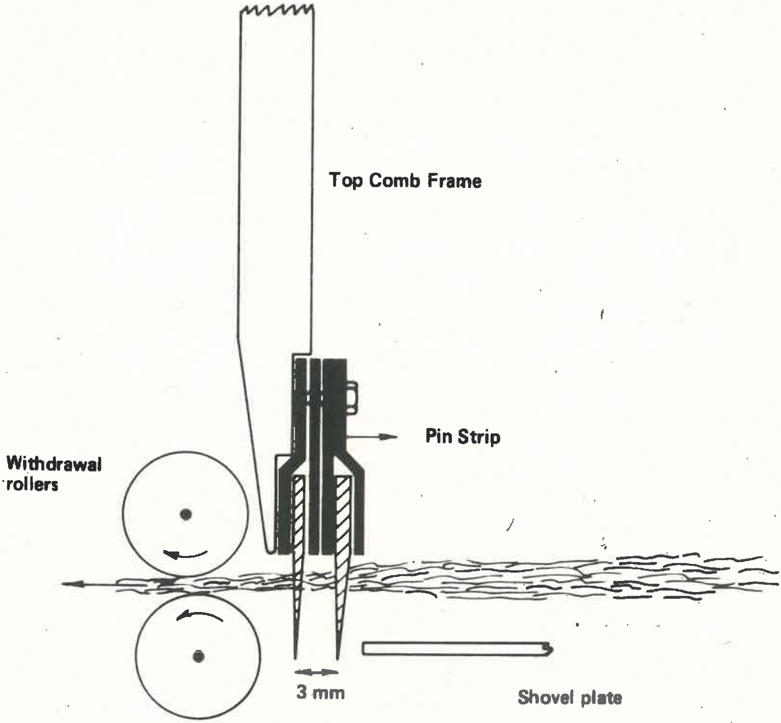

FIGURE 1
Cross-section through the Top Comb Frame showing the Double Top Comb Arrangement

ly A to E, are given in Table 1. Wool B formed part of the same scoured bulk lot from which wool A was taken, but was carded, gilled and combed separately at a later stage.

Scouring, carding and gilling:

The wool was scoured in a four-bowl Petrie and McNaught pilot scale scouring plant, with a nonionic detergent and 0,1% soda ash in the first bowl. After scouring, 1% Eutectal (0,3% dichloromethane extractable) was added, the residual grease content of the five lots varying from 0,77% to 0,98% after carding.

Carding was carried out on a F.O.R. Biella Worsted Card with a continental forepart at a production rate of 16 to 18 kg per hour. The card slivers were subsequently conditioned for at least 48 hours in an atmosphere of 20°C and 68% relative humidity. All subsequent experiments were carried out under these conditions.

Each lot was subjected to three preparatory gillings on an NSC Intersecting gillbox with fallers having a pin density of 6,5 pins per cm.

Combing:

The wool was combed on a Schlumberger (Model PB 26L) rectilinear comb. The comb was set properly before the commencement of each series of experiments, using the Instruction Manual supplied by the manufacturer as a guide. The burr beater was used in conjunction with a standard comb cylinder suitable for combing 64^S quality wools, and set in strict accordance with the manufacturer's specifications.

The double top comb arrangement consisted of a combination of two pin strips, mounted back-to-back as shown in Fig. 1. These pin strips were of the ready-made type (commercially available) each having a pin density of 28 pins per cm. In all cases the double top comb arrangement was compared with a standard single top comb using one of the pin strips of the double top comb arrangement. The setting of the double top comb relative to the withdrawal rollers and the distance between the back row of the double top comb and the shovel plate were the same as the equivalent settings for the single top comb (see Fig. 1). The relevant details of the pin strips were –

Pin density	=	28 pins per cm
gap	=	51 microns
percentage void	=	$\frac{\text{gap} \times 100\%}{\text{pitch}} = 14{,}3\%$
pin thickness	=	0,307 mm; and
pin width	=	0,738 mm.

Preliminary investigations showed that a double top comb, of which each pin-row had 28 pins per cm, gave a better performance than other combinations of pin density such as 25/25 and 25/28 pins per cm. The choice of 28 pins per cm for the single top comb as a standard was also based entirely on its superior performance in preliminary experiments.

Preliminary investigations also showed that, in the range 2 mm to 6 mm, the distance between the two pin-rows of the double top comb does not have a critical effect on the combing performance. Three millimetres were, therefore, chosen as a practical distance and used throughout.

The comb was allowed to run for at least 10 minutes before commencing with a series of experiments. For each experiment three 3-minute tests were carried out, and the average value of the three tests taken to be the result of the experiment. The top comb was cleaned after each test.

Measurements:

The nep and vegetable particle content of the precombed and top slivers were determined on a Toenniessen Top Tester.

In the case of the precombed slivers, one determination was made (three each by two operators) on each six samples drawn from six alternative cans as they left the third preparatory gillbox. A mass of 30 grams was tested, or 500 impurities counted per sample, whichever limit was reached first after which the results of the six determinations were then averaged.

TABLE 2

THE CHARACTERISTICS OF TOPS PRODUCED FROM WOOL B COMBED AT DIFFERENT GAUGE SETTINGS USING DIFFERENT TOP COMB ARRANGEMENTS

Top comb	Gauge Setting (mm)	Noil (%)	Impurities per 20 grams						Mean fibre length Top (Hauteur -mm)	Coeff. of Variation (Hauteur -%)	% Fibres <25 mm
			Neps	Vegetable particles							
				>3 mm <10 mm	>10 mm	<3 mm	Total				
28*	24	8,90	66,0	14,4	4,0	33,1	51,5	–	–	–
28/28**		9,65	60,1	9,5	3,4	27,2	40,1	–	–	–
28*	26	9,22	58,5	7,4	1,8	16,0	25,2	57,8	54,8	15,3
28/28**		10,11	53,0	3,6	1,6	13,6	18,8	58,5	53,8	14,2
28*	28	9,84	55,0	4,6	1,5	11,0	17,1	57,9	53,5	14,4
28/28**		10,58	48,3	3,4	1,0	9,2	13,6	58,6	51,0	13,0
28*	30	10,81	53,1	3,4	0,6	12,0	16,0	58,4	52,5	12,8
28/28**		11,74	40,6	2,8	0,6	9,6	13,0	59,6	51,0	11,0
28*	32	12,12	48,5	1,9	0,6	10,2	12,7	–	–	–
28/28**		13,16	37,2	1,6	0,4	9,1	11,1	–	–	–
28*	34	13,66	48,4	1,8	0,2	9,7	11,7	59,5	51,0	9,0
28/28**		15,15	29,8	1,6	0,1	9,1	11,0	60,7	50,1	7,6

* Single Top comb – 28 pins/cm
** Double top comb – each row 28 pins/cm
(Distance between rows = 3,0 mm)

TABLE 3

THE EFFECT OF A DOUBLE TOP COMB ON THE IMPURITY CONTENT OF TOPS PRODUCED FROM WOOLS C, D AND E

Wool	Top Comb (pins/cm)	Gauge Setting (mm)	Noil (%)	Impurities per 20 grams		Mean Fibre Length Top (Hauteur -mm)	Coeff. of Variation (Hauteur -%)	Percentage Fibres <25 mm
				Neps	Total Vegetable particles ***			
C	28*	30	5,40	12,5	3,0/11,6	61,8	54,3	10,4
	28/28**	30	5,85	7,5	1,8/7,8	62,4	53,2	9,2
	28*	28	4,90	15,8	3,8/13,1	60,1	54,9	12,8
	28/28**	28	5,35	7,9	2,7/7,5	61,6	54,6	9,9
D	28*	30	3,75	15,9	0,9/2,9	64,8	49,8	3,8
	28/28**	30	4,20	12,1	0,5/2,7	67,0	48,5	3,2
	28*	28	3,32	16,8	0,6/2,7	64,8	49,8	3,9
	28/28**	28	3,70	11,9	0,6/2,5	65,2	49,7	3,7
E	28*	30	5,95	29,5	0,4/2,2	68,2	49,1	7,5
	28/28**	30	6,80	21,0	0,2/1,7	69,9	46,6	6,0
	28*	28	5,32	32,0	0,8/3,9	67,9	49,5	7,8
	28/28**	28	6,10	23,7	0,4/2,5	68,4	47,9	6,5

* Single Top Comb – 28 pins/cm
** Double Top comb (28/28 pins per cm)
*** Longer than 3,0 mm/Shorter than 3 mm

In the case of top samples a mass of 50 grams was tested or 250 impurities counted, whichever limit was reached first, for every test. The results of the six determinations by two operators (one each per test) which involved a minimum of 300 grams of material or 1 500 impurity counts, were then averaged and taken as the impurity content of the top for the particular experiment.

In all cases the nep and vegetable particle content is expressed as the number of each per 20 grams material. Neps of all sizes were counted which resulted in the quoted values for nep content being relatively high. Where relevant, the vegetable

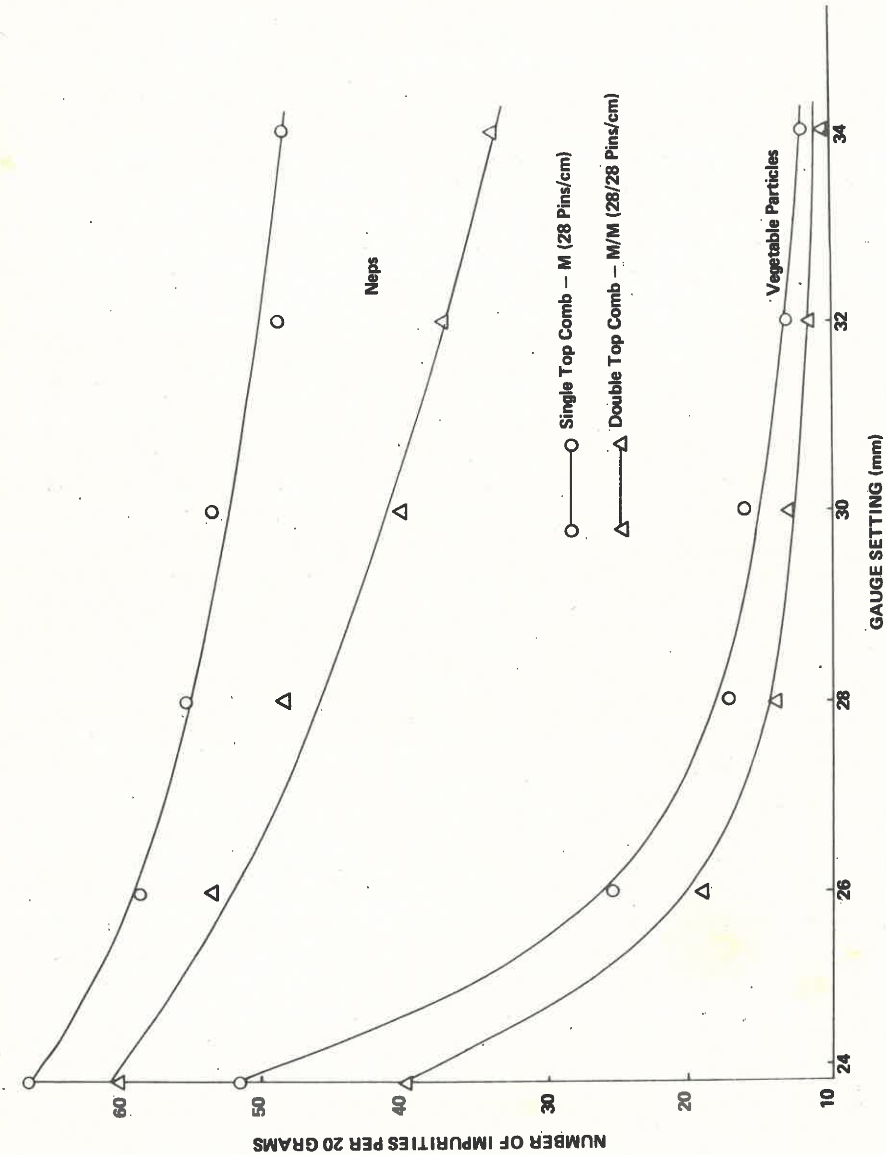

FIGURE 2

Number of Impurities per 20 grams versus Gauge Setting using a Double and a Single Top Comb. (Wool B)

particles were divided into three groups: those shorter than 3 mm, those longer than 3 mm but shorter than 10 mm, and those longer than 10 mm.

Fibre length measurements of the precombed slivers were carried out on the WIRA Single Fibre Length Tester and those of the top samples on the Almeter.

RESULTS AND DISCUSSION

The results of the combing performance of the double top comb compared with that of the single top comb are given in Tables 2 and 3. The corresponding graphs of nep and total vegetable particle content, and percentage noil versus gauge setting are given in Figs. 2 and 3, respectively.

From the graphs in Fig. 2 it is clear that the use of a double top comb resulted in a significant improvement of the cleanliness of the tops, although the improvement was most significant with regard to neps at large gauge settings and vegetable particles at smaller gauge settings.

The relatively better performance of the double top comb in removing the vegetable particles at the smaller gauge settings as compared with the better removal of neps at the larger gauge settings could be explained in terms of the difference in the efficiency with which the vegetable particles of different sizes are removed. With the more efficient removal of the longer particles at larger gauge settings[4], only the small, difficult-to-remove particles remained. The performance of the double top comb relative to that of the single top comb, therefore, reduced with increasing gauge setting. In the case of neps, the double top comb was more competent in preventing the advance of floating neps into the combed sliver at large gauge settings than was the single top comb. The double top comb, therefore, performed increasingly better with increasing gauge setting compared with the single top comb.

Fig. 3 shows that the improved performance of the double top comb in removing impurities was accompanied by an increased percentage noil (approximately 0,75 to 1,5% absolute) at all gauge settings. Table 2, however, shows that the use of a double top comb always resulted in a top having a longer mean fibre length. The fact that there was an increase in mean fibre length with the use of a double top comb is probably due to the increased percentage noil extracted. This also indicates that the amount of fibre breakage could not have differed much from that occurring with the use of a single top comb. The use of the double top comb, therefore, resulted in a more efficient removal of impurities and short fibres with a concommitant improvement in length characteristics, but resulting in more noil.

In trying to eliminate the disadvantage of the increased percentage noil produced by the double top comb, the performances at two different gauge settings were compared. The two gauge settings were chosen in such a way that the percentage noil produced by the double top comb at the smaller gauge setting was approximately equal to that produced by the single top comb at the larger gauge setting. In Table 3 the performance of the two top combs was compared at 28 and 30 mm gauge settings for three different wools C, D and E. For wools C and D the

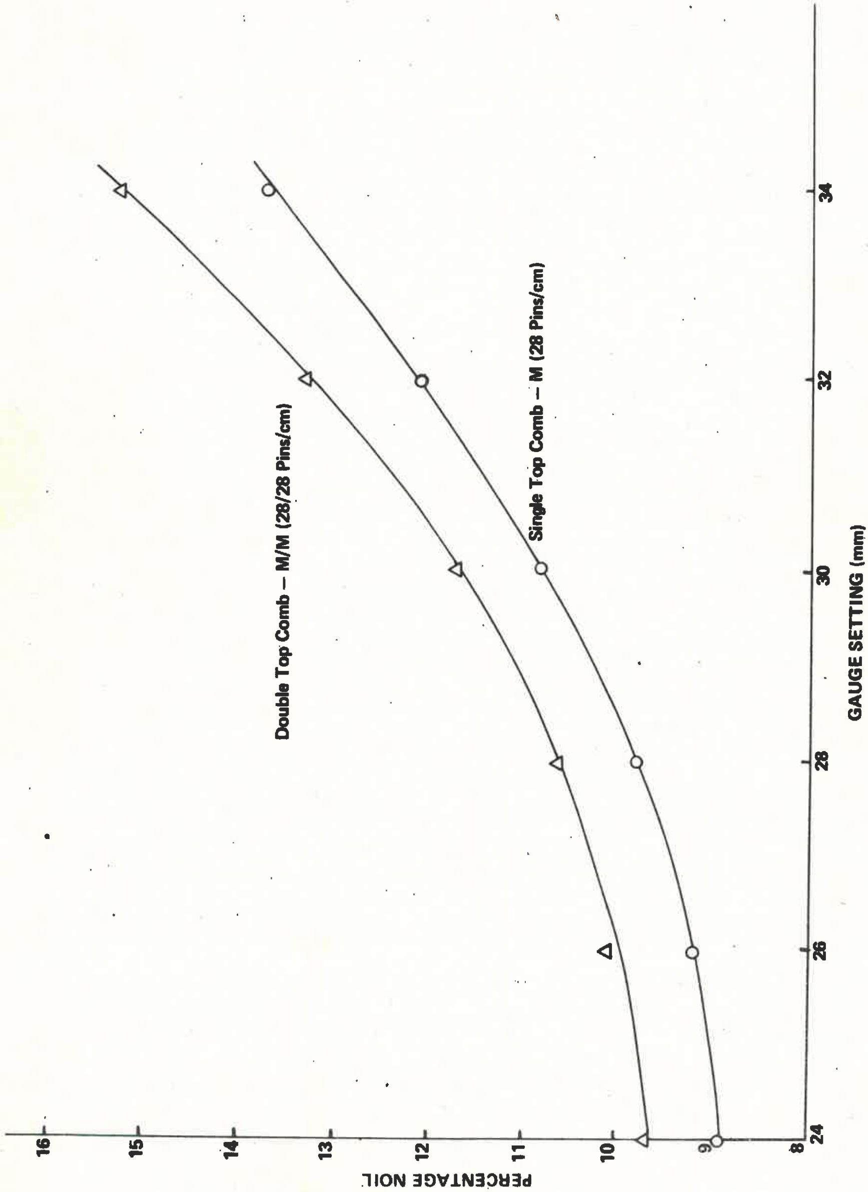

FIGURE 3

Percentage Noil versus Gauge Setting using a Double and a Single Top Comb. (Wool B)

TABLE 4

THE EFFECT OF THE BURR BEATER ON THE COMBING PERFORMANCE AT DIFFERENT GAUGE SETTINGS (WOOL A)

Burr Beater	Gauge Setting (mm)	Noil (%)	Impurities per 20 grams					Mean fibre length Top (Hauteur - mm)
			Neps	Vegetable particles				
				>3 mm <10 mm	>10 mm	<3 mm	Total	
IN	24	7,94	41,2	17,2	2,2	36,2	55,6	57,6 (16,8)*
OUT		7,99	45,3	15,7	1,9	31,8	49,4	56,9 (16,4)*
IN	26	8,62	36,6	6,7	0,6	15,9	23,2	57,7 (16,2)*
OUT		8,74	40,1	7,1	1,3	14,0	22,4	58,6 (15,2)*
IN	28	9,37	31,0	3,5	0,7	12,1	16,3	59,1 (13,8)*
OUT		9,38	32,3	5,2	0,9	12,3	18,4	59,4 (13,5)*
IN	30	10,39	24,9	3,6	0,5	9,2	13,3	60,3 (10,5)*
OUT		10,38	26,0	4,2	0,7	12,6	17,5	60,7 (11,3)*
IN	32	11,23	24,0	2,7	0,3	9,1	12,1	61,6 (8,8)*
OUT		11,53	26,3	2,4	0,2	10,0	12,6	61,5 (8,9)*
IN	34	12,96	23,3	1,9	0,2	8,7	10,8	62,6 (7,1)*
OUT		13,14	26,0	3,7	0,2	10,6	14,5	63,0 (6,8)*

* (Percentage fibres shorter than 25 mm)
Top comb = M (28 pins/cm)
Gill-feed = 4,2 mm

percentage noil at 28 mm gauge setting with the double top comb was equal to that at 30 mm gauge setting with the single top comb, while for wool E the former was slightly higher than the latter. The length characteristics of the top produced by using the double top comb at 28 mm gauge setting were similar to those of the top produced by using the single top comb at 30 mm. The double top comb at 28 mm gauge setting, however, produced a cleaner top than did the single top comb at 30 mm gauge setting, despite the disadvantage of the smaller gauge setting. A double

TABLE 5

THE EFFECT OF THE BURR BEATER ON THE COMBING PERFORMANCE AT DIFFERENT GAUGE SETTINGS (WOOL B)

Burr Beater	Gauge Setting (mm)	Noil (%)	Impurities per 20 grams					Mean fibre length Top (Hauteur - mm)
			Neps	Vegetable particles				
				>3 mm <10 mm	>10 mm	<3 mm	Total	
IN	26	9,14	55,1	7,7	1,0	17,9	26,6	57,6
OUT		9,22	58,5	7,4	1,8	16,0	25,2	57,8
IN	28	9,86	49,6	2,8	0,9	11,1	14,8	58,0
OUT		9,84	55,1	4,6	1,5	11,0	17,1	57,9
IN	30	10,79	48,5	2,3	0,3	10,1	12,7	58,2
OUT		10,81	53,1	3,2	0,5	12,3	16,0	58,4
IN	32	12,12	46,7	1,8	0,3	9,2	11,3	–
OUT		12,12	48,5	2,0	0,5	10,2	12,7	–
IN	34	13,77	46,7	2,0	0,1	9,4	11,5	59,7
OUT		13,66	48,4	1,9	0,1	9,7	11,7	59,5

Top comb = M (28 pins/cm)
Gill-feed = 4,2 mm

top comb at 28 mm gauge, therefore, produced a cleaner top with similar fibre lengths and similar amounts of noil than did a single top comb at 30 mm gauge setting for these particular wools.

The effect of the burr beater on the combing performance at different gauge settings was investigated, using wools A and B. As wools A and B were from the same scoured lot, being processed at different times, they were similar in character and the results obtained from wool B may be taken as a repeat of those from wool A.

The results given in Tables 4 and 5 and Figs. 4 and 5 show a small, almost negligible improvement in the cleanliness of the top when the burr beater was used. The

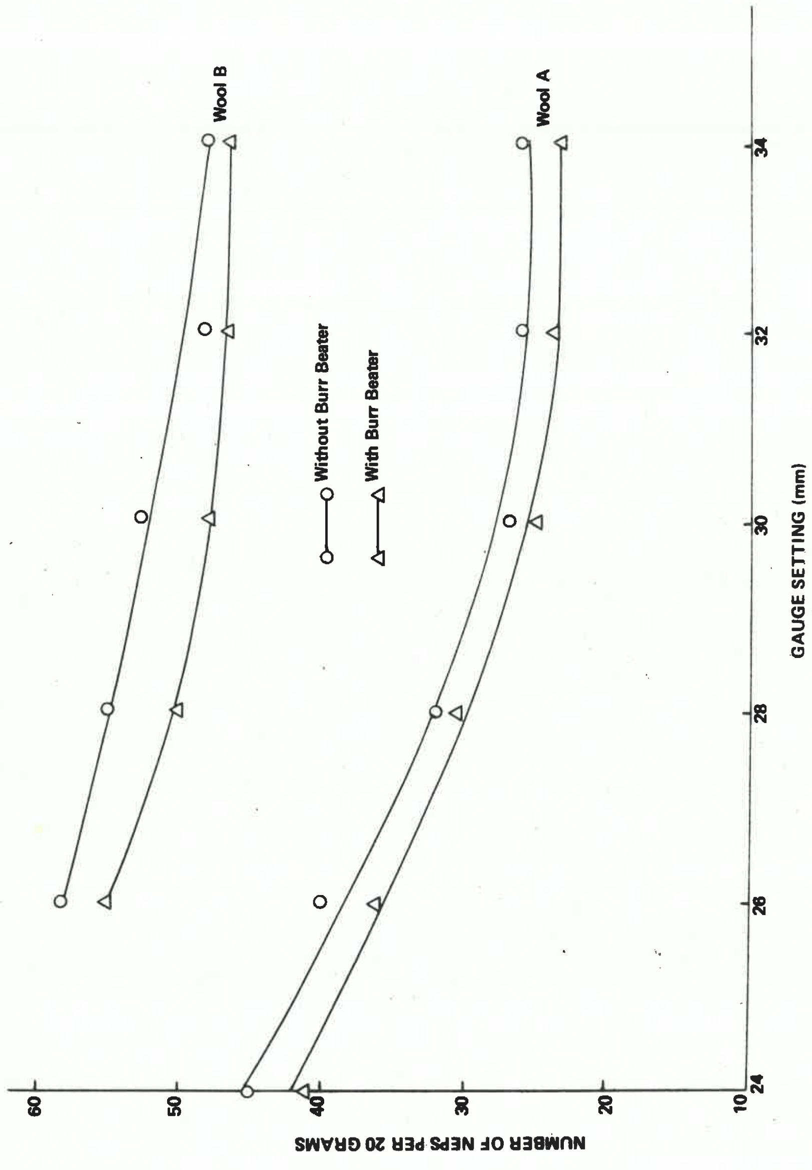

FIGURE 4
Number of Neps per 20 grams versus Gauge Setting with and without the Burr Beater. (Wools A and B)

effect of the burr beater on the percentage noil was negligible as was its effect on the mean fibre length of the top. For this type of seedy wool the use of a burr beater, therefore, offered no real advantage if one considers its limiting effect on the maximum speed of the comb, the increased damage hazard and the additional care necessary in setting it properly. In the case of wools containing high amounts of vegetable matter the use of a burr beater may be beneficial in that it will assist the comb cylinder to cope with the increased load of impurities present in the fringe after withdrawal.

CONCLUSIONS

It was demonstrated that the efficiency of the rectilinear comb in removing impurities can be improved by the use of a double top comb arrangement instead of the conventional single top comb.

For the same gauge setting the use of a double top comb resulted in a top with a longer mean fibre length containing less neps and vegetable particles, when compared with the top produced with a single top comb. The double top comb, however, produced more noil than did the single top comb. The increase in percentage noil can, however, be counteracted by using a smaller gauge setting in conjunction with the double top comb, than would have been the case with the single top comb. Under these circumstances the double top comb would still produce a cleaner top, but there will be no gain as far as the noil and the mean fibre length of the top are concerned.

The possible problem of proper penetration of the fringe by the double top comb arrangement is not insurmountable and can be solved by suitable mechanical alterations to the comb.

As far as the use of the burr beater is concerned, the results showed that the improvement in cleanliness of the top was only slight. The wools used for these investigations contained 1,3% vegetable matter (by mass) which is relatively low compared with wools containing up to 10%. Although these results are, therefore, not strictly applicable to wools having such high amounts of vegetable matter, they certainly indicate that the use of the burr beater results only in a limited improvement of the cleanliness of the top (at least when the vegetable matter contents are low to medium). The mechanical problems, caused by the burr beater at high speeds, will probably limit its use in future high speed machines.

These results also emphasize that the efficiency of the top comb should be increased rather than that of the comb cylinder, as the latter already operates at its maximum efficiency and little is to be gained by marginally increasing its efficiency.

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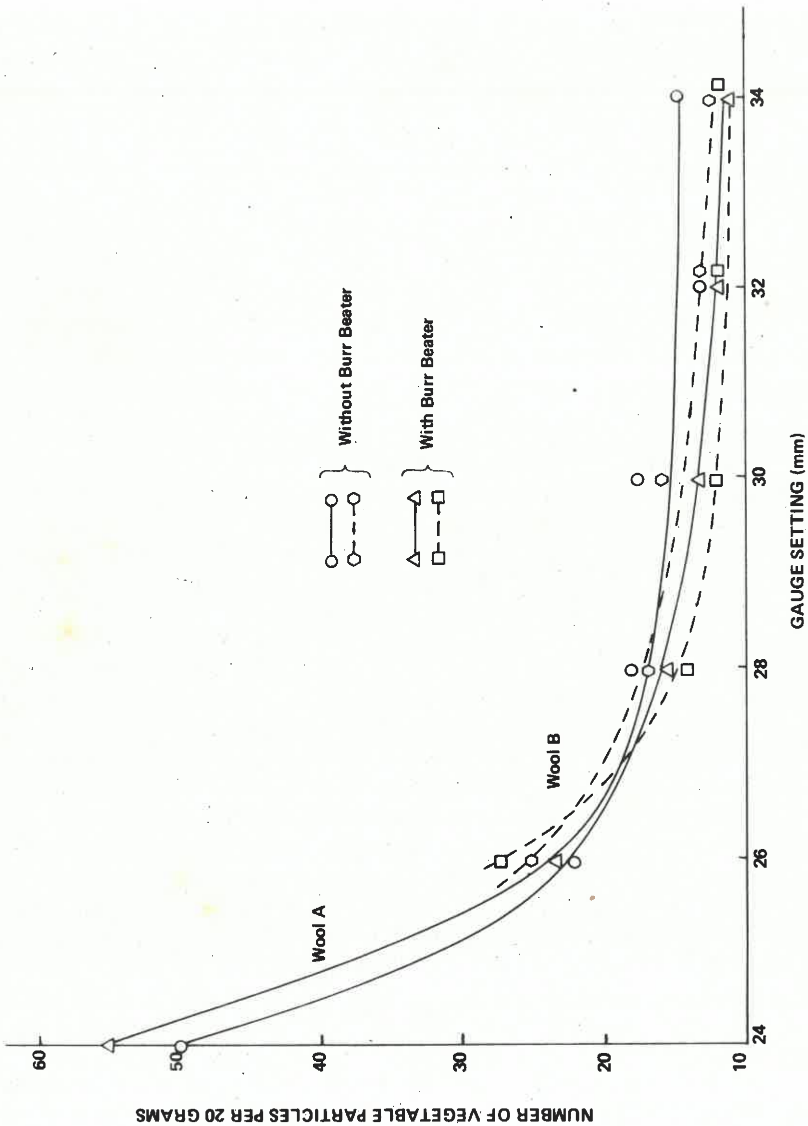

FIGURE 5

Number of Vegetable Particles per 20 grams versus Gauge Setting with and without the Burr Beater. (Wools A and B)

Thanks are also due to the Division of Carding and Combing for their assistance in preparing the samples. Finally the authors wish to thank the S.A. Wool Board for permission to publish the results of this investigation.

THE USE OF PROPRIETARY NAMES

The fact that chemicals and machines with proprietary names have been mentioned in this report, does not in any way imply that SAWTRI recommends them or that there are not substitutes which may be of equal value or even better.

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