FABRICATION OF ELECTRO-MAGNETIC TENSIONER

A PROJECT REPORT

Submitted by

M.SUJIVAN	71205212049
V.VASUPRATHA	71205212052
VISHNU SAJAN	71205212054
ARUN VARMA	71205212302

In partial fulfillment for the award of the degree

of

BACHELOR OF TECHNOLOGY

in

TEXTILE TECHNOLOGY

KUMARAGURU COLLEGE OF TECHNOLOGY,

COIMBATORE

ANNA UNIVERSITY: CHENNAI 600 025

ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report **"FABRICATION OF ELECTRO-MAGNETIC TENSIONER"** is the bonafide work of **"M.SUJIVAN, V.VASUPRATHA, VISHNU SAJAN & ARUN VARMA"** who carried out the project work under supervision.

SIGNATURE
DR. LOUIS D'SOUZA
PROFESSOR AND HEAD
DEPARTMENT OF TECHNOLOGY
KUMARAGURU COLLEGE OF TECHNOLOGY
COIMBATORE - 641 006

SIGNATURE
DR. K. THANGAMANI
SUPERVISOR
Asst. PROFESSOR
DEPARTMENT OF TEXTILE TECHNOLOGY
KUMARAGURU COLLEGE OF TECHNOLOGY
COIMBATORE – 641 006

For Viva-Voce examination held on 30/04/2009

30/4

30/4/09

EXTERNAL EXAMINER

ACKNOWLEDGEMENT

ACKNOWLEDGEMENT

We are the students of this project, give our entire honor to '**THE LMIGHTY**' for blessing this combined works of our hand.

We wish to thank **OUR PARENTS** for their constant encouragement, elp rendered and making all the facilities to carry out this project.

We are grateful to our President Prof. **C.RAMASAMY**, Principal **Dr. JOSEPH V. THANIKAL**, and Vice Principal **Dr.M.ANNAMALAI** for providing the opportunity to carry out this project.

Our whole hearted thanks to **Dr. LOUIS D'SOUZA,** Head of the department, Textile Technology for his optimal encouragement and guidance.

We would like to show our gratitude to **PROF.S.KATHIRVELU**, Department of Technology, who has coordinated us throughout the project.

We express our sincere gratitude to our beloved Guide **DR.K.THANGAMANI**, Asst. Professor, Department of Textile Technology, who provided us a complete guidance in successfully finishing this project.

We would be failing in our duty if we do not express our bountiful thanks to the Management of **RESHMI INDUSTRIES**, Coimbatore who helped us to study the current types of tensioners available and help us in manufacturing the new Electro-magnetic tensioner with our ideas and their technology.

We profusely thank the chief engineer **MR. SAMPATH KUMAR** for helping bridge our theoretical and practical knowledge in-spite of his busy schedule.

We also like to say our hearty thanks to **MR. K.B. SAJAN** for his co-operation and assisting us in the completion of the project.

ABSTRACT

ABSTRACT

In 21st century, all the textile process machines usually posses online monitoring and control system and the process of winding is no exception to it. The winding tension is also monitored and controlled on line in modern Autoconer winding machines apart from the parameter such as production, efficiency and objectionable fault clearance. But no such device exists on non automatic high-speed winding machine, which is still used extensively in India for winding of spun yarn from ring cops.

Tension Control being an important parameter for retaining yarn elasticity, reducing tension breaks and getting uniform build of the package, an attempt has been made in this project to design and develop an "Electro-magnetic tensioner" in high speed winding machine and to study its performance.

The Electro-magnetic tensioner works on the principle of "Electro-Magnetic Induction"

The study conducted on the Electro-Magnetic tensioner reveals that

1) The variation is reduced from present level of 35-45% for disc type tensioner to around 15-18% during the full cop unwinding.

2) A reduction in breakage rate of 15% is expected to the result in increase in efficiency.

3) A reduction in average tension also provides the scope for the increase in

CONTENTS

INTRODUCTION

1. INTRODUCTION:

In the high speed winding like rotoconer, winding tension is not maintained constant and it varies depending upon the supply package shape, position and dimension. The Electro-magnetic tensioner works on the principle of "Electro-magnetic induction" which says "The emf in any closed circuit is equal to the time rate of change of the magnetic flux through the circuit".

The variation in tension is quite significant, which is to the tube 40-50% and also increases with increase in winding speed. Towards retaining yarn elasticity, optimizing the winding speed and achieving less breakage and uniform build of the package maintenance of winding tension is very essential. The Electro-magnetic tensioner is more accurate than all the other tensioners available in the market.

In India, many spinning industries still use non - automatic winders, because it is less capital expensive. Electro-magnetic tensioner can be used in Post-spinning and sewing thread winders. This tensioner can be used for all types of yarn of any count.

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE:

In winding process, to get a firmly built package of cone or cheese, which can unwind well in subsequent process, certain level of tension should be maintained on the yarn apart from applying pressure on the package. This is practically of the order of 8-10% of single yarn strength of the yarn.

Disc type of tensioner is used for spun yarn and Gate type tensioner is used for filament yarn. Principles of working of each type are dealt in the following sections.

It is generally accepted that the tension of yarn being unwound from a cop or pirn having a long through tube, increases as the package empties, the highest tension occur during the unwinding of the last few yards of the yarn. The friction between the running yarn and the bare tube gradually increases as the tube empties. Any reduction in these variations will be advantageous and a reduction in the large tensions occurring in the base of the packages that could be achieved will result in, less yarn breakages and consequently less wastage.

2.1. VARIOUS TENSION DEVICES:

Yarn tension plays an important role in winding. Too high tension can damage the yarn, whereas too low tension can lead to unstable packages, which will not unwind cleanly. Variations in yarn tension in different parts of a wound package can cause undesirable effects.

Variations in running tension alter the level at which the thin places are removed and so affect the regularity in the final product.

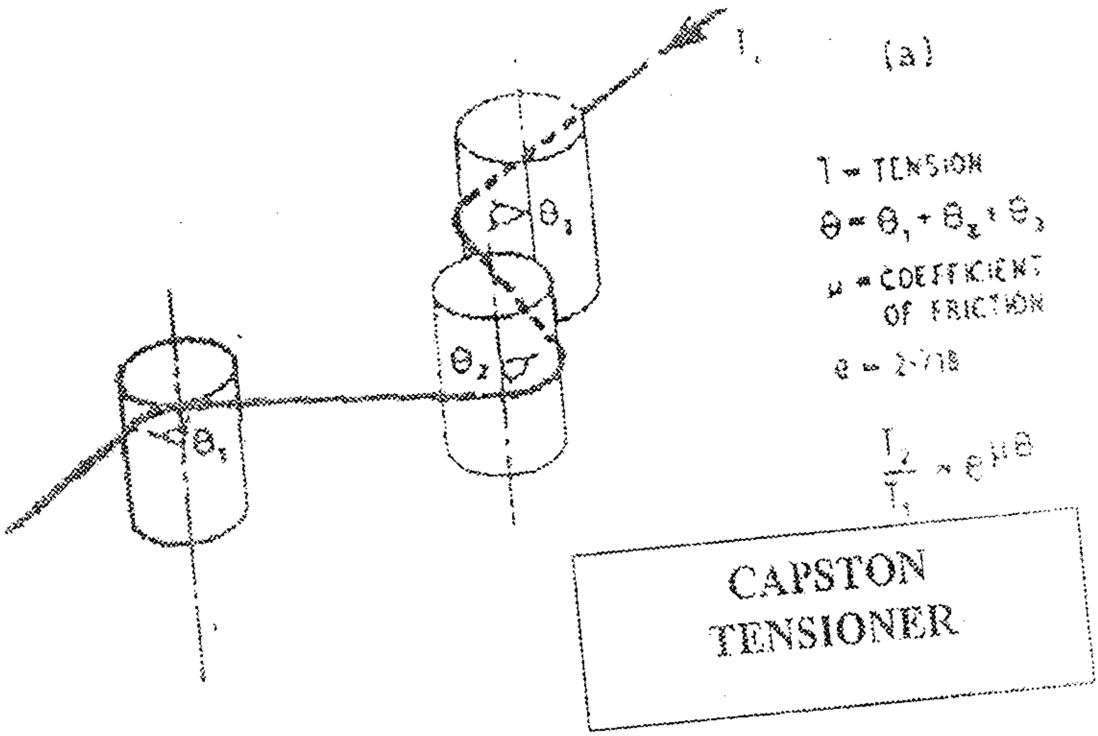
There are many forms of tension devices:

i. Capston
ii. Combined
iii. Compensating

2.1.1. CAPSTON:

It works merely deflecting the yarn around the fixed post. This induces a capston effect, which follows the classical law.

$$\text{Output Tension} = \text{Input Tension} \times e^{\mu T}$$



μ-coefficient friction between yarn

? -angle of lap measured in radians

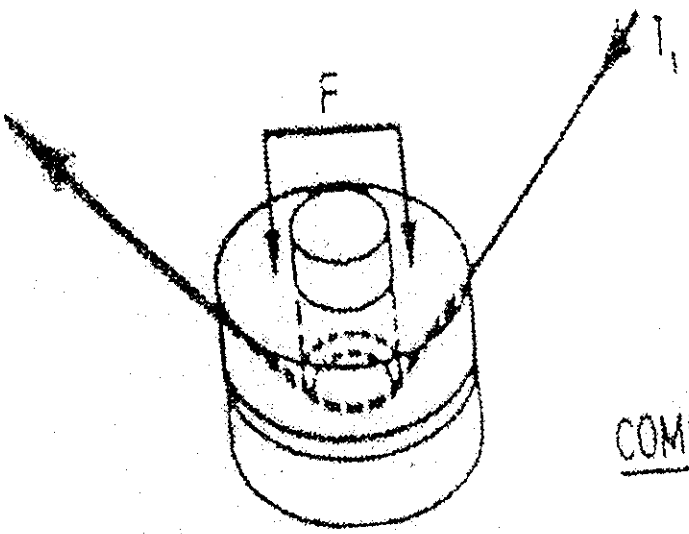
e -2.718

μ, ?, & e are constants.

... is merely a constant multiple of the incoming tension.

2.1.2. COMBINED TENSIONER:

This device permits the tension level to be raised to any desired extent, but they do not permit a reduction in tension, the only way to decrease the tension is to use a positive drive, which tends to over feed these device are seldom used.

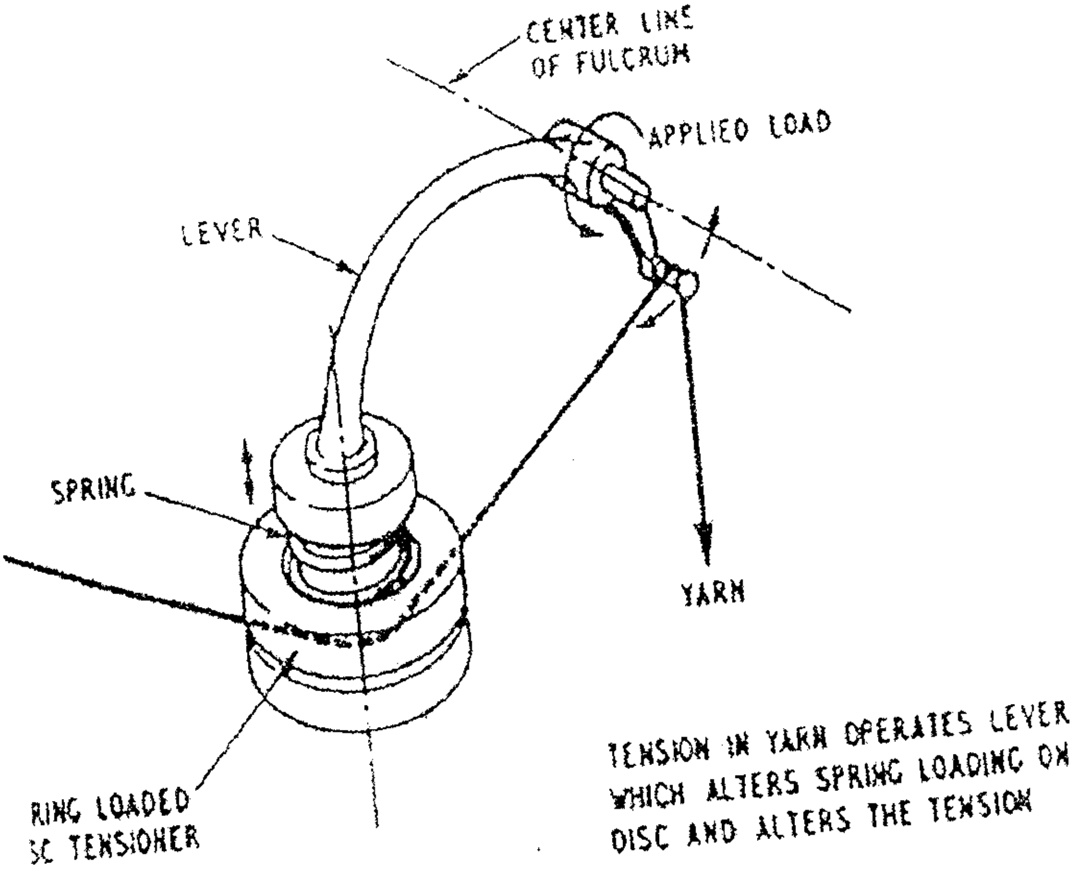


(c)

COMBINED TENSIONER

2.1.3. COMPENSATING TYPE OF TENSIONER:

Lever operated compensator tensioner. The yarn tension operates on the pin at the free end of the lever and alters the amount of load applied in the disc region, which in turn changes the tension. The device is arranged so that when the measured yarn tension is too high, the pressure in the disc region is reduced ... ner level.



2.2. SEVERAL REQUIREMENTS, WHICH INFLUENCES THE CHOICE OF A TENSIONING DEVICE:

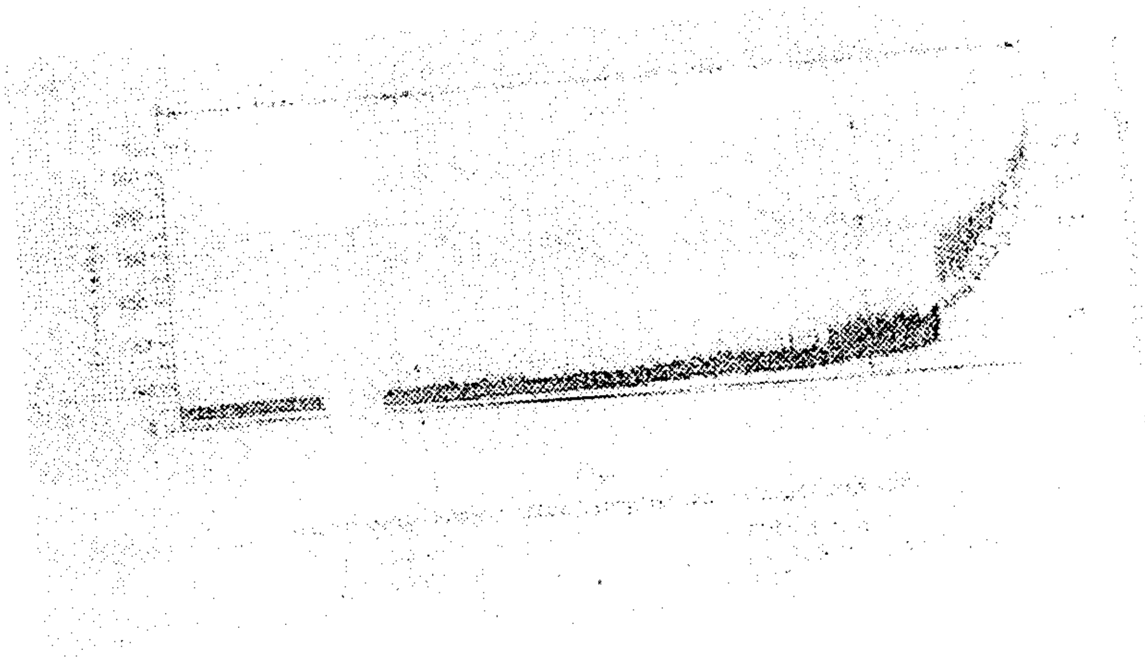
- The device must be reliable
- It must be easily threaded
- It must neither introduce nor magnify tension variation
- It must not introduce difference in twist
- It must not be affected by wear
- It must be easily adjustable

- It must not be affected by the presence of oil or dirt
- It must be capable of easy cleaning
- It must be inexpensive
- The operating surfaces must be smooth.

2.3. GENERAL TENSION CHARACTERISTICS FROM BEGINNING TO END OF COP:

As unwinding proceeded, (from left to right), the tension remained low and quite constant during the unwinding of the body and part of the base,

But, as the base was further unwound, the tension rose with abrupt increase to a maximum value at the end.



= 700yds/min; l= 9.8inches; c= 242.2tex; D= 9inches.

The two principal tensions used in the subsequent analysis are shown n fig and are the average peak tension around the end of the body and the beginning of the base, referred to as the body tension (t) and the peak tension obtained as the last few yards of yarn are unwound, referred to as the base tension (T).

$$\text{Base tension } T^2 = \frac{K(l+D)}{C\, d_c B}$$

Where,

T = base tension in gms

B = whole number immediately below $(l + D) / (l + 0.5)$

d_c = the cop tube diameter in inches

C = yarn count in y.s.w.system

K = speed factor

l = distance from the tube tip to the yarn base in inches

D = the distance from the tube tip to the guide

... in yds/min increases, K increase linearly

SPEED IN YDS/MIN	700	470	230
K	191	119	40

2.4. THE EFFECT OF CHANGES IN UNWINDING CONDITIONS IN BASE TENSION:

- **2.4.1.changes in guide distance:**

The lowest base tension is obtained, with safety, when the guide distance is chosen so that,

1 + D / 1 + 0.5 = 1.0, 2.2, 3.2, 4.2, 5.2.

The base tension increasing as the guide distance increased from the positions represented by these values.

- **2.4.2.changes in tube length:**

No change in tension occurs so long as l + d remains constant unless guide distance is such that a change l alters the value by D. Tests on "3 or 4" long tube have shown only small rises in tension at base. Higher base tensions expected with long tubes and less base tensions with short tubes. Disadvantage in short is the cop breakage during handlings.

- **2.4.3. Changes in base diameter:**

Tension is inversely proportional to the diameter. There is a possibility of reducing the base tension by using the tubes, which has large diameter bases.Trebling the base diameter would reduce the base tension to a third of its original value.

- **2.4.4. Changes in speed:**

There is a limiting speed above which the base tension must exceed the strength of the yarn for any condition of unwinding. The unwinding speed are becoming increasing the popular , mean that these limiting speeds are being approached, resulting end breakages near the cop base, with the possibility of more waste during winding or warping. This danger can be eliminated satisfactorily only by using cop tubes with conical bases.

2.5 VARIATION OF BODY TENSION:

Body tension t = K ? / 4 vC

Where,

C is count in Y.S.W system

? is balloon length in inches

- During unwinding of cop, once a particular number of balloon has been established, no appreciable changes in body tension occurs until the number of balloons changes in spite of the increase in balloon length during the period. Thus the body tension would appear to be independent to balloon length.

- At the changes in number of balloons however the body tension also changes, as the balloon increase in no of body tension decreases but these tension drops are significant only when there are numbers, more than 4 balloons.

- The body tension decreases as the unwinding speed decreases.

- The number of balloon decreases as the unwinding speed decreases.

- The body tension is larger with coarser than with fine counts.

- The number of balloons increases as the guide distance increases, the balloon length tending to reach a constant value when the guide distances is about equal to, and greater than the cop length.

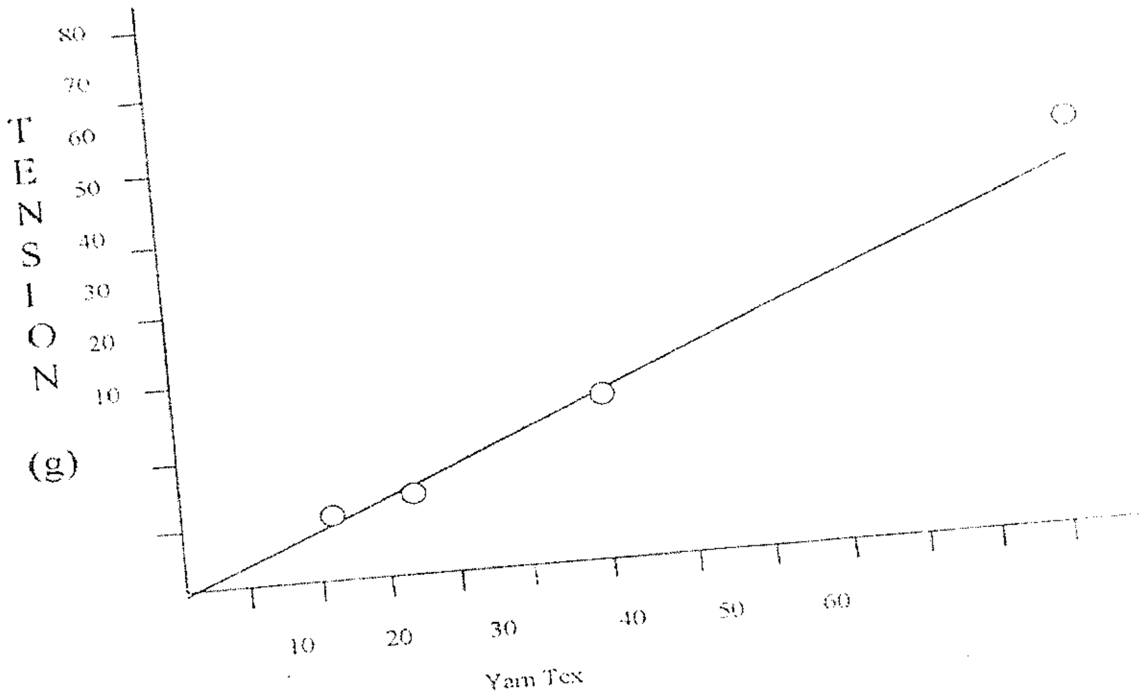
- The tube diameter apparently has no appreciable effect on the body tension.

2.6 FACTORS AFFECTING THE CONDITION OF UNWINDING:

An attempt has been made to isolate and study various factors, which affect the conditions of unwinding. Such factor which affect the conditions of unwinding. Such factors include,

1. The relative position of the supply package and the guide eye.
2. The yarn unwinding speed.
3. The winding and the dimensions of the supply package.
4. The yarn counts.

.7. RELATION BETWEEN THE UNWINDING TENSION AND YARN:



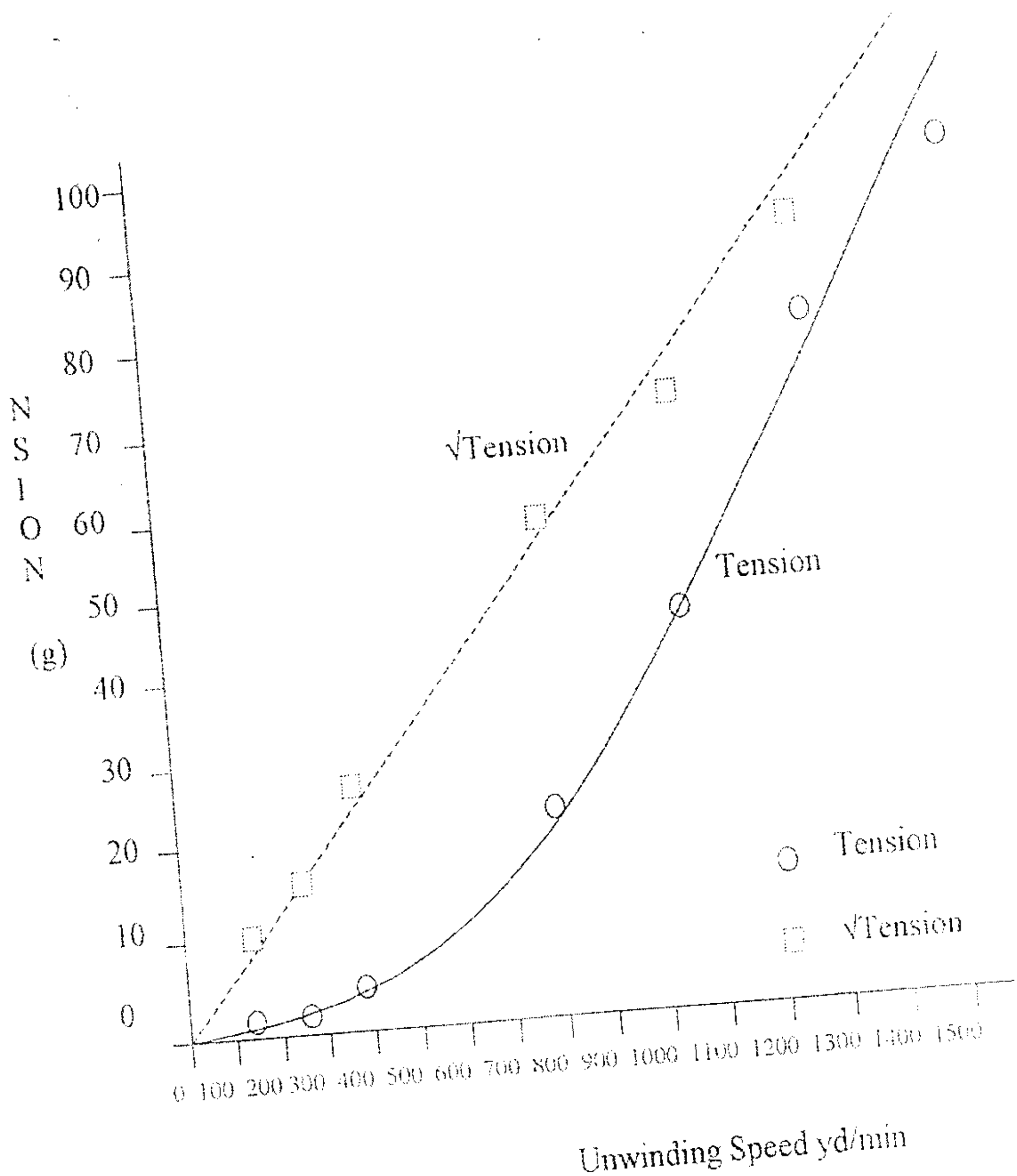
Speed: 500 yds/min; cop lift: 7 inches; guide distance: 6 inches;

Number of yarn loops:1.

The plotted tension is the average peak tension at 80% of empty cop.

The point in the figure, lie closely on a straight line passing through the origin, giving experimental confirmation that the unwinding tension is proportional to ... per unit length.

.8. THE RELATION BETWEEN THE SPEED AND UNWINDING TENSION:



Yarn count: 20s fibre; cop lift: 7 inch; guide distance; 10 inches;

Unwinding Diameter; 22.5 mm; no of balloons: 2

The plotted tension is the average peak tension at 75% empty cop

The tension varies as the square of the unwinding speed, if other unwinding conditions are kept the same. This was verified by plotting the square root of the tension against the speed.

2.9. SHORT – TERM TENSION:

Variation peak tension values occur when winding off at the nose and minimum tensions when winding off at the shoulder of the chase. This is due to the much smaller winding off the radius at the nose. Although unwinding at constant speed.

The shoulder means an increase in the balloon height, the decrease in the radius much greater and thus the peak tensions occurs when unwinding at the nose.

The balloon tension at the guide eye, to be related to the balloon height, Z and the package radius. By the following relationship

$$T O / M V^2 = A + B [Z/a]^2$$

Z/a decides the yarn tension during unwinding, which is highest at the nose and lowest at the base.

Values of the coefficients A, B in the Expression $T = A + B (Z/a)^2$

P^4 is the air resistance parameter

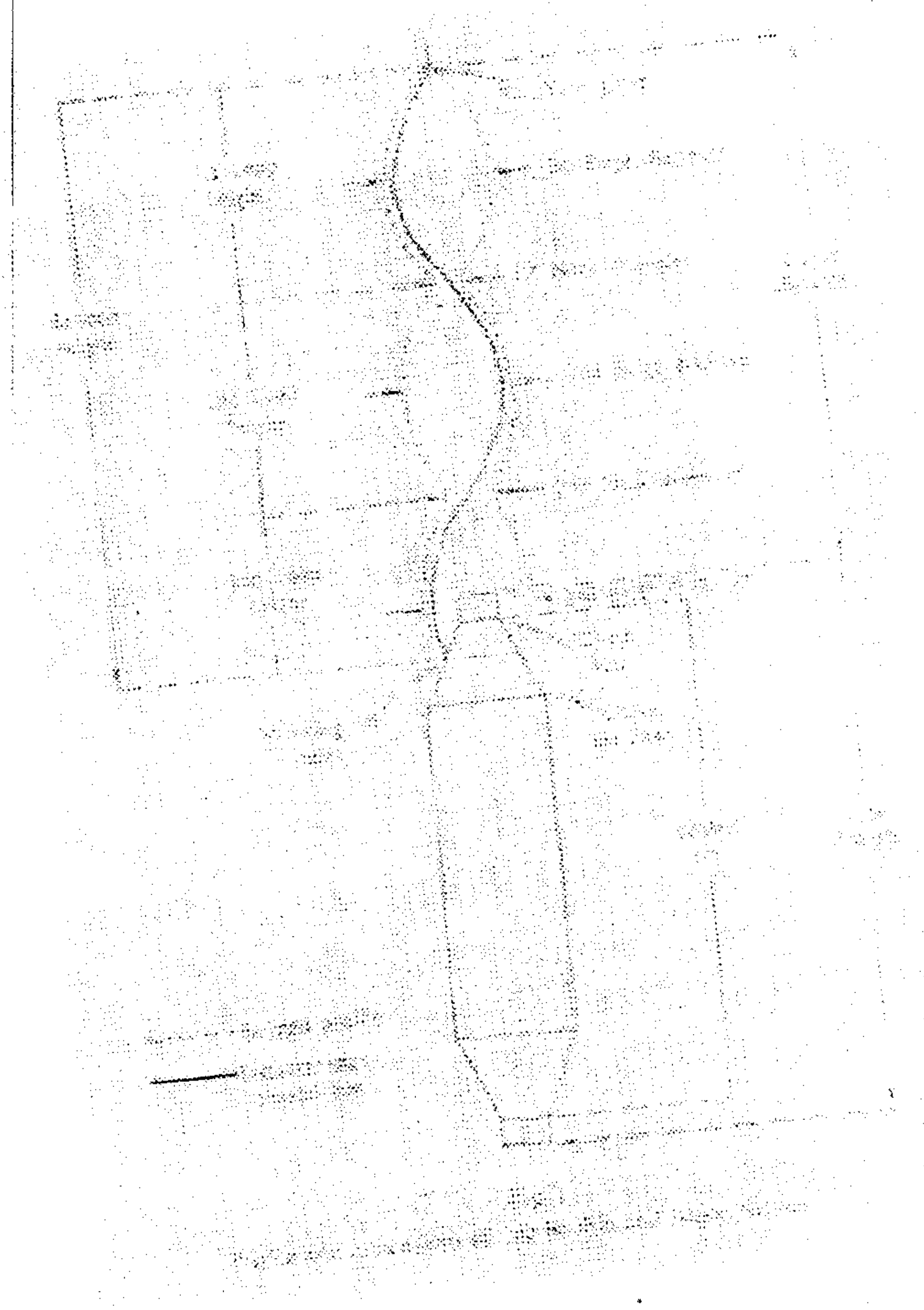
F is the winding angle

$T = T O/ M v^2$

F =	- 20°	-10°	0°	10°	20°
P = 1, A =	5.97	7.80	10.31	14.35	19.45
B =	0.050	0.072	0.102	0.143	0.201
P = 1, A =	4.06	4.97	6.11	8.01	10.63
B =	0.051	0.074	0.106	0.149	0.211
P = 1, A =	3.42	4.03	4.72	5.88	7.36
B =	4.03	0.076	0.110	0.155	0.220
P = 1, A =	3.10	3.56	3.99	4.84	6.22
B =	0.054	0.079	0.112	0.161	0.230

2.10 THEORY OF BALLOONING:

The theory of ballooning suggests that the length of the balloon is a most important guide to the tension set up in the yarn by the ballooning, the longer ... set o conditions.



Yarn was unwound from the base of the cops 10.5" paper tubes at ifferent speeds and a guide was used at different distances from the tube tip, inal balloon formation up to the end of the unwinding was invariably a single balloon.

Moving the guide further away from the cop increased the length of the single balloon until a guide distances was reached at which two balloons resulted.

2.10.1 Guide Distance (D) In Inches At Which The Number Of Balloons:

Changed from 1 to 2

Unwinding Speed(ypm)

Count (Tex)	700 Ypm	467 Ypm	233 ypm
242.2	10.5	10.5	10.5
161.5	10.5	11.5	13.5
107.7	10.5	10.5	11.5
96.9	10.5	11.5	11.5

2.10.2 Guide Distance (D) In Inches At Which The Number Of Balloons Change For 2 to 3:

Unwinding Speed (ypm)

Count (Tex)	700 ypm	467 ypm	233 ypm
242.2	21	21	21
161.5	23	23	24
107.7	21	21	22
96.9	25	24	27

2.10.3. Guide Distance (D) In Inches At Which The Number Of Balloons:

Changed from 1 to 2

Unwinding Speed (ypm)

Distances from cop top to bottom (L in Inches)	700 Ypm	467 ypm	233 ypm
6 ¾	7	8	9
8 ¾	10		
9 ¾	11	11	13
10 ¾	12		
12 ¾	15	15	18

The result shows that the ultimate balloon length when unwinding from through tubes is such as to give the largest no of balloon and at the same ensure that all the necks form in the space between the cop and the guide.

- Several balloons are present between the yarn source and the guide and the necks them are seem to differ in diameter, that nearest the guide being the smallest and the one nearest the yarn source being fairly large. The balloon length when unwinding the last few yards of yarns.

- Longer than the distance from the tube tip to the base of the yarn(l)

- Equal to the distance between guide and the yarn base.(l+D) divided by the largest whole number consistent with

  B = the whole numbers immediately, below l + D/l + (l/2)

  Where, D and l are measured in inches.

2.11. YARN TENSION AND BALLOON SHAPE:

- Number of balloon loops is expected to increase with increasing balloon height.

- Increasing the balloon height would increase the number of balloon loops.

- Lower number of loops occurs as the quantity of the yarn on the package diminishes.

- 3-loops balloon is formed as the start, a double and finally a single loop balloon occurs as unwinding proceeds.

- Increase in balloon height tends to increase in the number of loops.
- Increase in tension will tend to cause a decrease the number of loops.
- Increase in frictional drag due to the lengthening of rubbing parts of the tube, together with the loop height.
- The distance between the guide eye and the winding off position.
- Changed from 10" to 12.5" the actual balloon height changed only from 8.25" to 9.25"
- Due to higher coefficient of friction the value of tension increases.
- Increase of the duration of single-loop loop balloon with the coefficient of friction.

2.12. TENSION VARIATION WITH SHORT GUIDE DISTANCE:

- Mounting supply package about 2" average peak tension is lowest when unwinding starts unwinding the whole package a single loop balloon starts.
- True balloon height increases from 2.5" to 8".
- ... rises only from 5 to 10 gram.

- Tension behaviour and change in the balloon shape with a guide distance of 6".

- Guide distance increased to 12" the number of balloon loops at the start increase to 8, loops at the package base increases to 2, but single loop balloon occurs with guide distance up to 9".

- Change from 8 to 7 loops means an increase of 11.4% in the loop height, 4 to 9 loops means an increase of 33.3%.

2.13. TENSION VARIATION WITH LONG GUIDE DISTANCE:

- Guide distance of 18", balloon loops at the start and the end are increased to 11 and 3.

- Increase of the guide distance to 24", 13 and 14 loops are formed at the start and end.

- At very short guide distance of 1" to 2" the unwinding tension throughout the supply package is fairly low. Rising steadily and slowly towards the end of the package.

- Guide distance increases, higher number of loops occur at the start with little variation in the loop height.

Guide Distance (inches)	No of loops of the final balloon (n)	Balloon Height (m)	Tension (T)
1	1	8	16
2	1	9	18
4	1	11	27
8	1	15	45
10	2	8.5	18
12	2	9.5	20
15	2	11	35
17	3	8	16
18	3	8.3	16
20	3	9	20
21	4	7	12
23	4	7.5	17
24	4	7.75	20

- Effect of inverting the supply package shows no distinguishable differences in the tension value variations in tension and balloon shapes.

- By increasing the non alignment from 0 to 0.5 inches, no significant difference occurs in the unwinding tension.

For Yarns Of 20^s Lift 7"; Speed: 670 yd/min; Guide Distance: 6inches;

- There are 2 loops at the start.

- At the end of the package when the unwinding radius is greatly reduced, a triple loop balloon is formed at top of the traverse and a single loop balloon at the bottom.

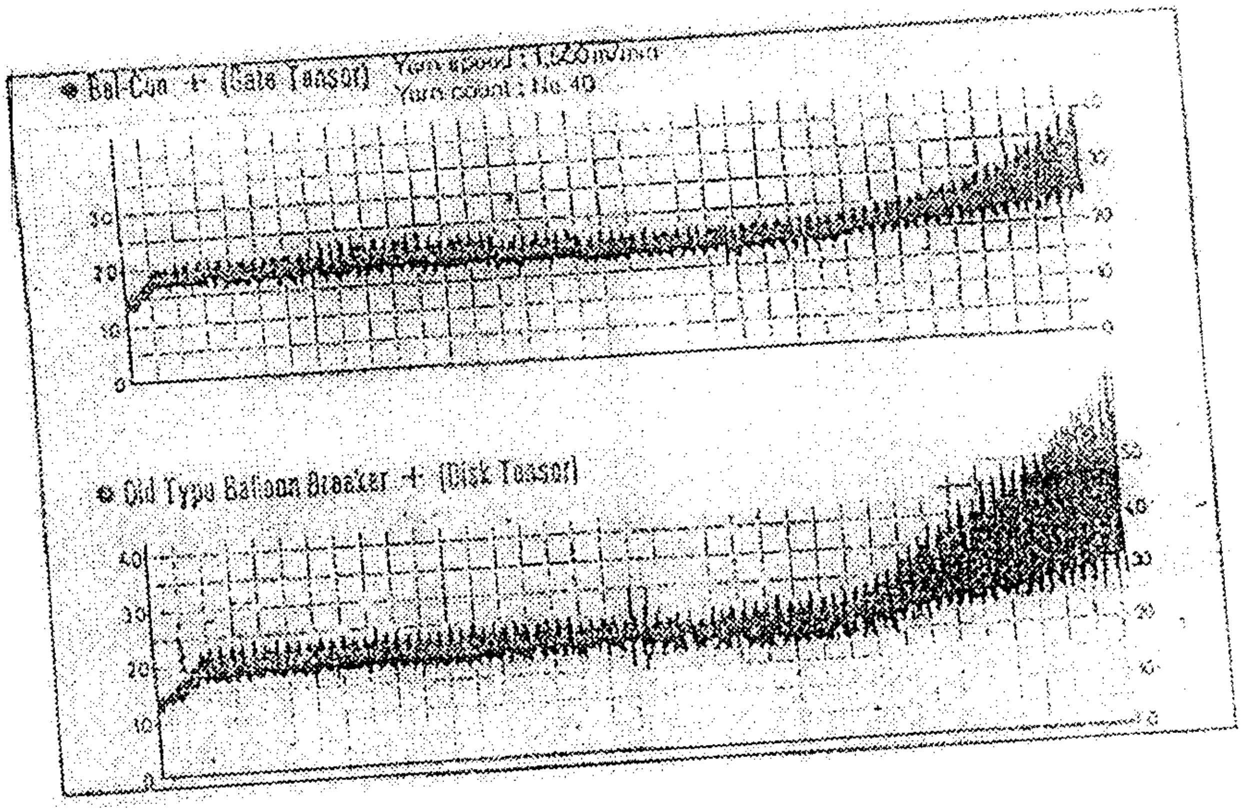
- Start of unwinding the number of balloons at the traverse is 4, unwinding at the bottom of the traverse is reduced to 2.

2.14. TENSION CONTROL IN MODERN CONE WINDING MACHINE:

The unwinding tension from a stationary ring bobbin always increases from start to end, due to the increase in balloon height in particular, and also due to increase in balloon diameter. On modern winding machines, balloon breakers are employed just little above the tip of the balloon is known as unwinding accelerator or bal-con balloon controller, as offered by Murata. This suppresses balloon and winding tension fluctuations, which also permits higher speeds.

2.14.1. MURATA – Machconer:

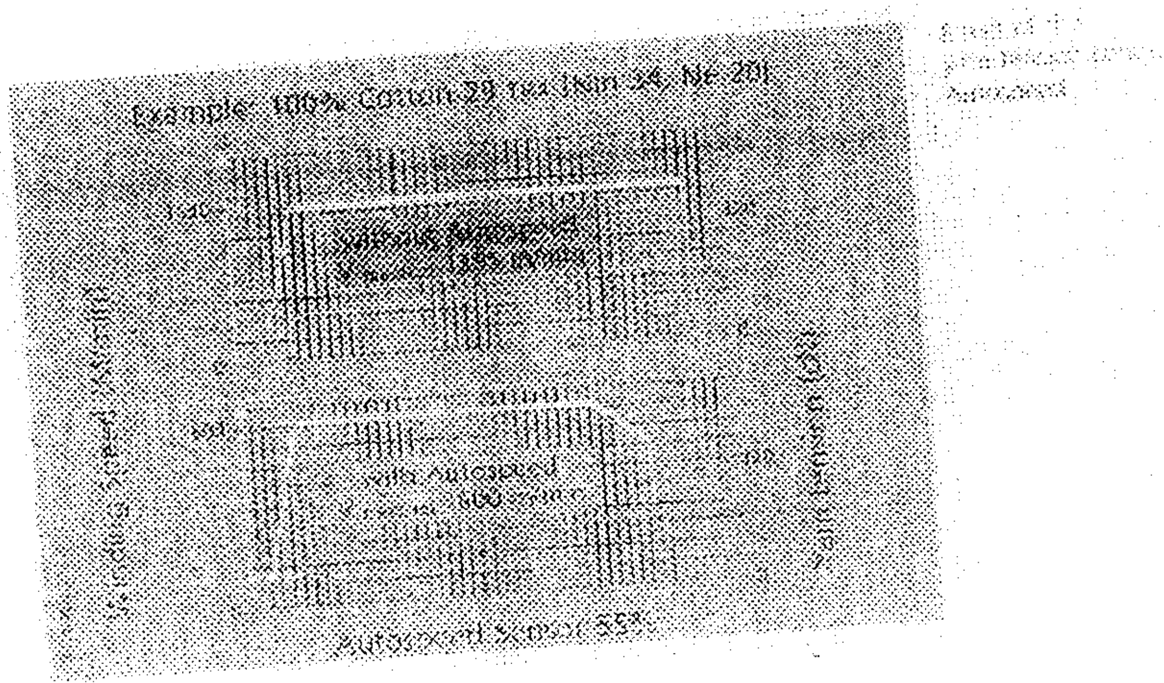
As mentioned, use of Balcon balloon controller is made here. Balcon works with the help of the sensor which senses the yarn position and accordingly the Balcon guide moves down on the cop thus maintaining the same ballooning and is keeping the unwinding tension almost constant thus the helping in maintaining constant speed till the end of winding.

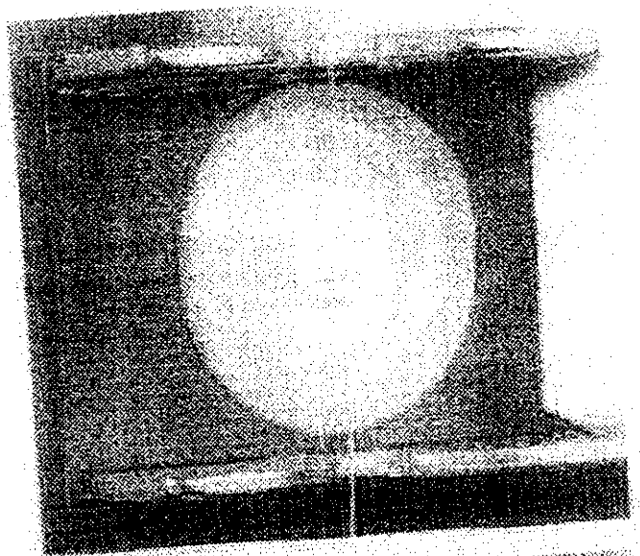


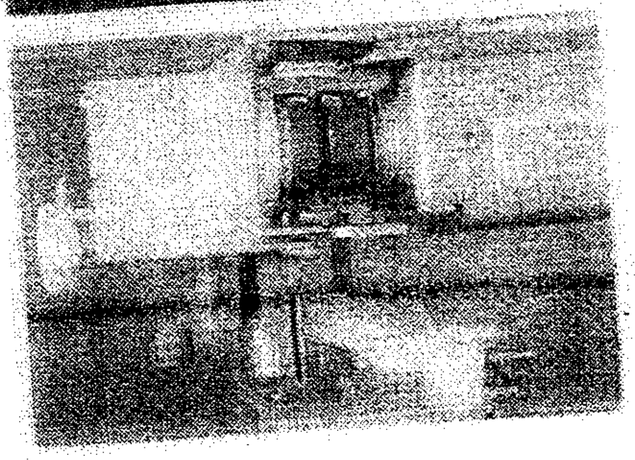
.14.1.1.Advantages:

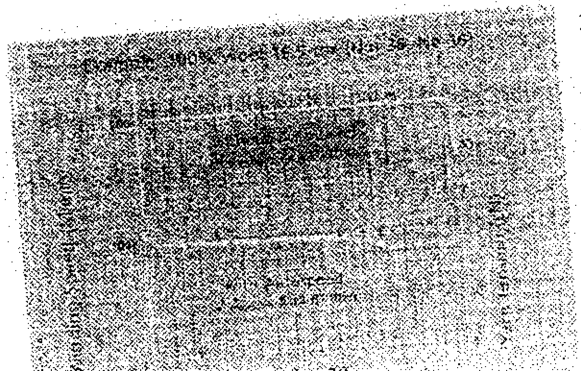
1. We can achieve higher speed and maintain the speed till the end of winding.
2. No need to reduce the speed towards the end of the cop in order to maintain the unwinding tension as in the conventional winding system, so chance of high productivity.
3. Since it maintains constant ballooning and winding tension from the top to bottom of the cop, it does not allow the yarn to touch against the cop or the yarn itself. Therefore suppressing the increase in hairiness and neps level in the yarn.
4. Use of BALCON reduces the fluff generation thus helping in keeping a conducive working environment.
5. It helps in lowering sloughing.

2.14.2. Autoconer by Schiafhorst and Savio:

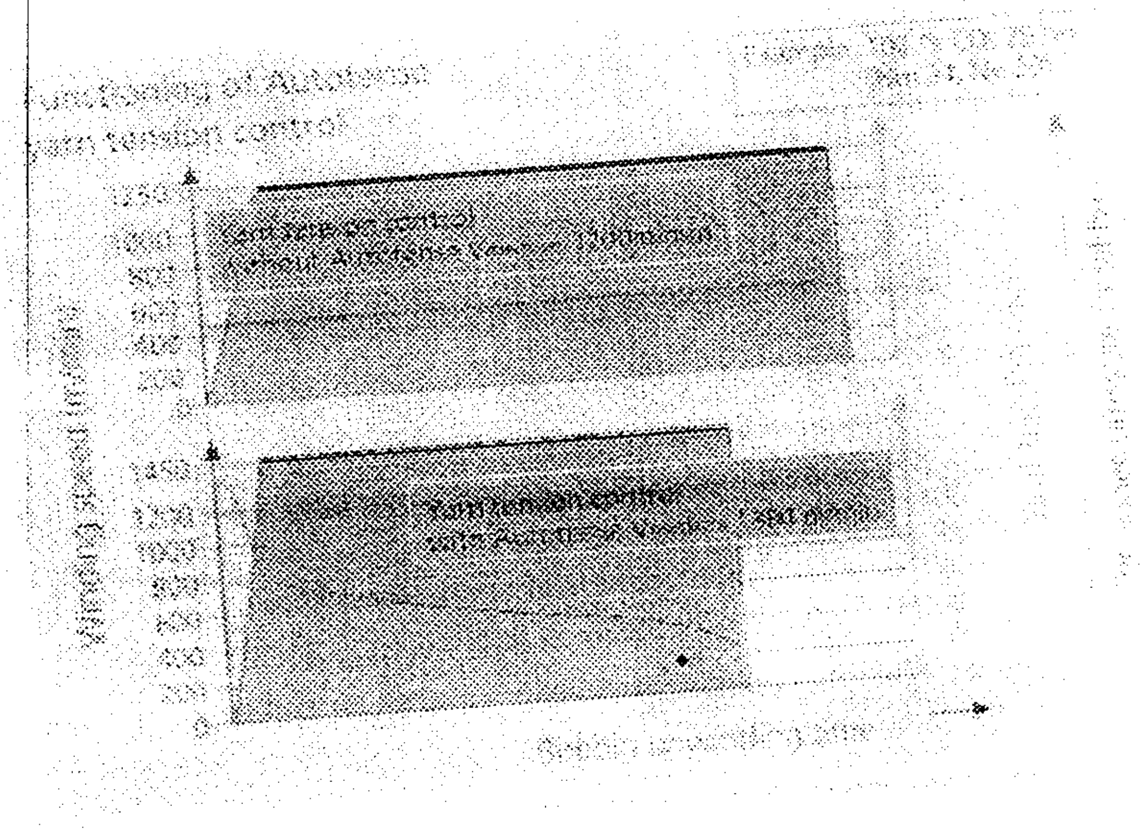








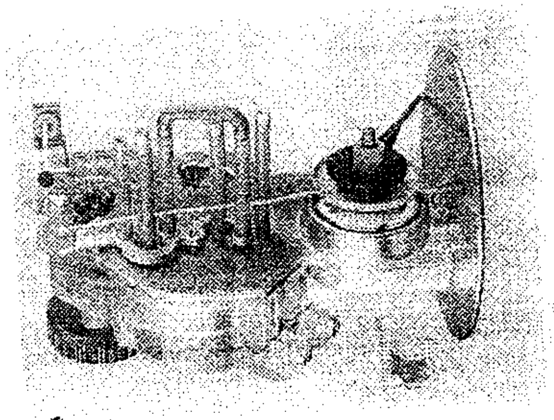
On modern machines the speed control principle is used to control the tension, only during winding top to bottom as the severe fluctuations occur when unwinding from the portion of the bobbin, because of the cop-heel geometry and balloon height. This principle is known as "Auto Speed" by Schlafhorst, similar principle is employed by Savio. The signal for increase in tension during winding is taken from the sensor mounted in the yarn guide so that when the tension increases, the temperature also increases. The increase in temperature is used as the signal to reduce the speed. On the modern machines, a pair of revolving disc tensioner is used, against the spring pressure. The setting dial is provided to adjust the yarn tension through the spring. Thus on the modern machines the yarn tension is precisely monitored to get uniform built of package, which in turn control end breaks. In Autoconer-138 a revolving disc with ceramic tension-shoe under spring pressure were employed to apply the yarn tension.



2.15. NEW TYPE OF YARN TENSION CONTROL IN THE WARPING DEPARTMENT:

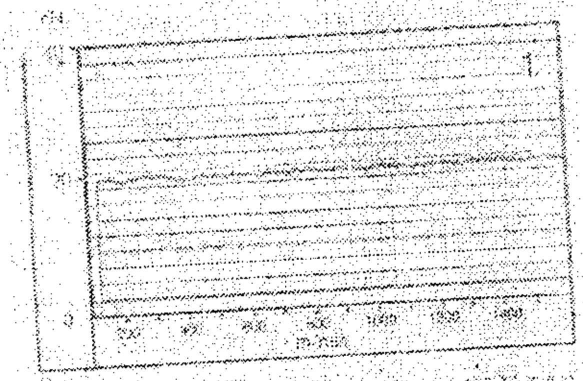
Precise tension control is of prime importance. It frequently permits higher running speeds, reduces unwanted yarn breaks and produces better quality yarns. There have ofcourse been electronic tension control systems, which truly regulate tension, but they are complicated and very expensive.

Shown on Custom Industries stand for the first time at ATME-I 2000 in Greenville, SC (USA) was a truly compensating yarn tensioner, which operates on a simple mechanical basis. This device is called as "KN-Tension Device".

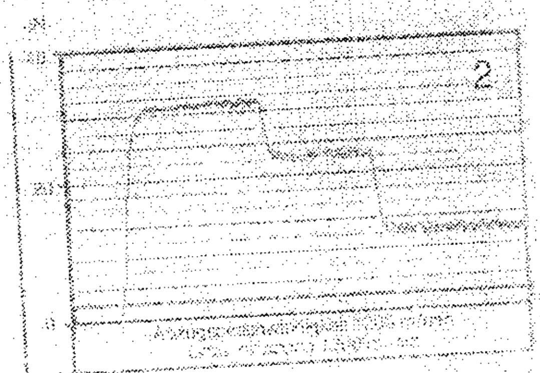


Kompensations-
Fadenspannungsregler

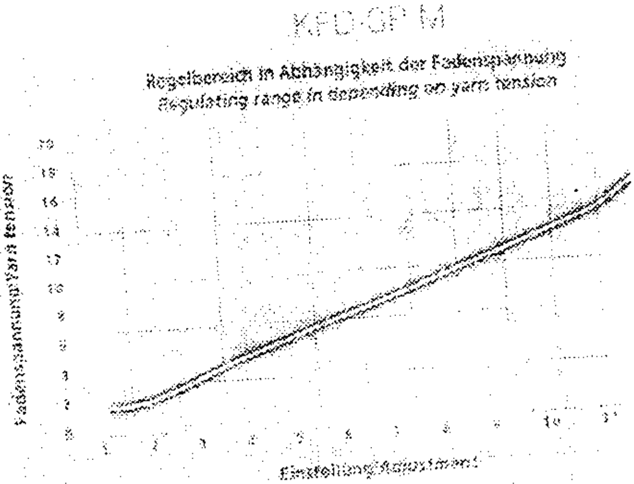
Compensating
Yarn Tension Regulator

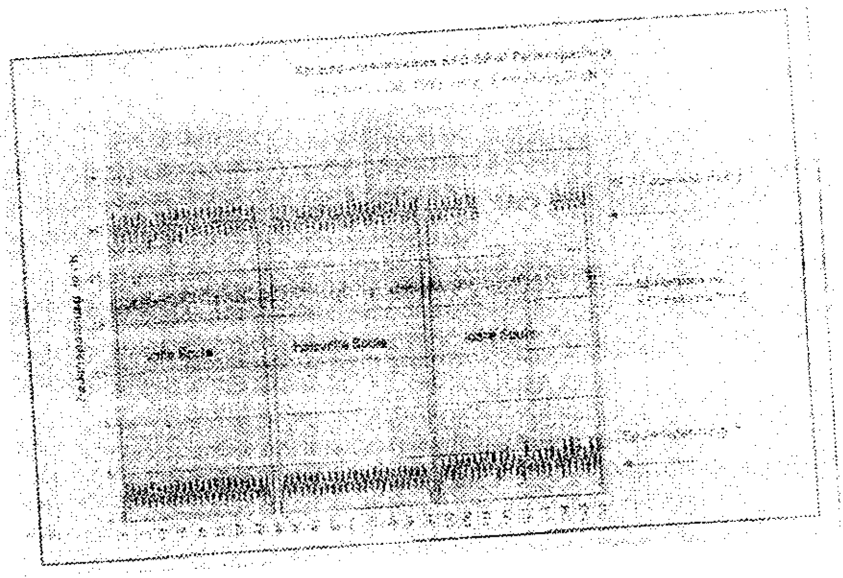


1



2


KFD-GP M
Regelbereich in Abhängigkeit der Fadenspannung
Regulating range in depending on yarn tension
Fadenspannung/Yarn tension
Einstellung/Adjustment



2.16. INFLUENCE OF WINDING TENSION ON YARN QUALITY:

2.16.1. Influence of tension on imperfection:

In the case of 40^s at lower level of speed i.e.800mpm, the increase in tension results in the trend of increase in imperfections. But there is no trend at higher speeds. Similarly for 88^s count at lower speeds there is increase in imperfections with the increase in tension for 800, 900mpm, but at 1000mpm this turn is not reflected.

2.16.2. Influence of tension on U%:

In the case of 40^s at 800mpm only increase in tension shows deterioration in U%. At higher speed with the increase in tension there is no change noticed in the U% of yarn for the same count. In the case of 88^s Ne, there are no significant changes in U% observed with increase in tension.

2.16.3. Influence of tension on yarn tenacity:

In the case of 40^s count, if the odd reading i.e. 16.59 is omitted, then there is no significant change noticed in the tenacity, at various levels of tension. In the case of 88^s Ne, there is no marked reduction in tenacity with the increase in tension.

2.16.4. Influence of tension on yarn elongation:

In the case of 40^s there is a significant reduction in breaking elongation at higher speeds i.e. 1000mpm but at lower speeds no specific trend is noticed. In the case of 88^s Ne, there is marked reduction noticed in breaking elongation with the increase in tension at all speeds.

2.16.5. Influence of tension on yarn hairiness:

There is no trend noticed for the various tension on the hairiness for 40^s and 88^s count.

OBJECTIVE AND SCOPE

3. OBJECTIVE AND SCOPE:

The objective and scope of this project work are as follows,

1. To study the winding tension variation on high speed winding machine working with Disc type tensioner during cop to cone winding of spun yarn.

2. To design and develop a Electro-magnetic tensioner to control winding tension.

3. To install the above mechanism and study its performance towards winding tension control.

4. The study of comparative performance is restricted to Ne 20^s, 40^s & 60^s cotton count which is generally spun by the mill.

METHODOLOGY

4. METHODOLOGY:

The following materials and methods adopted for the present project work.

1. Study of different types of tensioners available
2. Design and development of suitable electro-magnetic mechanism to compensate winding tension which is also cost effective
3. Design appropriate circuit diagram for the tensioner
4. Study of electro magnetic tensioner's performance on various count and types of yarn

4.1. STUDY OF WINDING TENSION ON EXISITING DISC TYPE TENSIONER:

To study the winding tension and its variation on high speed non-automatic winding machine, cotton counts Ne 30^s K , 40^s C and 60^s C were chosen and run at 500 mpm. The required cops are produced from Devi Karunamigai and sangeeth mills. The tension variation was measured in three different cop positions namely bottom, middle and top.

.2. ELECTRO - MAGNETIC TENSIONER:

PRINCIPLES OF WORKING:

On the following principle, Electro-magnetic tensioner has been designed and developed,

"The emf in any closed circuit is equal to the time rate of change of the magnetic flux through the circuit"

It is based on Faradays law,**Faraday's law of induction** describes a basic law of electromagnetism, which is involved in the working of transformers, inductors and many forms of electrical generators.

The law states that, "The induced electromotive force or EMF in any closed circuit is equal to the time rate of change of the magnetic flux through the circuit".

Electromagnetic induction was discovered by Michael Faraday in 1831, a independently and at the same time, by Joseph Henry. The above law is sometimes also stated as "The EMF generated is proportional to the rate at which flux is linked".

Faraday formulated the law quantitatively in the form as follows,

$$\mathcal{E} = -\frac{d\Phi_B}{dt}$$

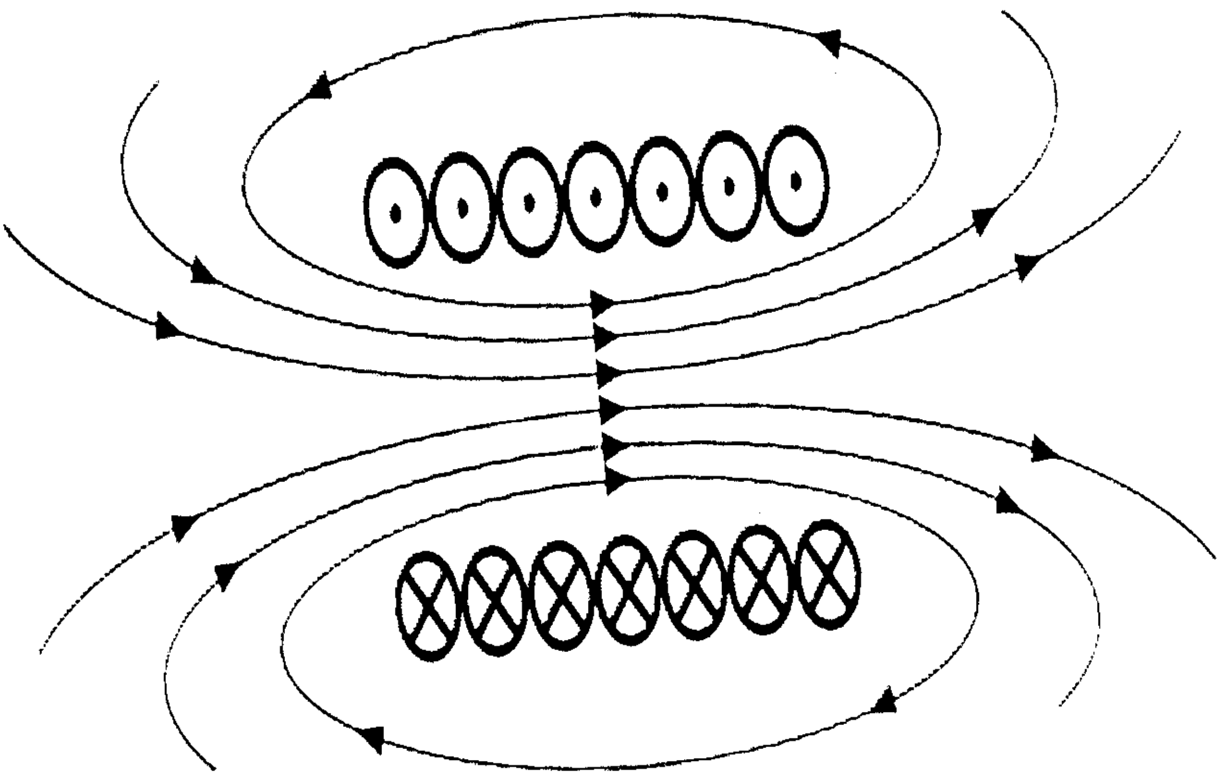
Where,

$\mathcal{E}$ is the electromotive force (EMF) in volts

F_B is the magnetic flux through the circuit in webers.

The direction of the electromotive force (the negative sign in the above formula) is given by Lenz`s law. The meaning of "flux through the circuit" is elaborated upon in the examples below.

Traditionally, two different ways of changing the flux through a circuit are recognized. In the case of **transformer EMF,** the idea is to alter the field itself, for example by changing the current originating the field (as in a transformer). In the case of **motional EMF**, the idea is to move all or part of the circuit through the magnetic field, for example, as in a homopolar generator.



4.4. DESIGN AND DEVELOPMENT:

On the basis of the above principle a device has been designed and developed taking in to considerations the following points

1. Space availability of existing tensioning device.
2. Availability of parts at economic cost.
3. Smoothness of operating surface.
4. Wear.
5. Accuracy.

4.4.1.Technical specifications of an Electro-magnetic coil are,

- voltage - 24 V DC
- coil resistance -75 ?
- wire gauge – 38 SWG (sheet wire gauge)
- no. of turns - 850

TENSION SETTINGS:

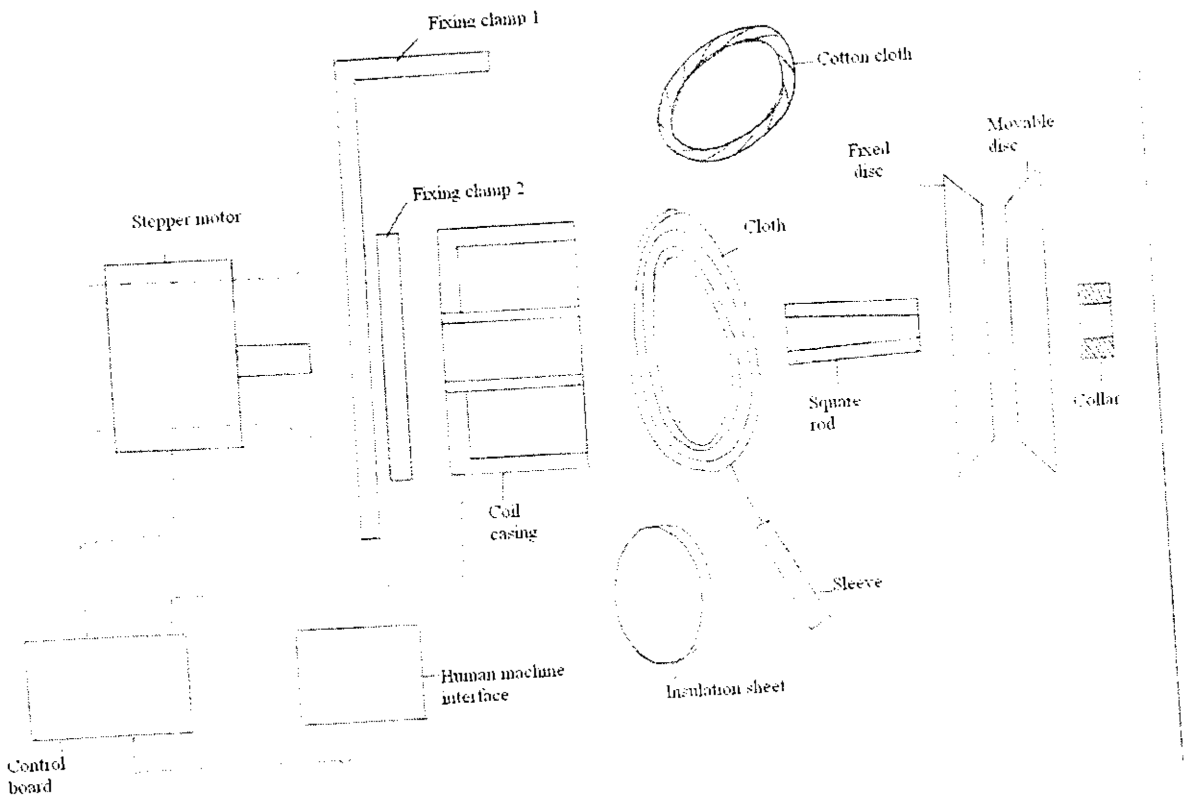
BITS	VOLTAGE (V)	TENSION (cN)
250	7.12	2
300	7.32	3
400	9.76	5
650	15.54	14
[illegible]	17	16

DEVELOPMENT COST:

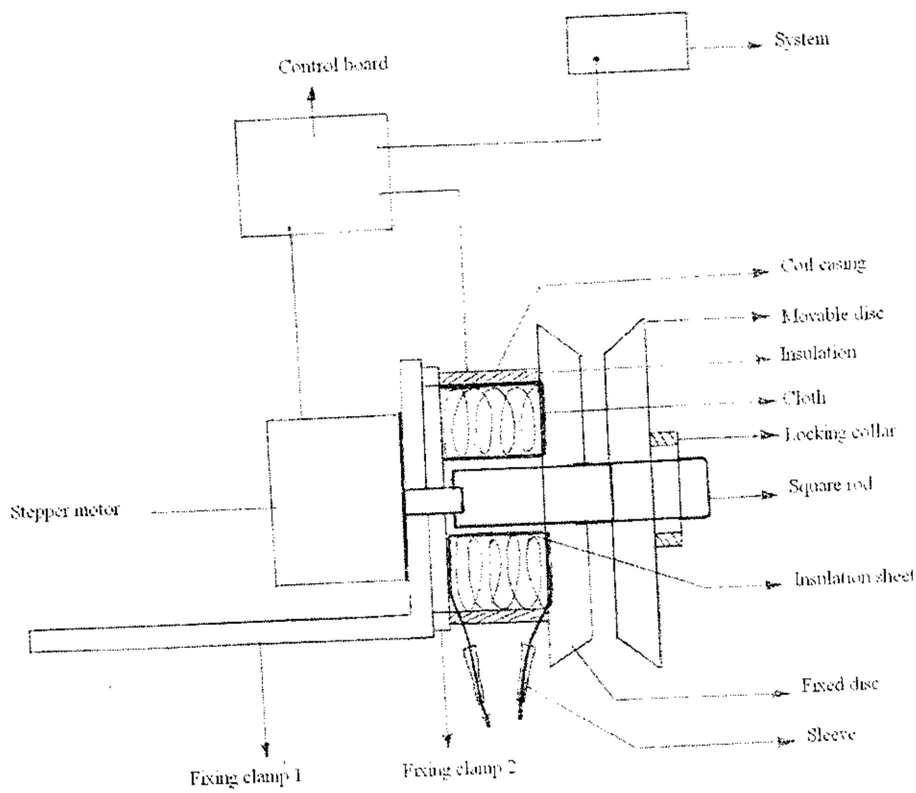
PARTS	COST (Rupees)
Stepper Motor	350
Copper Coil	30
Control Board	400
Fixing Clamp	65
Coil Casing	95
Insulation Cloth	1
Insulation Sheet	0.50
Insulation Sleeve	1
Square Rod	30
Fixed Disc(Stainless steel)	85
Movable Disc(mild steel)	45
Rubber Locker(Collar)	2
Wires	6
Miscellaneous	10
TOTAL	Rs. 1120.50

The diagram of various parts of the Electro- magnetic tensioner that has been developed as follows,

EXPLODED VIEW OF ELECTRO-MAGNETIC TENSIONER:



A SCHEMATIC DIAGRAM OF THE DESIGN OF THE ELECTRO-MAGNATIC TENSIONER:



RESULTS AND DISCUSSIONS

4.5. CALIBRATION OF EQUIPMENT:

For every count the average tension and extent of compensation are calibrated by running a cop and adjusting the add on weight and sensitivity of the transducer and its amplification of the output voltage.

5.RESULTS AND DISCUSSIONS:

5.1. STUDIES CONDUCTED ON UNWINDING TENSION VARIATION WITH THE PRESENT DISC TYPE TENSIONERS:

The Table.1 given below shows the results of tension variation study carried out on the high speed winding machine working at 500mpm for cotton count Ne 30^S K, 40^S C and 60^S C. The results show the average tension increase is of the order 20-23% from top to middle and 35-45% from top to bottom. This is in line with the earlier studies carried out by different researches. This variation occurs due to the change in the shape of the balloon and no. of balloons which results from the change in the position of the unwinding.

Table.1

COUNT	WEIGHT (g)	WINDING SPEED (Mpm)	AVERAGE WINDING TENSION AT DIFFERENT POSITIONS OF COP		
			Top	Middle (%change*)	Bottom (%change*)
30s K	60	500	30.5	37.5 (+23%)	43.5 (+42.6%)
40s C	60	500	28.0	34 (+21.4%)	40.5 (+44.6%)
60s C	60	500	25.5	30 (+19.6%)	34.5 (+35.3%)

(*Figure. given in the bracket indicate the % increase in tension in relation to the tension at the top)

5.2. WINDING TENSION STUDY CONDUCTED ON THE ELECTRO-MAGNETIC YARN TENSIONER:

The table.2 given below indicates the results of tension at different positions of unwinding from a cop Electromagnetic yarn tensioner .In comparing this results with the normal tensioner, one can conclude that the increase in tension from top to middle and bottom of the cop is reduced to 8-9% and 15-18% respectively, there by avoiding the sudden rise of tension.

Table.2

UNT	WEIGHT (g)	WINDING SPEED (mpm)	AVERAGE WINDING TENSION AT DIFFERENT POSITIONS OF COP		
			Top	Middle (%change*)	Bottom (%change*)
0s K	60	500	27.4	29.6 (+8%)	31.4 (+14.6%)
40s C	60	500	25	27.2 (+8.8%)	29.2 (+18%)
60s C	60	500	21.4	23.2 (+8.4%)	25.2 (+18.2%)

(*Figure. given in the bracket indicate the % increase in tension in relation to the tension at the top.)

The reduction in the rise of peak tension is made possible by the mechanism of electro-magnetic tensioner that is developed. If may be noted from the study on the existing and newly developed electo-magnetic tensioner device that average optimum tension to be maintained to get a desired package density is reduced around 20%. This will facilitate to retain the yarn elasticity better.

To achieve the tension, for 400-415gpl with 1kg package of certain counts of yarn are as follows,

- 30s single = 28-30 cN
- 40s single = 23-25 cN
- 60s single = 18-22 cN.

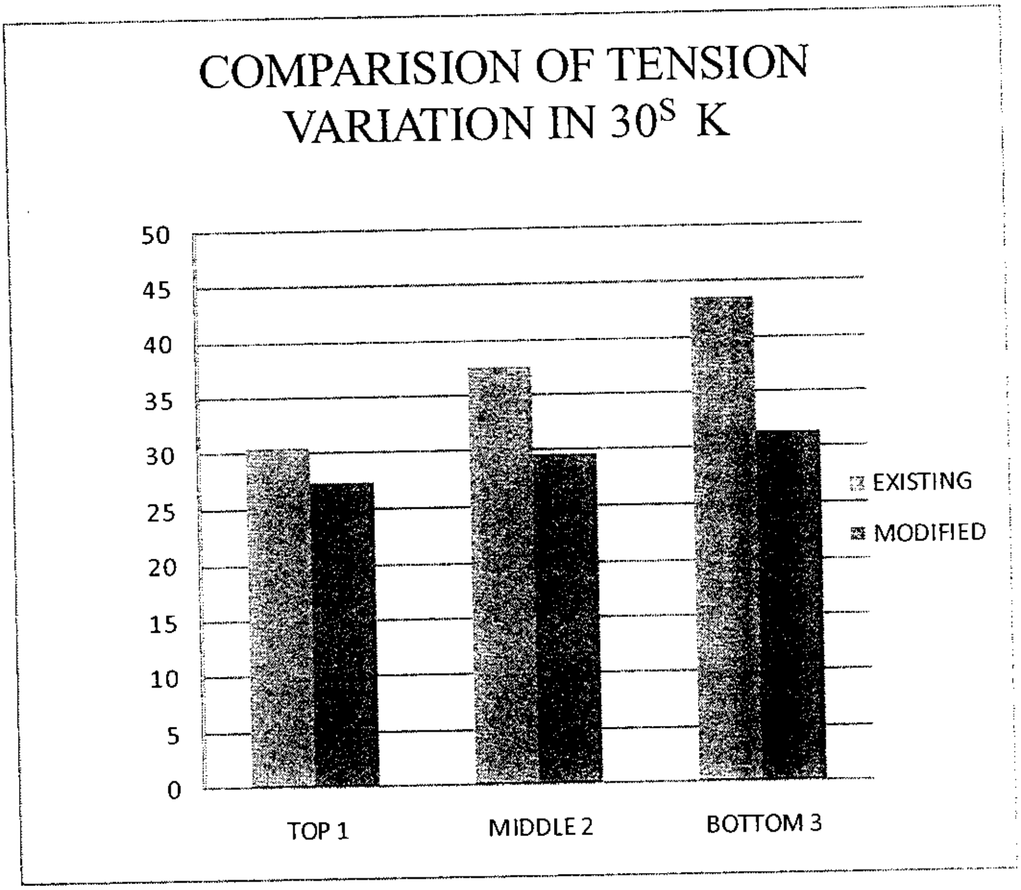
5.3.BREAKAGE STUDY:

Breakage rate on 50cops of 40^s C cotton count reveals that there is a reduction in breakage rate in order of 15%.

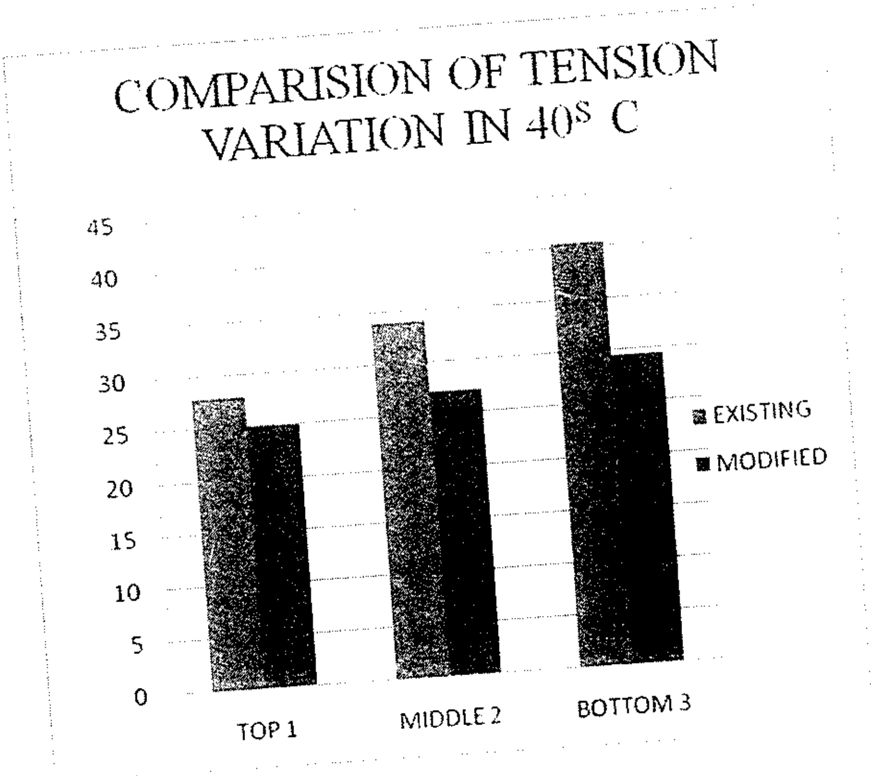
Yarn content : 3170 meter

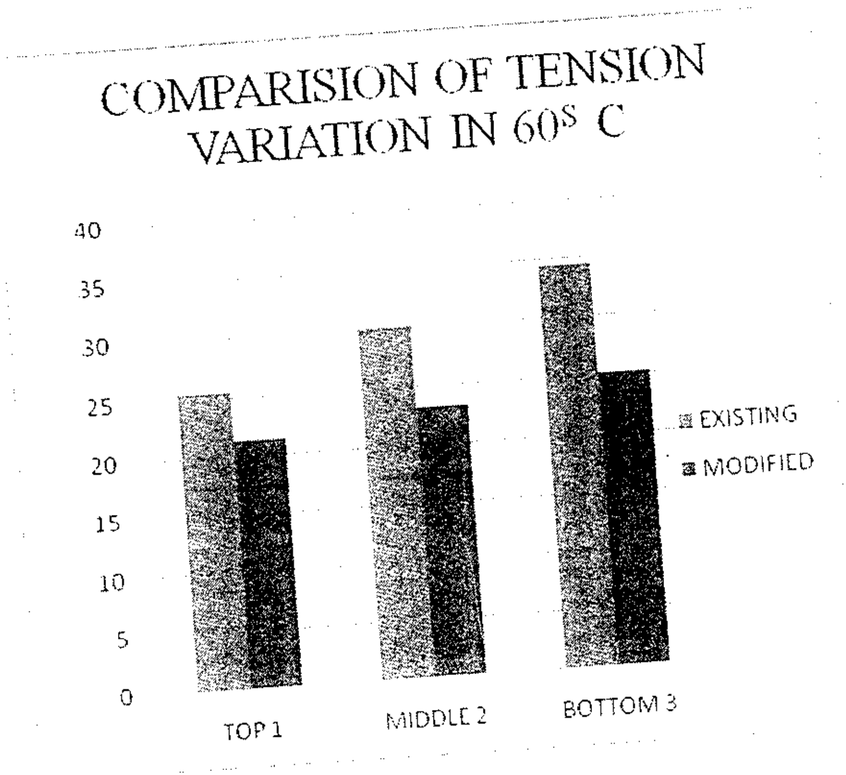
	Breaks / bobbin	Breaks / lakh meter
Existing	0.76	25
Modified	0.65	20.02

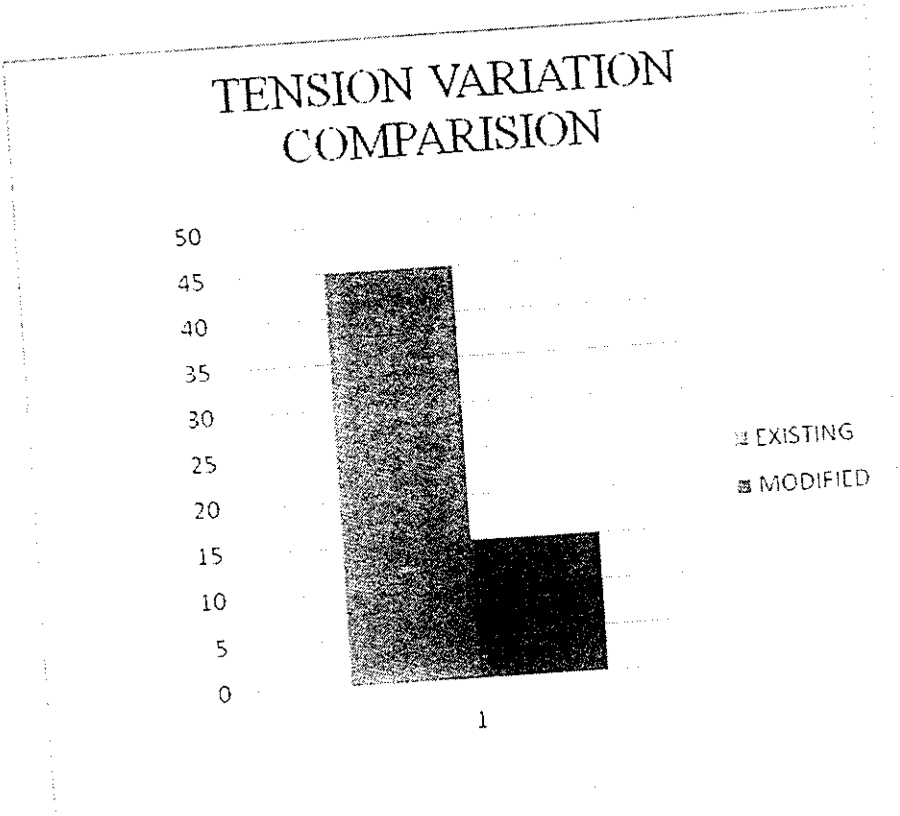
This reduction in breakage rate of 15% could be attributed to the reduction in variation in the winding tension. The reduction in breakage rate is expected to give raise to the efficiency of the machine. On the other hand gain in tension shall be utilised to increase the winding speed, results in higher productivity.



COMPARISION OF TENSION
VARIATION IN 30S K
50
45
40
35
30
25
20
15
10
5
0
TOP 1
MIDDLE 2
BOTTOM 3
EXISTING
MODIFIED


COMPARISION OF TENSION VARIATION IN 40^{S} C
45
40
35
30
25
20
15
10
5
0
EXISTING
MODIFIED
TOP 1
MIDDLE 2
BOTTOM 3


COMPARISION OF TENSION VARIATION IN 60^{S} C
40
35
30
25
20
15
10
5
0
EXISTING
MODIFIED
TOP 1
MIDDLE 2
BOTTOM 3


TENSION VARIATION COMPARISION
50
45
40
35
30
25
20
15
10
5
0
1
EXISTING
MODIFIED

CONCLUSION

6.CONCLUSION:

- The electromagnetic yarn tensioner developed reduces the variation in the winding tension to 15 – 18 % from 35 – 45 %.

- It results in the reduction of optimum tension requirement to get a desired package density up to the same level.

- Yarn elasticity retain ability is improved consequent to the above.

- Reduction in breakage rate provides scope to increase machine efficiency or winding speed resulting in higher production.

- The electromagnetic yarn tensioner developed being simple in nature that cost around Rs.550/- drum only, which could easily be retrofitted on the existing tension with minor modification.

7. BIBILOGRAPHY:

1. R.Foster, "Tension variations occurring during the unwinding of cops and pirns", J.Text.Inst. 1959, 50, P7.

2. D.Brunnschweiler and I.S.Mohammadaian, " Experimental studies of variation in yarn tension during unwinding from ring frame package", J.Text.Inst.,1956,50,P74.

3. Daphne G. Padfield, "Fluctuations of Tension during unwinding" J.Text.Inst. 1956, 47, T 301.

4. P.R.Lord and M.H.Mohamed, "Convertion of yarn to fabric", Merrow Publishing Co.Ltd., England.

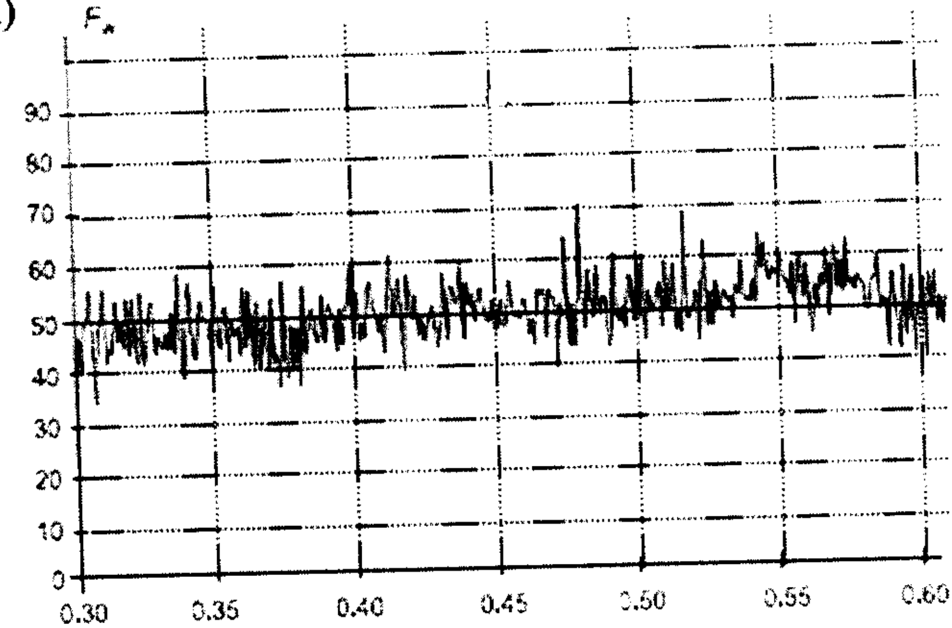
5. M. Palaniappan et.al. (IV B.Tech) Fabrication of tension control mechanism in high speed cone winding machine.

6. Manuals and catalogues: Karl Mayer, Schlafhorst, Savio and Murata.

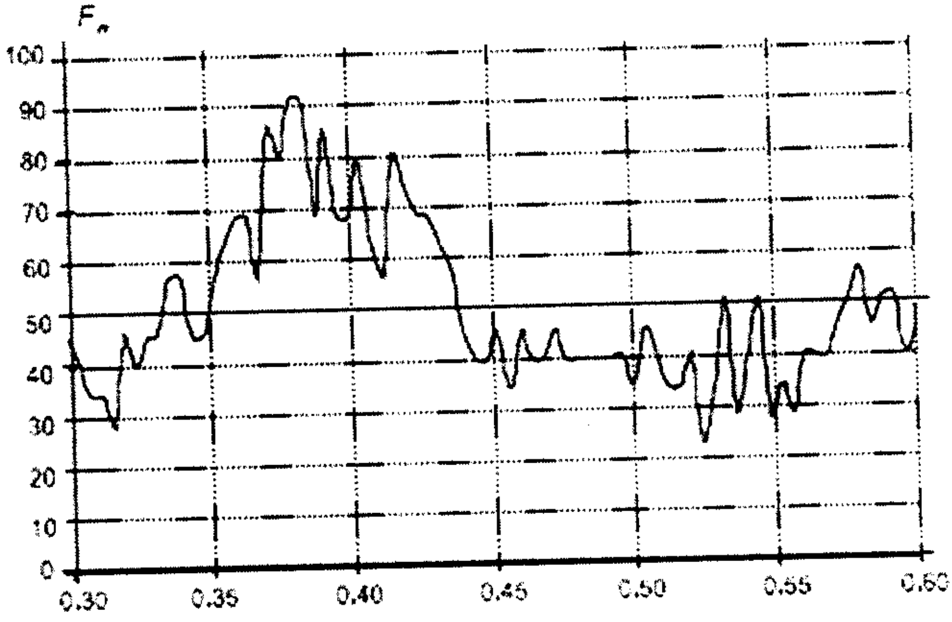
7. V.H.Kapadia, "Quality Monitoring By Modern Technology On Winding Machines", M.S.University, Boroda.

8. Kurt W.Niederer, Charlotte, U.S.A., "New Type of Yarn Tension Control in the Textile Sector", International Textile Bulletin, March.

A)



B)



F_W - the mean arithmetic tension value in successive time intervals

Comparison - Graphs of yarn tension variationwith time recorded at linear speed of 500m/min and mean tension setting 50cN A)Electromagnetic

PHOTO COPIES OF ELECTRO-MAGNETIC TENSIONER