EFFECT OF THE DIMENSIONS OF BALLOON BREAKER WITH TRIANGULAR CROSS SECTION ON YARN TENSION
(Part II)

تأثير الأبعاد لكاسر البالون المثلث على سلوك الشد

أثناء فك الخيط من بوبينة الغزل

By

A. SHAHIN* and I. RAKHA**

* Assoc. prof., ** Lecturer in Textile Department, Faculty of Eng. Mansoura University.

الخلاصة — في هذا البحث تم قياس الشد أثناء سحب الخيط من بوبينة الغزل بسرعة ٩٠٠ م/دقيقة وذلك بعد مرور الخيط خلال كاسر البالون ذو المقطع المثلث لدراسة تأثيره على سلوك شد الخيوط أثناء فكها . وقد استخدم نظام تصميم التجارب (٣^٣) لتوضيح تأثير العوامل المختلفة مثل بعد نقطة الفك عن دليل خط ، طول ضلع مثلث مقطع الكاسر وكذلك ارتفاع الكاسر على سلوك شد الخيوط .

وقد أوضحت النتائج أن أبعاد كاسر البالون المثلث تؤثر على قيم الشد في الخيط أثناء فكه من بداية البوبينة حتى نهايتها خاصة مع الخيوط السميكة .

كما أنه تم التوصل الى امكانية تقليل الاختلاف بين قيم الشد عند بداية الفك ونهايته من على البوبينة باستخدام كاسر بالون ذو أبعاد مناسبة .

ABSTRACT: The yarn tension during unwinding from cops was measured for different types of balloon breakers. It was found that the triangular breaker acts to reduce the value of yarn tension to a minimum level.

In this work the behaviour of yarn tension under the effect of various dimensions of triangular breaker was measured. These measurements were carried-out for different cotton yarn counts Ne 20, Ne 30 and Ne 50.

The experiments designed according to the $(3)^3$ factorial design to investigate the effect of unwinding distance, breaker cross-section and breaker height on the behaviour of yarn tension.

The results declared that the dimensions of balloon breaker have a significant effect on the values of yarn tension during unwinding from spinning cops , specially for coarse yarn counts.

The difference between the maximum value of yarn tension at the cops base and its maximum value at the top of cops can be reduced by using a modified triangular breaker With a suitable dimensions.

1- INTRODUCTION:

From the important parameters in the winding process is the productivity c machine. And from the main parameters which affect the productivity is the wi speed of yarn from cops. But as known before, the yarn tension increases with yarn speed, and this respectively affects the percent of yarn breaks and machine . Thus, to increase the yarn withdrawing speed, without a high increase in yarn tension breaker must be used.

According to the measurements in Ref./1/, the yarn tension was meas two types of balloon breakers, the first type has a square cross-section and the s has a ciscular cross-section. By measuring the tension using the first type, it was found that the level of yarn tension increases with decreasing the length of balloon breaker (from 9 cm to 3 cm) with constant cross-section (2,5x2,5 cm). And with decreasing the dimensions of balloon breaker (length up to 7.5 cm and cross-section to 2x2 cm) the yarn tension increased. Then, by measuring the yarn tension using the second type of balloon breaker, it was found that, by varying the breaker diameter from (2.5 to 3.0 cm) and at constant length (9 cm), the yarn tension does not have any significant variation.

In Ref./2/, the yarn tension was measured under the effect of the variation in cops dimensions, from which, it is noticed that, the level of yarn tension increases with increasing the cops length. And this behaviour of yarn tension is the same either by using balloon breaker or during direct withdrawing from cops.

The difference in the level of yarn tension at the top and base of cops must be reduced because this difference affects package density during winding process and consequently the subsequent processes efficiency and final product quality. According to Ref./3/, the package density is affected by the value of yarn tension, i.e. the pakage density increases with increasing yarn tension. It is also evident from Ref. /4/, that the radial force which acts to press the yarn layers on the package is affected by the yarn tension during unwinding from cops.

In Ref./5/ it was found theoretically that the value of yarn tension decreases with changing the single yarn balloon to multi-balloons.

According to Ref./6/, the measurements for yarn tension using different forms of balloon breakers was carried-out. It was cleared that, the balloon breaker with a triangular cross-section acts to reduce the value of yarn tension to a minimum value.

In the present study, the yarn tension was measured during unwinding from cops to investigate the effect of triangular breaker dimensions on the behaviour of yarn tension and to obtain the suitable dimensions of balloon breaker.

2- EXPERIMENTAL:

2.1 Material Used:

The experiments were carried-out for three cotton yarn counts of Ne 20, Ne 30 and Ne 50 .

2.2 Experimental Design:

A (3^3) factorial design was applied to demonstrate the significant effect of the dimensions of triangular breaker on yarn tension.

The considered factors are:

- Distance between yarn guide and unwinding point on cops surface= D.
- Dimension of cross-section for triangular breaker = C.
- Height of balloon breaker = H.

The above factors were experimentally carried-out and statistically analysed at the following three levels of equal intervals:

	D_1	-1	from the top of cops .
- Unwinding distance (D):	D_2	o	from the middle of cops .
	D_3	+1	from the base of cops .
- Triangle length (C) :	C_1	-1	for triangle length 2.5 cm
	C_2	o	for triangle length 3.5 cm
	C_3	+1	for triangle length 4.5 cm

2.4. Tension Measurements:

Fig. (1) shows the arrangement of the apparatus used for measurements of yarn tension. The yarn is withdrawn from cops by means of take-up drum with a speed of 900 m/min., then the yarn passes through a modified triangular breaker to reduce the value of yarn tension. After that, the yarn is withdrawn through a measuring head (Rotschild) to record an electric signal. The electric signal varied according to the variation in yarn tension. The electric signal from the measuring head was amplified using an amplifier and then the signal was calibrated in force units and recorded on a chart recorder.

The force-time diagram was recorded during unwinding the total amount of yarn from cops. This experiment was repeated for 9 modified balloon breakers with different dimensions. In case of direct withdrawing from cops without using balloon breaker, the cops was adjusted at a distance of 5 cm from yarn guide.

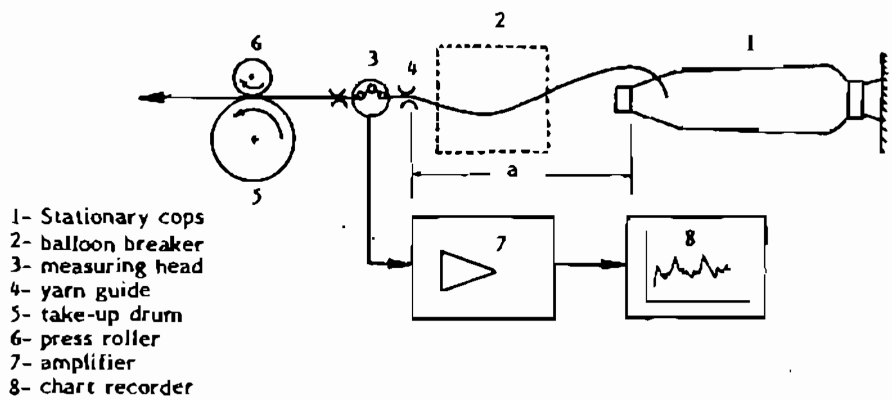

Fig. (1): Arrangement of the apparatus

2.5 Evaluation of Results:

From the recorded chart for yarn tension, the maximum values of tension were calibrated in force units (CN) and drawn as shown in figures(2,3,4 and 6).

3- RESULTS AND DISCUSSION:

The yarn tension results according to the (3^3) factorial design which are shown in table (3). The three factors discussed in this work are considered quantitative. The variance analysis is shown in table (4).

From the quantitative analysis, it is cleared that, the linear and quadratic effect of the unwinding distance (D) and the breaker cross-section dimension (C) are highly signifi - cant for all yarn counts, although the level of significance of the factor (C) seems to be low for Ne 50.

In other words, the value of yarn tension for all yarn counts increases by decreasing the amount of yarn on cops. And at the beginning of unwinding from cops the value of yarn tension is decreased with increasing the cross-section of balloon breaker, as shown in Figs. (2,3 and 4) .

- Height of breaker (H) H_1 -1 for breaker height 5 cm
  H_2 o for breaker height 7 cm
  H_3 +1 for breaker height 9 cm

shown in table (1) is the arragement of the factors which are used in the factorial design

Table (1): Arrangement of the factors

		value of Yarn tension (y_i).								
		C_1 (- 1)			C_2 (o)			C_3 (+1)		
		H_1 (-1)	H_2 (o)	H_3 (+1)	H_1 (-1)	H_2 (o)	H_3 (+1)	H_1 (-1)	H_2 (o)	H_3 (+1)
D_1	(-1)	Y1	Y2	---	Y10	---	---	Y19	--	---
D_2	(o)	---	---	---	---	---	---	---	---	---
D_3	(+1)	---	---	Y9	---	---	Y18	--	--	Y27

2.3. Specification of the dimensions of balloon breaker with triangular cross section

As shown in table (2), 9 modified balloon breakers were manufactured to demonstrate the yarn tension behaviour during unwinding from the spinning cops.

Table (2): Dimensions of the used triangular breakers

breaker No.	dimensions CxH (cm)	Specification
1	2.5 x 5	
2	2.5 x 7	
3	2.5 x 9	
4	3.5 x 5	
5	3.5 x 7	
6	3.5 x 9	
7	4.5 x 5	
8	4.5 x 7	
9	4.5 x 9	

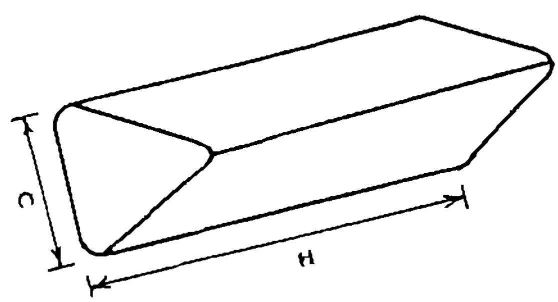

Table (3): Yarn tension results

yarn count Ne	Height of breaker (H)		Triangle length (C) C_1			C_2			C_3		
			H_1	H_2	H_3	H_1	H_2	H_3	H_1	H_2	H_3
20	unwinding distance(D):	D_1	22.1	23.2	16.6	7.7	8.0	8.9	6.5	6.5	5.8
		D_2	26.2	23.5	13.0	10.0	13.0	15.0	13.0	15.0	12.6
		D_3	46.5	47.0	24.7	39.0	32.0	28.0	45.5	36.8	34.0
30		D_1	15.16	13.0	9.7	4.8	4.8	4.9	4.33	4.33	4.8
		D_2	18.3	14.1	13.3	10.8	8.3	8.0	11.7	10.18	8.4
		D_3	27.7	26.0	23.2	23.2	24.5	22.5	300	28.2	25.9
50		D_1	4.3	2.8	4.9	4.1	2.8	3.5	4.3	3.5	3.6
		D_2	9.0	7.3	6.5	7.3	6.0	6.5	8.6	6.9	6.7
		D_3	15.6	17.7	14.5	15.6	16.5	18.3	21.7	19.5	20.8

The linear component of the breaker height (H), is highly significant for the yarn counts of Ne 20 and 30 and its quadratic effect is signifcant only for Ne 20. This can be noticed in Figs. (2 and 3), where the level of yarn tension for all cross-sections of balloon breakers increases with decreasing the height of balloon breakers. Neither quadratic effect of breaker height is significant for the discussed counts, except that for Ne 20 .

The interaction effects of each two factors shows that, the interaction of unwinding distance (D) with the breaker dimension (C), involving the linear component of both factors is highly significant for all yarn counts, while the quadratic effect of (D) with the linear effect of (C) approaches significance at the 10% level for Ne 30 and 50 only. All interactions of breaker height (H) and dimension (C) are significant for yarn count of Ne 20 and their interactions involving linear component of breaker height (L_H) are also significant for Ne 30, while all their interactions for Ne 50 are not significant. None of the (DxH) interactions are significant for all discussed count, except that which involves their linear components ($L_D L_H$) for Ne 20.

The Two-way tables which are given in table (5), shows that, the unwinding distance (D) has a significant effect on the values of yarn tension whatever the condition of the other factors and its maximum values were obtained at D_3. There is a sharp peak at this level which is responsible for the large linear component of D. which is in fact the largest single effect. From the (HC) table, it is noticed that, the minimum tension values are obtained at the highest level of (H) with the middle level of (C) for both yarns of Ne 20 and Ne 30, but for Ne 50, the minimum yarn tension obtained either at (H_2 with C_2) or at (H_3 with C_1). From the other hand, it is important therefore to consider the unwinding tension behaviour by using the different balloon breakers shown in Figs. (2,3 and 4). From these figures it is noticed that, at the beginning of unwinding from cops, there are different breakers acting to reduce the yarn tension to a minimum value, such that, breaker No 9 (4.5 x 9 cm) for Ne 20, breaker NO 7 (4.5 x 5 cm) or 8 (4.5 x 7 cm) for Ne 30 and breaker No 2 (2.5 x 7 cm) or 5 (3.5 x 7 cm) for Ne 50. While at the end of unwinding from cops, the breaker No 3 (2.5 x 9 cm), acts to reduce the yarn tension to a minimum values. Thus, it is essential therefore to choose the best breaker and the differences in the yarn tension levels at the beginning and end of unwinding must be studied.

Source of Variation		Mean Squares			Variance Ratio		
Yarn Count Ne		20	30	50	20	30	50
1- Main Effects:							
- Unwinding Distance (D),	L	2983.1	1511.4	887.6	534.85***	1590.52***	739.66***
	Q	5542.2	154.36	76.8	102.46***	162.43***	64.0***
- Traingle Length (C),	L	250.1	60.72	9.38	46.24***	63.91***	7.81**
	Q	232.7	78.57	5.35	43.02***	82.70***	4.46*
- Height of Breaker (H),	L	219.3	36.77	1.5	40.64***	38.7***	1.25
	Q.	20.3	0.0001	1.78	3.75*	0.001	1.48
2- Two-Factor interactions: -Unwind-Distance and Triangle							
Length (DxH)	$L_D L_H$	128.7	1.3	0.16	23.79***	1.36	0.13
	$Q_D L_H$	13.57	1.59	3.0	2.5	1.67	2.5
	$L_D Q_H$	1.03	0.63	1.32	0.19	0.66	1.26
	$Q_D Q_H$	0.01	2.23	0.07	0.002	2.4	0.06
- Unwind-Dist. and Height of							
Breaker (DxC)	$L_D L_C$	141.45	85.54	18.25	26.15***	90.04***	15.2***
	$Q_D L_C$	0.02	4.84	6.08	0.003	5.1*	5.06*
	$L_D Q_C$	0.69	0.13	1.14	0.13	0.13	0.95
	$Q_D Q_C$	3.77	0.0003	0.006	0.7	0.0003	0.005
- Height of Breaker and Triangle							
Length (HxC)	$L_H L_C$	64.87	5.98	0.02	11.99***	6.29**	0.01
	$Q_H L_C$	42.46	0.1	1.24	7.85**	0.1	1.03
	$L_H Q_C$	31.17	6.7	2.3	5.76**	7.05**	1.9
	$Q_H Q_C$	19.85	0.1	0.17	3.66*	0.1	0.14
3- Three-Factor interactions (DxCxH)		5.41	0.95	1.2			

(***) significant at 99 %
(**) " " at 95 %
(*) " " at 90 %

Table (5). The two-way tables.

Yarn count Ne	D x H					D x C					H x C				
		H_1	H_2	H_3	Sum		C_1	C_2	C_3	Sum		C_1	C_2	C_3	Sum
20	D_1:	36.3	37.7	31.3	105.3	D_1:	61.9	24.6	18.8	105.3	H_1:	94.8	56.7	65	216.5
	D_2:	49.2	48.1	35.6	132.9	D_2:	62.7	29.6	40.6	132.9	H_2:	93.7	49.6	58.3	201.6
	D_3:	131	115.8	86.7	333.5	D_3:	118.2	99	116.3	333.5	H_3:	54.3	46.9	52.4	153.6
	Sum:	216.5	201.6	153.6	571.7	Sum:	242.8	153.2	175.7	571.7	Sum:	242.8	153.2	175.7	571.7
30	D_1:	24.73	22.13	19.4	66.26	D_1:	38.3	14.5	13.46	66.26	H_1:	61.6	38.8	46.03	146.43
	D_2:	40.8	32.58	29.7	103.08	D_2:	45.7	27.1	30.28	103.08	H_2:	53.1	37.6	42.71	133.41
	D_3:	80.9	78.7	71.6	231.2	D_3:	76.9	70.2	84.1	231.2	H_3:	46.2	35.4	39.1	120.7
	Sum:	146.43	133.41	:20.7	400.54	Sum:	160.9	111.8	127.84	400.54	Sum:	160.9	111.8	127.84	400.54
50	D_1:	12.7	9.1	!2	33.8	D_1:	12	10.4	11.4	33.8	H_1:	28.9	27	34.6	90.5
	D_2:	52.9	20.2	19.7	64.8	D_2:	22.8	19.8	22.2	64.8	H_2:	27.8	25.3	29.9	83.0
	D_3:	52.9	53.7	53.6	160.2	D_3:	47.8	50.4	62	160.2	H_3:	25.9	28.3	31.1	85.3
	Sum:	905	83.0	85.3	258.8	Sum:	82.6	80.6	95.6	258.8	Sum:	82.6	80.6	95.6	258.8

Fig. (5) shows the difference in the level of yarn tension along cops length for different yarn counts. As a general trend the difference in yarn tension increases with increasing the cross-section of balloon breaker. For yarn counts of Ne 20 and 50 the minimum difference in tension level is by using balloon breaker Ne 3 (2.5x9 cm). And the difference in tension level is minimum for yarn count Ne 30 by using balloon breaker No 1 (2.5x5 cm) or 2 (2.5x7 cm) or 3 (2.5x9 cm). For all balloon breakers the level of the difference in yarn tension and the rate of fluctuation for these differences increase with increasing the yarn linear density.

Fig. (6) shows the behaviour of yarn tension along cops length without using balloon breaker. The values of yarn tension at the end of unwinding from cops can be reduced up to 50% when a suitable balloon breaker is used.

CONCLUSION:

From the measurements and discussion the following conclusions can be drawn.

- The spinning cops dimensions have a significant effect on the behaviour of yarn tension. To reduce the difference in the level of yarn tension along cops length a suitable dimensions of the cops must be used.

- It was statistically found that the dimensions of balloon breaker affect significantly yarn tension during unwinding from cops, specially for yarns of high linear densities.

- It is preferable to use a balloon breaker with small cross-section, because the value of yarn tension increases with increasing the dimensions of the rotating yarn balloon during unwinding from cops.

* It was found that the balloon breaker NO 3 (2.5x9 cm) is considered the most suitable form, because this breaker reduces the yarn tension and with a small difference in the level of tension along cops length.

REFERENCES:

/1/	Walz & Gyler	Ablaufverhältnisse an Kreuzspulmaschinen mit hoher Fadengeschwindigkeit II, Textil. Praxis 12/1957, S. 1202.
/2/	Walz & Gyler	Ablaufverhältnisse an Kreuzspulmaschinen mit hoher Fadengeschwinchigkeit III, Textil Praxis 1/1958, S. 36.
/3/	Neuhaus, L.	Zur Durchfärbung Von Färbspulen, Textil Praxis 4/1971, S. 230 .
/4/	Shahin, A.	Analysis of the residual yarns in the doffed packages from warp creel, Bulletin of the Faculty of Engineering, EL-Mansoura University, Vol. 13 No. 2 December 1988 .
/5/	Walz & Gyler	Ablaufverhältnisse an Kreuzspulmaschinen mit hoher Fadengeschwindigkeit I, Textil Praxis 10/1957, S. 965 .
/6/	Shahin, A.	Effect of the shape for balloon breaker on yarn tension during unwinding from cops, under issue.

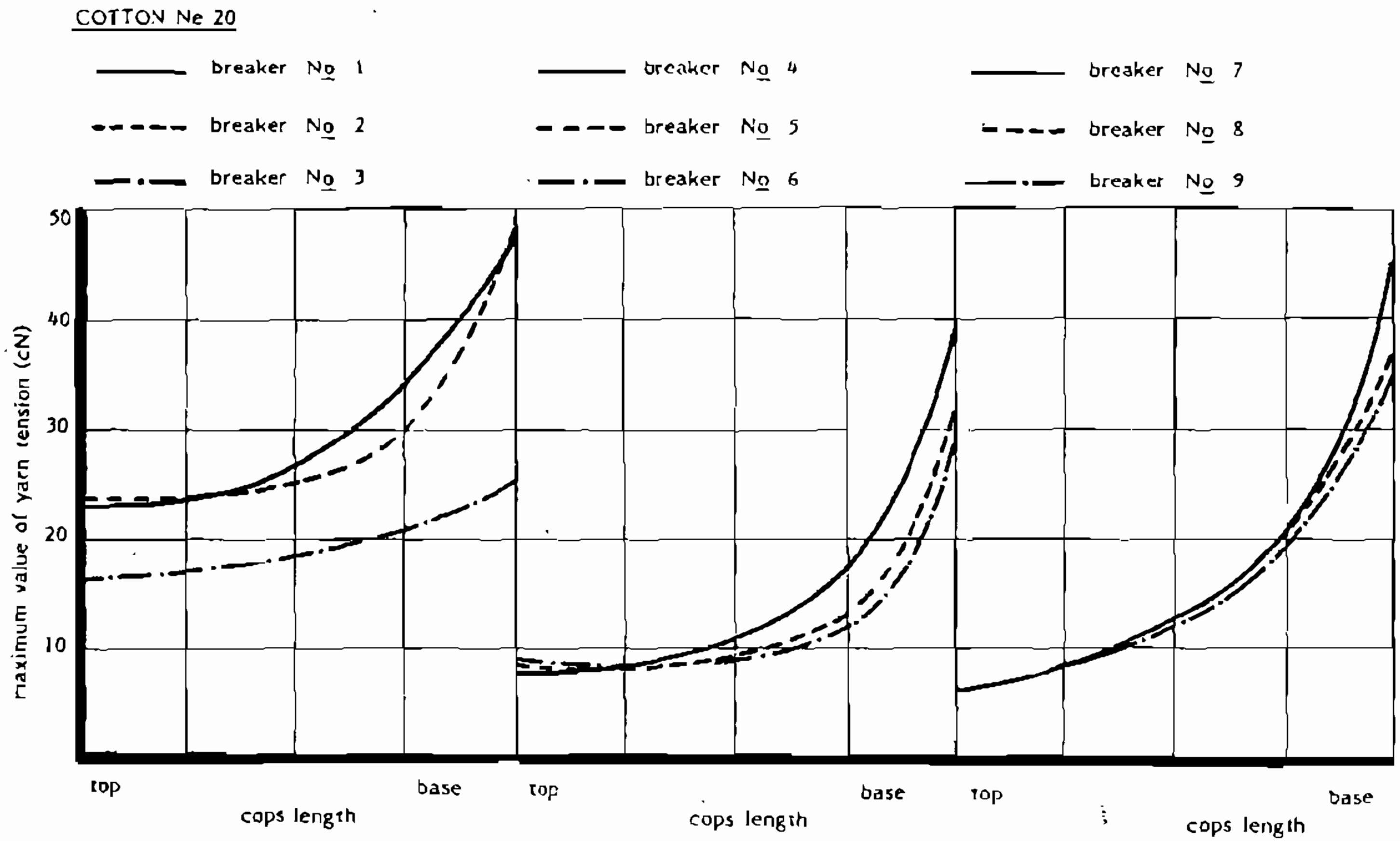

Fig.(2): Maximum values of yarn tension versus cops length for different dimensions of triangular breaker

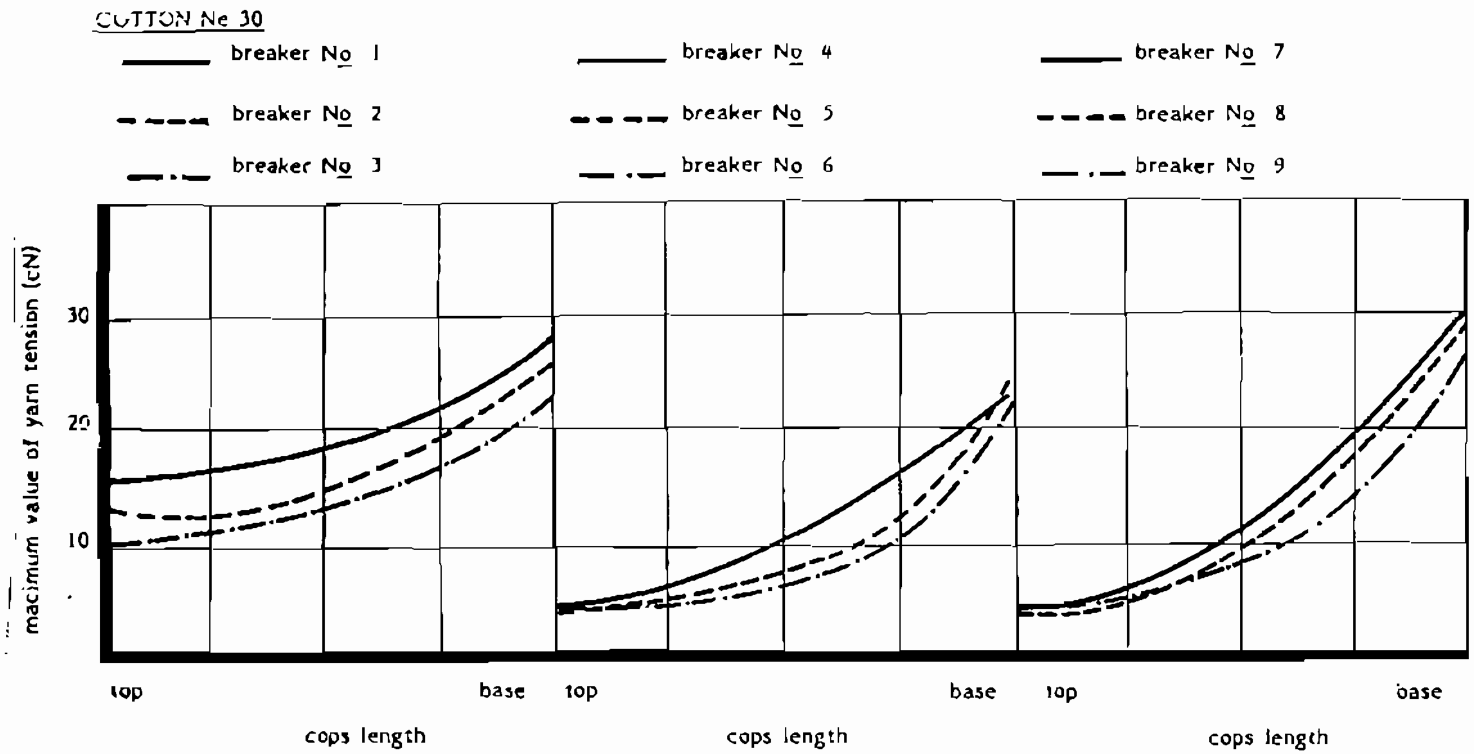

Fig. (3) : Maximum values of yarn tension versus cops length for different dimensions of triangular breaker

Mansoura Engineering Journal (MEJ) Vol. 14, No. 1, June 1989

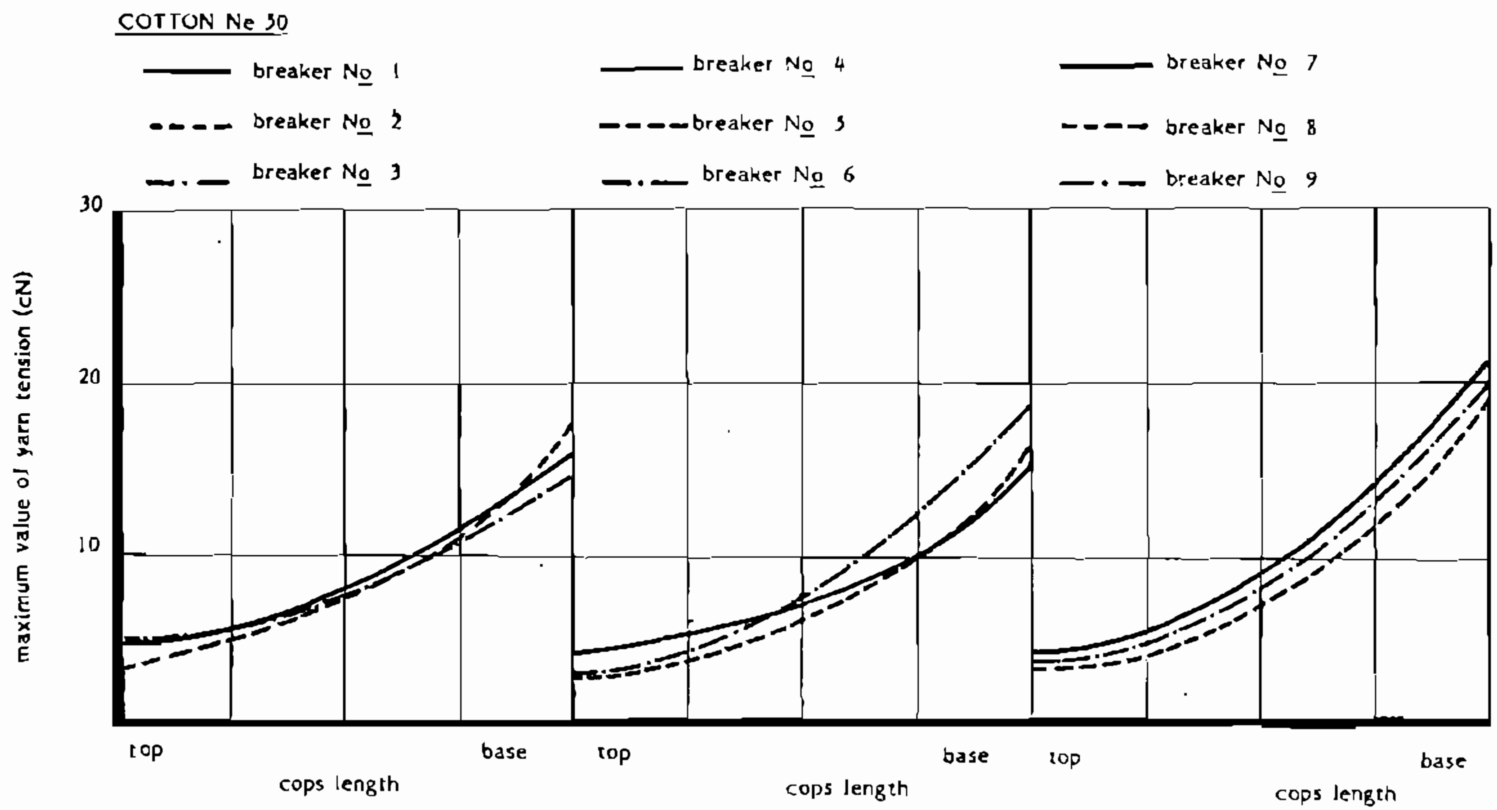

Fig.(4): Maximum values of yarn tension versus cops length for different dimensions of triangular breaker

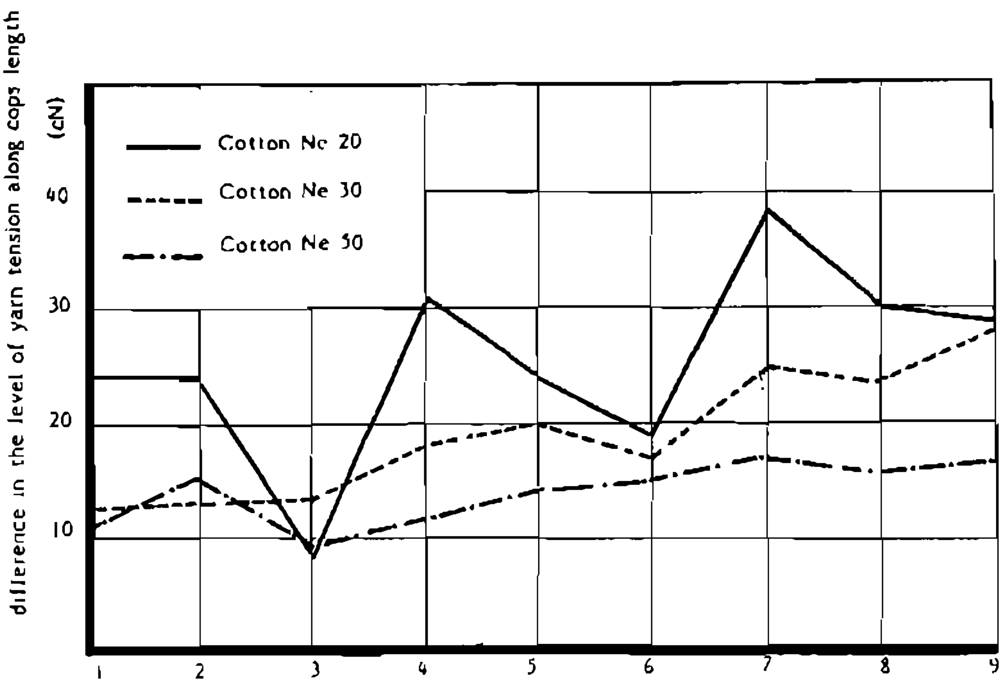

Fig.(5): Differene in the level of yarn tension versus balloon breaker No

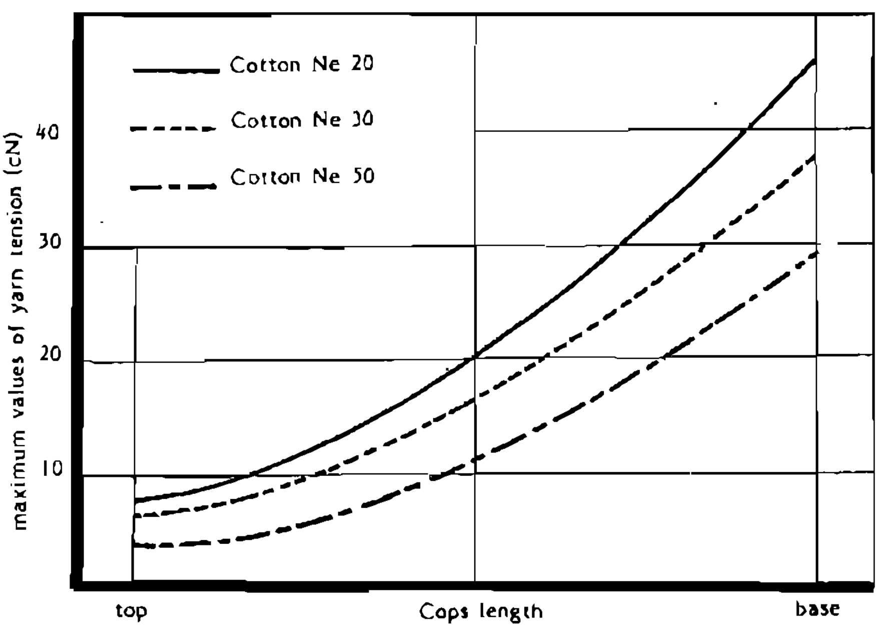

Fig.(6): Maximum yarn tension versus cops length (without using balloon breaker)