AN INVESTIGATION OF SPINNING WINDING LINKAGE SYSTEM

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ABSTRACT

The modern arrangement in the spinning mill is to link a spinning machine to a winding machine. This affects both the flexibility and economics of the yarn formation process. In this study the factors affecting the work of such systems are investigated.

1. INTRODUCTION

The demand of the textile markets needs processing of various types of yarns in small lots and short cycle production. In the other words, it needs quick response of the spinning mill. This makes some disturbances in the spinning production lines which may lead to the occurrence of the mixed ends, and in consequence the deterioration of the product quality.

A linkage system is a spin-winder which connects one spinning frame with one automatic winder directly. This linkage should satisfy the following aspects: flexible manufacturing system, saving in the floor space, labour saving, quality improvement, easy maintenance, and peripheral equipment cost saving.

The aim of the present work is to study the problems of the linkage balance specially the determination of the necessary number of spindles which can be linked with an automatic winding machine as well as to investigate the effect of the different processing parameters on the linkage balance.

2. CALCULATION OF THE LINKAGE BALANCE

In order to calculate the number of the spindles to be served by one winding head under the different spinning and winding conditions, one should balance the production of the spinning machine to that of winding machine linked to it.

2.1. Production of a spinning machine

On that type of links, a spinning machine is usually equipped with an automatic doffing. The total stopping time, in seconds per one running minute, can be calculated in the terms of the following parameters:

- Doffing time and starting a machine, t_d in seconds;
- Time required for piecing the end breaks, t_b in seconds;
- Expected number of the end breaks, per 1000 spindle per hour, P.

The production of one spindle (Ps) in gm./min. is given by:

$$P_s = \frac{T_p x V_d x EFF_s x (1 - c\,\%) x (60 - Tss)}{60000} \qquad (1)$$

Where:

T_p = Yarn count, in tex;
V_d = Yarn delivery speed, mt/min;
EFF_s = Efficiency of spinning machine;
$c\%$ = Yarn contraction due to twist;
T_{ss} = Total stopping time, in sec/run. min.

The parameter T_{ss} can be calculated as following:

$$T_{ss} = \frac{P x T_p + 60 x t_d x T_b x V_d}{60000 x W_b} \qquad (2)$$

Where:

W_b - bobbin weight, in gm.

2.2. Production of a winding head.

Production of a winding head depends on the yarn tex. T_b, winding speed, N_w m/min, winding efficiency, and the total stopping time in one running minute, T_{sw}.

- Time required for changing new bobbins and setting the machine into the operation. The stopping time in sec/run min. due to changing the bobbins, T_1, can be calculated from the following equation:

$$T_1 = \frac{T_b x t_{cb} N_w}{1000 x W_b} \quad (3)$$

- Time required for changing already wound cones and setting a machine into the operation, T_2, can be calculated from the equation:

$$T_2 = \frac{t_{cc} x N_w}{1000 x W_c} \quad (4)$$

3. TOTAL TIME REQUIRED FOR THE YARN CLEARING, (T_3).

This time depends mainly on the required classimat clearing grade, this is the number of defects to be removed during winding (B_{ig}).

$$T_3 = \frac{T_{cl} x B_{ig} x T_b x N_w}{1000 x W_c} \quad (5)$$

Where:

t_{cl} - time required for mending a broken end due to clearing;

B_{ig} - the total number of breaks according to a required classimat clearing grade (per min).

Thus the total stopping time in sec/run.min. in winding will be:

$$T_{sw} = T_1 + T_2 + T_3 \quad (6)$$

Then the production of one winding head, P_w, is calculated as following:

$$p_w = \frac{T_b x N_w x EFF_w X (60 - T_{sw})}{60000} \text{ gm/min} \quad (7)$$

Consequently, from the equations (1 to 7) it is possible to calculate the number of spindles which are required to link with one winding head (N):

$$N = \frac{N_w x EFF_w x (\frac{60 - A}{B})}{\alpha^2 x EFF_s x C x D} \quad (8)$$

Where:

$A = t_{cb} \text{ x } W_c + t_{cc} \text{ x } W_b + t_{cl} \text{ x } B_{ig} \text{ x } W_b) \text{ x } T$ / N_w

$B = 1000 \text{ x } W_c \text{ x } W_b$

$$C = \frac{V_d}{(1 - 9 x T_b^{\frac{1}{2}} x 10^{-6})}$$

$$D = 60 - \left[\frac{P x t_b + 60 x t_d x T_b x V_d}{6000 \text{ x } W_b} \right]$$

α = Twist factor ($t_p$cm$\sqrt{tex}$)

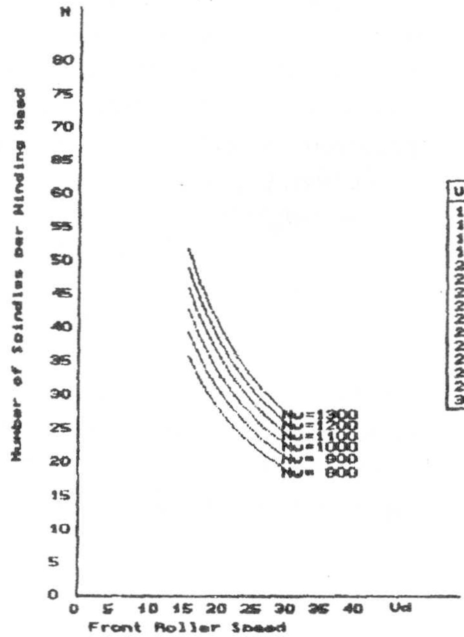
From the equation (8) it is clear that the m important parameters which determine the number spindles to be linked with one winding head are:

- Front roller speed, V_d;
- Winding speed, N_w;
- Efficiency of a winding machine;
- Cone weight, W_c;
- End breaks on both spinning and winding machin
- Machine efficiencies.

A computer program was developed to anal graphically the effect of different variables.

4. INFLUENCE OF A WINDING MACHI PARAMETERS ON A LINKAGE BALANCE

It is a common practice to change the parameters a spinning machine and winding machine to suite eit the produced yarn count or requirement of next proc (winding speed, weight of wound cone, efficiency winding). Figures (1,2,3) give the change of t number of spindles per a winding head as a function front roller speed of a spinning machine linked to winding machine at the different levels of windi speed. From Fig. (1) it is clear that the relati between the number of spindles per a winding he decreases as delivery speed increases. This is a ma factor affecting the balance between a spinni machine and winding machine. This will impose a ne parameter since the delivery speed varies with t processing yarn count. Consequently, the designing the link balance should take into consideration t range of count processed. The winding machi efficiency is affected by a number of stops required change a spinning package and number of the ya defects to be removed during winding. Fig. (2) sho the effect of a winding machine efficiency on a numb



Nw	tex	Wb	Wc	TCon	Rig	ktex
1000	18.7	95	1000	5	100	33.5
EFFs	EFFw	tdof	tcb	tclr	tpce	EB
0.82	0.75	150	7	5	5	40.0

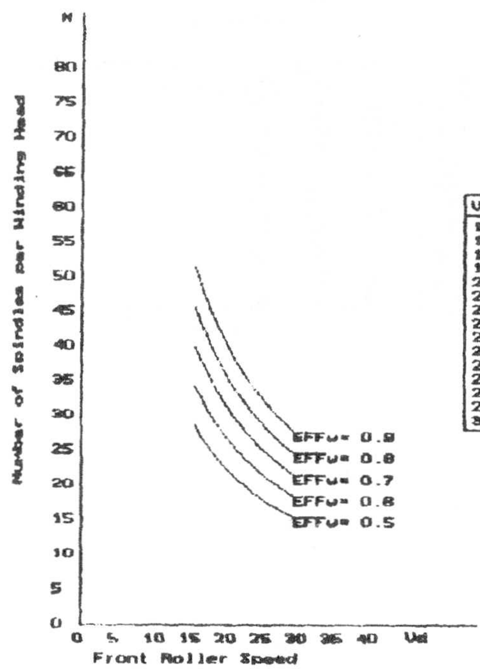
Table (1A)

Number of Spindles per Winding Head

Ud	800	900	1000	1100	1200	1300
16	36	39	43	46	49	52
17	34	37	40	43	46	49
18	32	35	38	41	44	46
19	30	33	36	38	41	44
20	29	32	34	37	39	41
21	27	30	33	35	37	39
22	26	29	31	34	36	38
23	25	28	30	32	34	36
24	24	26	28	31	33	35
25	23	25	26	30	31	33
26	22	24	26	28	30	32
27	21	23	25	27	29	31
28	21	23	25	26	28	30
29	20	22	24	26	27	28
30	19	21	23	25	26	28

Table (1B)

Figure 1.



Nw	tex	Wb	Wc	TCon	Rig	ktex
1000	18.7	95	1000	5	100	33.5
EFFs	EFFw	tdof	tcb	tclr	tpce	EB
0.82	0.75	150	7	5	5	40.0

Table (2A)

Number of Spindles per Winding Head

Ud	0.5	0.6	0.7	0.8	0.9
16	29	34	40	46	51
17	27	32	36	43	48
18	25	30	36	41	46
19	24	29	34	38	43
20	23	27	32	37	41
21	22	26	31	35	39
22	21	25	29	33	37
23	20	24	28	32	36
24	19	23	27	31	34
25	19	22	26	29	33
26	18	21	25	28	32
27	17	20	24	27	31
28	16	20	23	26	30
29	16	19	22	25	29
30	15	18	21	25	28

Table (2B)

Figure 2.

Figure (3) represents the effect of a cone weight on a number of the spindles per a winding head which has practically no significant effect.

Figure (4) gives the influence of change of the yarn count in the range from 6 to 36 tex. The processed count will affect greatly the number of spindles per a winding head, this besides the change of the nature of the yarn imperfection which will affect winding efficiency.

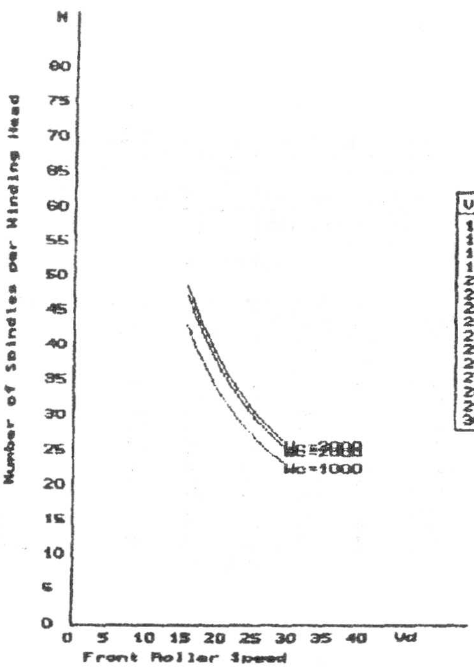
Finally, the efficiency of a spinning machine will vary due to the rate of the end breaks and other machine stoppages. Figure (5) indicates the significant effect of a spinning machine efficiency. This situation simulates the case of sudden change in the yarn quality increasing the number of the yarn imperfection to be removed during winding, Figure (6).

From the above analysis it is clear that for a certain linkage of a certain number of spindles t predetermined number of winding heads will subje a problem of linkage disbalance due to the chang the above parameters. The operator should ch these parameters in order to run the link balance. following parameters should be controlled accordi processing conditions and produced yarn quality:

- delivery speed;
- winding speed.

In the above analysis, it is assumed to have stop time constant.

The linkage is one step in a system for a comple interlined spinning mill for which the problem of interline not only in regard to interlined proce steps and processing levels of the yarn manufac should be solved, but also through all levels supervisory and monitory hierarchy.



Nw	tex	Wb	Wc	TCon	Big	etex
1000	18.7	85	1000	5	100	28.5
EFFs	EFFw	tdof	tcb	tclr	tpce	EB
0.82	0.75	150	7	5	5	40.0

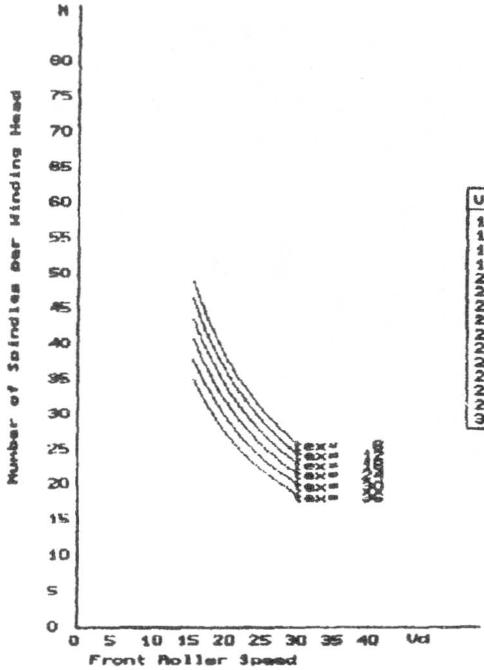
Table (3A)

Number of Spindles per Winding Head

Vd	1000	2000	3000
16	43	47	48
17	40	44	46
18	39	42	43
19	38	40	41
20	34	38	39
21	33	36	37
22	31	34	35
23	30	33	34
24	29	32	33
25	28	30	31
26	26	29	30
27	25	28	29
28	25	27	28
29	24	26	27
30	23	25	26

Table (3B)

Figure 3.

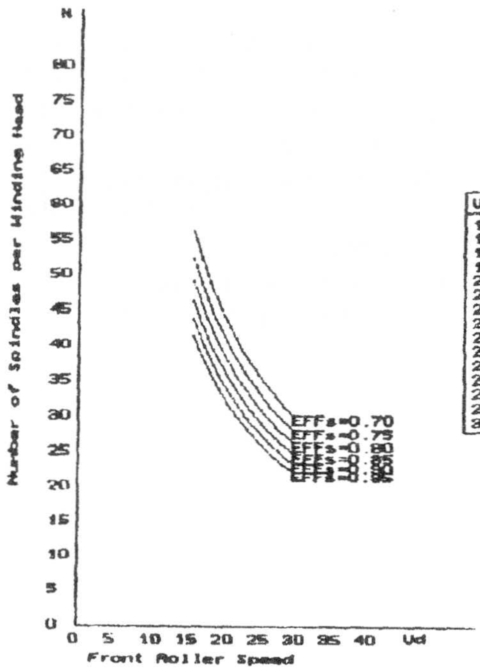


Nw	tex	Wb	Wc	TCon	#ig	ktex
1000	19.7	95	1000	5	100	33.5
EFFs	EFFw	tdof	tcb	tcir	tpce	EB
0.82	0.75	150	7	5	5	40.0

Number of Spindles per Winding Head

Ud	6	12	18	24	30	36
16	48	46	44	41	38	35
17	46	44	41	38	36	33
18	44	41	39	36	34	31
19	41	39	37	34	32	30
20	39	37	35	33	30	28
21	37	35	33	31	29	27
22	36	34	32	30	28	26
23	34	32	30	28	26	24
24	33	31	29	27	25	23
25	31	30	28	26	24	23
26	30	29	27	25	23	22
27	29	28	26	24	23	21
28	28	27	25	23	22	20
29	27	26	24	23	21	20
30	26	25	23	22	20	19

Figure 4.

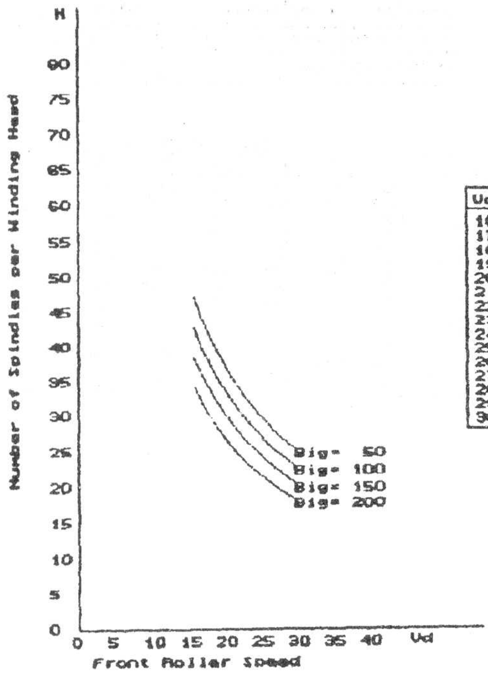


Nw	tex	Wb	Wc	TCon	#ig	ktex
1000	19.7	95	1000	5	100	33.5
EFFs	EFFw	tdof	tcb	tcir	tpce	EB
0.82	0.75	150	7	5	5	40.0

Number of Spindles per Winding Head

Ud	0.70	0.75	0.80	0.85	0.90	0.95
16	56	52	49	46	44	41
17	53	49	46	44	41	39
18	50	47	44	41	39	37
19	47	44	41	39	37	35
20	45	42	39	37	35	33
21	43	40	38	36	33	32
22	41	38	36	34	32	30
23	39	37	34	32	31	29
24	38	35	33	31	29	28
25	36	34	32	30	28	27
26	35	32	30	29	27	26
27	34	31	29	28	26	25
28	32	30	28	27	25	24
29	31	29	27	26	24	23
30	30	28	26	25	23	22

Figure 5.



Nw	tex	Wb	Wc	TCon	Big	xtex
1000	19.7	85	1000	5	100	29.5
EFFs	EFFw	tdof	tcb	tcir	tpce	E8
0.82	0.75	150	7	5	5	40.0

Number of Spindles per Winding Head

Ud	50	100	150	200
16	47	43	38	34
17	44	40	36	32
18	42	38	34	30
19	40	36	32	28
20	38	34	31	27
21	36	33	29	26
22	34	31	28	25
23	33	30	27	24
24	32	29	26	23
25	30	28	25	22
26	29	28	24	21
27	28	25	23	20
28	27	25	22	20
29	26	24	21	19
30	25	23	21	18

Figure 6.

CONCLUSION

The formula for the determination of a number of spindles per a winding head is given for various parameters of both spinning and linked winding machines.

From the above analysis it can be concluded that the balance of the linkage is possible only for the designed range of parameters.

Proper choice of winding speed and delivery roller speed may put the linkage in a balance.

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