K.S. RANGASAMY COLLEGE OF TECHNOLOGY

(Autonomous)

TIRUCHENGODE – 637 215

COURSE MODULE

YARN MANUFACTURING TECHNOLOGY - I

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YARN NUMBERING SYSTEM

Definition of Count:

According to the Textile Institute "Count is a number of indicating the mass per unit length or length per unit mass of yarn".

COUNT is defined as the numerical expression of fineness or thickness of yarn.

These count systems have been divided in two ways.

One is Direct System where length is fixed and another is In-direct system where weight is fixed

Direct System (Length Fixed):

1. **Tex**: Weight in grams present in 1000 meter length of yarn. It is a universal system of counting the yarn.

2. **Denier**: Weight in grams present in 9000 meter length of yarn. It is basically used for man-made fiber.

Indirect System (Weight Fixed):

1. **English Cotton Count (Ne)**:

   Number of hanks of 840 yards present in 1 lb of yarn.

$$\text{Count (Ne)} = \frac{\text{Length in Yards}}{\text{Weight in Lbs} \times 840}$$

2. **Metric Count (Nm)**: No. of hanks of 1000 meters present in 1 kg of yarn.

3. **Worsted count**: No. of hanks of 560 yards present in 1 lb of Yarn. It is basically used for Wool. (**Nw**)

4. **French count (Nf):** Number of 1000 meters per kilogram.

COUNT CONVERSION

Conversion of Count from Tex to Ne (or) Ne to Tex

$$\text{Count (Ne)} = \frac{590.5}{\text{TEX}}$$

OR)

$$\text{TEX} = \frac{590.5}{\text{Count (Ne)}}$$

Conversion of Count from Denier to Ne (or) Ne to Denier

$$\text{Count (Ne)} = \frac{5315}{\text{DENIER}}$$

(OR)

$$\text{DENIER} = \frac{5315}{\text{Count (Ne)}}$$

LENGTH & WEIGHT MEASUREMENTS

1 Inch = 2.54 cm (or) 25.4 mm

1 Yard = 0.914 mtr (or) 1 meter = 1.1 yard

1 Lea = 120 yards

7 Leas = 840 Yards (1 Hank)

1 feet = 12 Inches (12”)

1 yard = 36 Inches (or) 3 feet (3’)

1 Kg = 2.205 lbs (or)

1 lb = 453.6 gms (0.454 kgs)

1 lb = 7000 grains

1 lb = 16 ounces

INFLUENCE OF FIBER PARAMETERS ON SPINNING PERFORMANCE

Raw material represents 50 % of the production cost and hence fiber parameters significantly influence the processing and quality of yarn.

The important fiber parameters to be considered for spinning are,

1. Fiber length.
2. Fiber fineness (Micronaire value).
3. Maturity Co-efficient.
4. Fiber strength.
5. Fiber elongation.
6. Fiber cleanliness.
7. Fiber stiffness & Chemical deposits etc.

1. FIBER LENGTH

Fiber length is usually expressed in millimetre (mm) and fiber length influences the,

- Spinning limit (count to be spun),
- Yarn strength,
- Yarn evenness,
- Yarn hairiness,
- The required turns of twist,
- The end breakage rate,
- Luster.
- General spinning condition etc.,

It can be assumed that, very short fibers (under 4 – 5 mm) will go as waste and fibers upto 15 mm do not contribute to the strength of yarn, and long fibers contribute to all.

The fiber length can be classified as,

- Mean length
- Effective Length
- Staple Length

Mean length refers to the average length of short, medium and long fibers in a bunch. Mean length is required to find the strength and evenness etc., Effective length means, the average of longer fibers in a bunch and this is required to set the machinery parts. Effective length is almost equal to the 2.5 % span length measured on AUTO-SPAN.

The 2.5 % span length varies from 17 mm to 40 mm and the length of viscose and polyester fiber will have 40 mm, 50 mm, 61 mm etc., Longer fibers will go for FINER COUNT of yarn.

2. FIBER FINENESS

Fiber fineness determines the number of fibers in the cross section of a yarn. A multitude of fibers in the cross section provide not only strength, but also better distribution in the yarn. Normally, there must be 40 fibers in the cross section of the yarn. Additional fibers in the cross section provide not only additional strength, but also better evenness in the yarn.

According to the latest information, the number of fibers in the cross section of a yarn is above 100. The fineness is expressed in mass / unit length. i.e., Micronaire value.

The fineness scale is as follows

Micronaire Value	Fineness
3.0	Very Fine
3.1 – 4.0	Fine
4.0 – 4.9	Medium
5 – 5.5	Coarse

3. FIBER MATURITY

Fiber maturity refers to the number of matured fibers in the cross section of yarn. If the cell wall of the fibers is almost round in cross section, they are considered to be matured fibers. The matured fibers are denoted by maturity Co-efficient. The maturity influences the yarn strength, dye ability etc,.

Count (Ne)	Maturity Co-efficient
20s	0.80
40s	0.85
80s	0.95
100s & above	0.95

4. FIBER STRENGTH

Fiber strength is a dominating characteristic for the end use. The fiber should have approximately 6 CN/tex. The strength of the fibers will be tested on stelometer at 3 mm gauge.

The single yarn strength is expressed in gms/tex.

Count	Single Yarn Strength (gm/tex)
20s	13.5
40s	16.2
80s	22
100s & above	27

5. FIBER ELONGATION

Fiber strength and fiber elongation are in-separable because all textile fibers are elastic in nature. Otherwise, they cannot be used.

There are 3 types of elongation namely,

- Elastic elongation - Fiber extends on loading and return on relaxation
- Plastic elongation - Fiber extends and returns to its position with time.
- Breaking elongation - Fiber extends till break.

6. FIBER STIFFNESS (Fiber Slenderness Ratio)

Fiber stiffness refers to the binding of fibers to the surface of the yarn. A stiff fiber cannot bind properly. Fibers should be flexible for effective binding, uniformity and strength of yarn.

7. CHEMICAL DEPOSITS (Sticky Substances)

Chemical deposits refer to honey dew due to the secretion of fibers. This will lead to roller lapping at draw frame, speed frame and ring frame. Hence RH (Relative Humidity) should be low in the working area to minimize this problem.

8. FIBER CLEANLINESS

These includes vegetable and mineral matters, contaminations (Dust, Trash etc,) and other foreign matters like foreign fibers, Metal fragments, Cloth fragments and packing materials. These particles should be removed and cleaned.

FIBER QUALITY INDEX

Putting all the important fiber parameters, an **Index** has been derived known as "**Fiber Quality Index**" **(FQI).**

Fiber Quality Index is used as base to predict the count of yarn, strength of yarn, U% of yarn, total imperfection and hairiness index.

Fiber quality index can be found out by using the following formulae,

$$FQI = \frac{LSM}{F}$$

Where,

L – 50 % span length in mm,
S – Strength in gms/tex,
M – Maturity co-efficient,
F – Fineness value (Mi –value).

According to this formula, FQI is directly proportional to LSM and indirectly proportional to fineness.

$$FQI \ \alpha \ LSM$$

And

$$FQI \ \alpha \ \frac{1}{F}$$

(i.e.) If the value of the length, strength and maturity increases, FQI value found to be more. If the fineness value is more, then the FQI value proportionately reduced.

Case – I

Fiber length – 25 mm
Strength – 10 gms/tex
Mc - 0.80
Mi – 5.0

$$FQI = \frac{25 \times 10 \times 0.80}{5.0} = 40$$

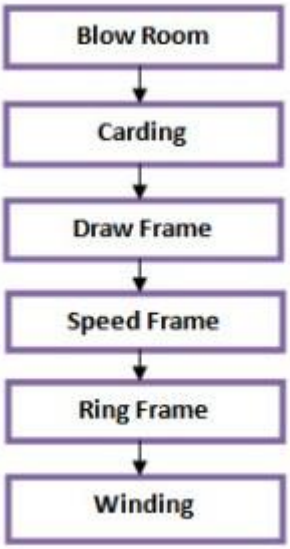
Case – II

Fiber length – 35 mm
Strength – 14 gms/tex
Mc - 0.95
Mi – 3.0

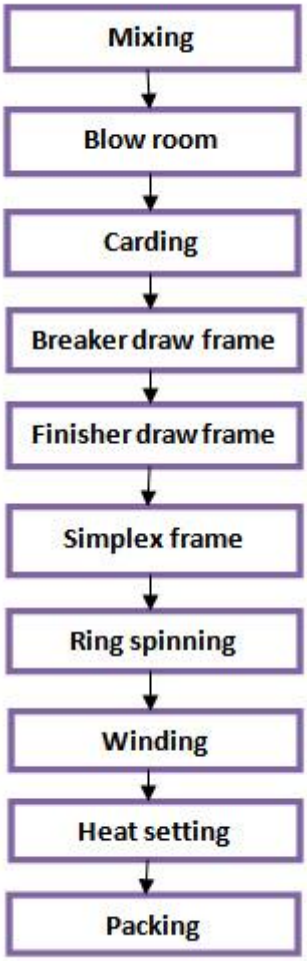
$$FQI = \frac{35 \times 14 \times 0.95}{3} = 155$$

The FQI ranges from 40 – 140 from coarser to finer yarn. (i.e) FQI value of 40 goes for coarser count and FQI value of 140 goes for finer count.

SEQUENCE OF SPINNING MACHINERY FOR PRODUCING CARDED YARN



Flow Chart for Modern Carded Yarn Manufacturing Process:



Flow chart of combed yarn with different processes:

Input → Process → Output

↓

Fiber → Bale Management → Bale

↓

Bale → Blow Room → Lap

↓

Lap → Carding Machine → Carded Sliver

↓

Carded Sliver → Pre-Comber Drawing → Pre-Drawing Sliver

↓

Pre-Drawing Sliver → Sliver Lap Forming → Lap

↓

Lap → Combing → Comb Sliver

↓

Comb Sliver → Post-Comb Drawing → Drawn Comb Sliver

↓

Drawn Comb Sliver → Simplex / Speed Frame → Roving

↓

Roving → Ring Frame → Yarn

↓

Yarn → Auto Coner → Yarn Package (Cone / Cheese)

COTTON GINNING

Ginning is the first mechanical process carried out in the industry. Ginning process is carried out only for cotton fiber.

Ginning process is defined as the process of separating seeds and fibers. Plucked cotton from the plant (KAPAS), consists of 66 % seeds, 33% of fibers and 1 % trash.

Seeds and fibers are separated using different ginning machines. After the ginning process, the separated fibers are packed into bales. Each bale contains 180 – 200 kgs of cotton fiber.

Cotton fiber has a dominating role among textile fibers, because it has inherent properties to keep the user comfortable. Hence, the utility of cotton is more than other fibers. The application of cotton has spread to all the fields because of its inherent characteristics to provide comfort for the user.

Cotton fibers is mainly used for the following end uses

- Shirts, Pants, Sportswear, Socks
- Sarees, Dress materials and T-Shirts
- Night suits, Mats, Bedspreads, Bed sheets and Towels
- Garments next to skin (Intimate garments like underwear, etc)

The inherent properties of cotton are,

- **Perspiration (Absorption)**
  i.e. it absorbs the sweat and allow air in to keep us comfortable

- **Dimension Stability**
  i.e. when load is applied, elongation is developed and when load is released, it comes back to its original position.

- **Stretch to fit**
- **Abrasion Resistance etc.,**

Cotton is an

- Important commercial crop
- Important foreign exchange earner
- Economic Indicator.

12 states in India have been identified as major cotton growing states and these are Punjab, Haryana, Rajasthan, Tamilnadu, Karnataka, Andhra Pradesh, Telangana, Maharashtra, Gujarat, Madhya Pradesh, Orissa and Assam.

COTTON GINNING

Ginning is the first mechanical process carried out in cotton industry.

Ginning process can defined as the process of separating fibers from the seeds. Plucked cotton from the plant (KAPAS) consists of 66% seeds and 33% fibers and 1% trash. Fibers are separated from the seeds using ginning machines. Cotton fibers have a dominating role among textile fibers. Cotton fiber has got inherent properties to keep the user comfortable.

Cotton is an important commercial crop and it is an important foreign exchange earner and economic indicator.

Ginning is the first mechanical process to be carried out and this process is required only for cotton fibers. The picked cotton from the plant (KAPAS), contain 66% seed and 33% cotton fibers and rest are leaf bits, crushed seeds, sands etc, The process of separating the cotton fibers from seeds is known as 'GINNING'. After the fibers are separated, they are packed into "DOCROS" (100 kgs) or "BALES" (180 – 200 kgs).

The fibers which are separated from the seeds are classified into 2 categories namely, "FIRST CUT LINTERS" and "SECOND CUT LINTERS". The major length of fibers extracted is known as first cut linters and the rest is second cut linters. Each seed will have around 7000 to 8000 fibers on its surface. After the ginning process, the seeds are used to extract oil for agricultural works.

Objectives of Ginning

The main object of ginning is to separate the lint or long fibers from the seed cotton (KAPAS). Before actual ginning process, the seed cotton may be subjected to pre-cleaning treatment.

Pre-Cleaning (Or) Pre-Ginning Treatment

In spite of the obvious disadvantage in mechanical picking pre-ginning treatment is of great advantage. Before actual ginning is done, the seed cotton (KAPAS) is subjected to a process of heating and cleaning where considerable amount of trash, dust etc, is eliminated. If this is not done, there is the obvious risk of their being broken up and included in the bale, thus throwing more work on the blow room machinery and the carding process.

TYPES OF GINNING

1. **Knife Roller Gin**
2. **McCarthy Gin.**
3. **Saw gin.**

Suitability of Ginning.

Saw ginning and knife roller ginning are the two popular methods. Both are generally employed for short and medium stapled. Neps are produced in roller gins, while the saw gin tends to damage the cotton. Therefore the McCarthy gin is used for long staple cotton. It gives much better treatment to the cotton fibers while detaching them from the seeds and hence protects the staple length.

Knife Roller Gin

The 'knife roller gin' is used chiefly for Indian cottons. The ginning percentage is higher than saw gin. It is quite suitable for medium and short stapled cottons.

McCarthy Gin

The 'McCarthy gin' is used for long stapled cotton such as sea island, Egyptian and for other kinds, where the fibers are easily separated from the seeds.

Saw Gin

The 'saw gin' is used for American cotton and where ever the American cotton is grown, such as West Africa, India, Sri Lanka etc., These cottons are of a type in which the fibers are not too easily separated from the seeds. Saw gin cotton is considered to be superior to roller – gin in staple length, and yarns spun from saw gin cotton are often to be stronger. If precautions are not taken ever saw gin tends to damage the fibers. Saw ginned cotton is found to have more impurities.

KNIFE ROLLER GIN

The knife roller gin is used mainly for Indian cottons. The ginning percentage is higher than the saw gin. It is quite suitable for medium and short stapled cotton.

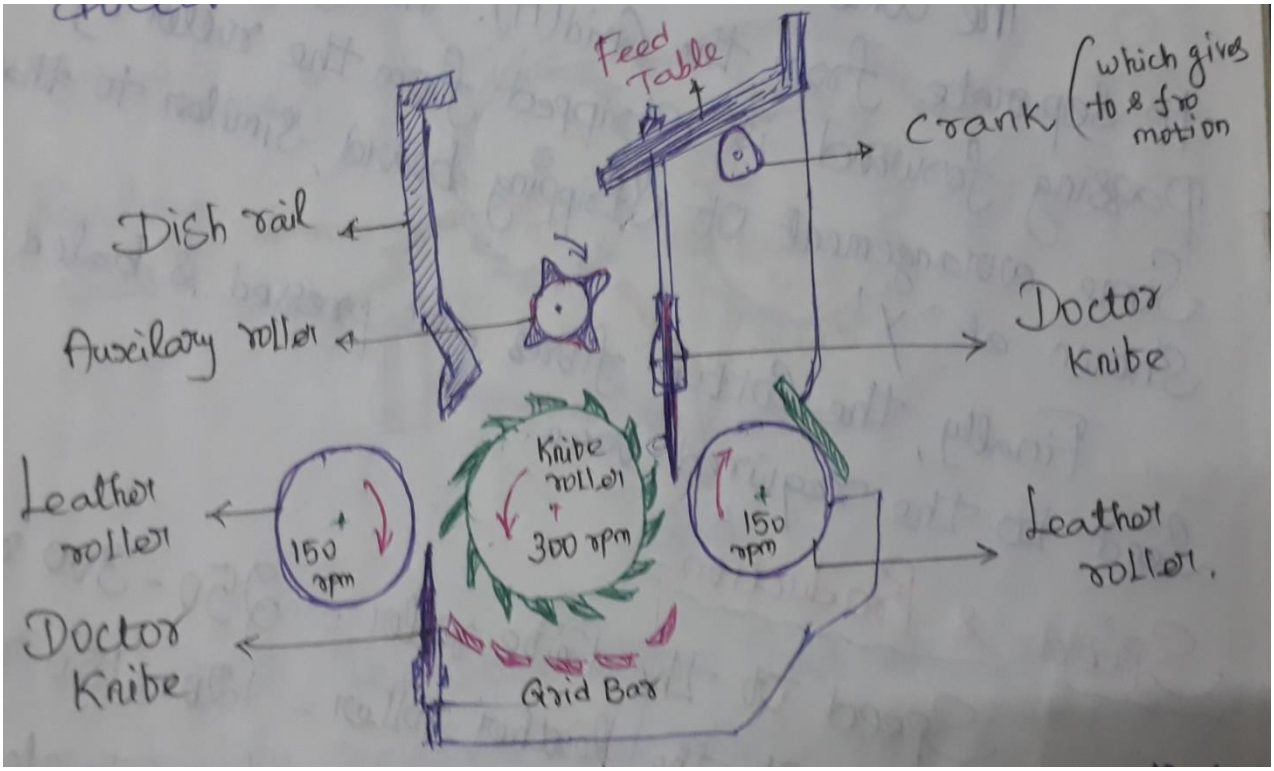
The seed cotton (KAPAS), is fed onto the machine through a feed table. The cotton comes into contact with the knife roller 'B' which is having number of knife discs on its surface and running at a speed of 250 – 300 rpm. The knife portion will cut the fibers from the seed surface.

The seed cotton is carried forward in the direction of B, until it is brought into contact with leather roller. The leather roller is of roughened surface, due to spirally – formed saw cuts, has pressing against it by means of spring and steel doctor knife.

Knife portion being arranged in such a manner that, anything coming into contact with, it is given a reciprocal (or) to and fro motion, as well as being subject to striking action.

The cotton fibers brought into contact with the leather roller adhere to it and are carried round past the knife. It is impossible for the seeds to follow.

So, seed will remain at the point of contact of the doctor knife and leather roller, with the fibers still connected with it.



The knife roller so set as to act upon these adhering seed and gives to them a gentle to and fro motion, repeated very quickly and at the same time a slight striking action (or) pressure also repeated quickly.

The combined action soon causes the seeds to separate from the grid (H). The freed fibers passing forward are stripped from the roller by some arrangement of stripping board.

Finally, cotton fibers are pressed and baled and send to the required areas.

SPEED & PRODUCTION

Speed of the knife roller = 250 – 300 rpm

Speed of the leather roller = 120 – 150 rpm.

Production = 100 – 120 lbs/hr (50 to 60 kgs/hr)

SAW GIN

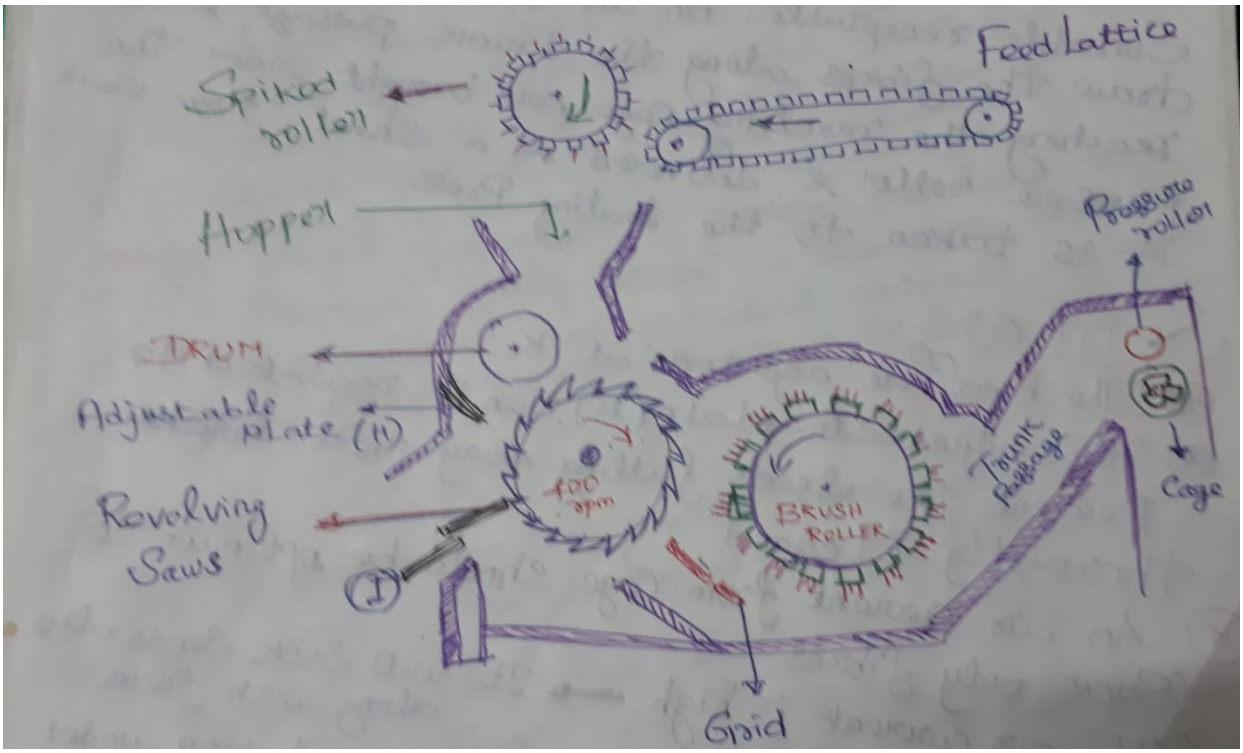
OBJECT

To separate the cotton fibers from the seed.

WORKING

The seed cotton is fed upon the lattice and carried forward to the spiked roller, which loosens the cotton and throw into the hopper.

In hopper, the seed cottons come into contact with rapidly revolving saw roller. Approximately 70 saws are threaded on a shaft.



As the saws revolve, the teeth carry the fibers forward, but it is impossible for the seeds to follow and also, due to the heavier beating of the rapidly revolving saws on the seed cotton, the fibers are separated from seed and taken round until the brush strips the fibers from the teeth.

Empty seed husks and other broken seeds are thrown into grid, thro' which they pass into suitable receptacle. An air current from the cage draw the fibers along the trunk passage and on reaching the revolving cage are brought under the pressure roller and delivered as a sheet, from which it is taken to the baling process.

SETTINGS

1. An air current from cage should be optimum to suck only fibers.
   If air current is high → it will suck seeds also along with fibers.
   If air current is low → fiber accumulation under brush roller & block the machine

Saw gin is suitable for American and Egyptian cotton.

GINNING PERFORMANCE ON YARN QUALITY

Unginned and broken seeds in cotton cause lot of difficulties in subsequent spinning preparation process.

- At scutcher, these seeds get crushed under the calendar roller and expel cotton seed oil, which affect the quality of lap.
- At the card, the metallic wire get loaded with seed coats, seed oil and wax substances. Some-times, seeds get crushed under feed roller (or) calendar roller & expel the seed oil, which affect the carding quality.
- Neps formation in ginning will tend to produce curly cotton in Blowroom, neps in card sliver and undrafted material, end breaks, in-sufficient twist insertion in fly frame and ring frame.

At every stage, control of material depends on the fiber length. So, fiber damage (or) gin cut fibers, in the ginning directly affect the subsequent spinning process.
For example, fiber damage in gin causes to produce short fibers, fly liberation, fiber loss in subsequent spinning departments and short fiber content greatly influences regularity of yarn.
Fiber length influences the yarn strength and spinning value.

DEFECTS IN GINNING

1. During ginning, seed coats may join the lint, giving maximum trouble at blow room and carding.

2. **Broken Seeds –** Due to wrong setting and excess roller speed and saw – disc speed in ginning machine adds trash in bale cotton.

3. **Crushed Seeds –** are more trouble in blow room and carding.

4. **Gin Cut Cotton –** It is the cotton, that shows fibers damaged in ginning thro' cutting by the saws. This will reduce the value of cotton.

5. **Seedy Cotton –** It is the cotton in which, during the ginning process, a considerable number of whole seeds as well as the part of the seeds have been left mixed with the lint.

6. **Oil Stained Cotton –** It is the cotton that has become more or less saturated with oil during ginning process.

BALING PROCESS

The fibers are carried into baling section after ginning process. The process of packing ginned fibers in a compact form is known as baling process.

The baling is done using the following procedure.

- Place the gunny bags / PP bag on the floor.
- Spread the ginned fibers uniformly across its width and length.
- Superimpose the layers
- Press the fibers using hydraulic pressure.
- Finally tie it with the help of strings.

Cotton growing countries	Bale Weight (in Kgs)
USA	220 - 250
Taiwan	200 – 220
India	170 - 200

Impurities Present In the Cotton Bales (Contaminations)

The impurities in the cotton are,

- Strings of jute, Nylon wire
- Leaves, feather pieces
- Pieces of plastic
- Human hair
- Stones
- Sand etc.

In order to minimize the contamination in the Indian cotton and also to grow contaminated controlled cotton, the following measures have been taken.

- Automatic devices at ginning industry to detect and remove impurities.
- Education to farmers / Ginners.
- Use of cotton cloth both for packing and transportation etc.

GRADING OF COTTON

Cotton grading is usually carried out by considering the following factors.

- Colour of cotton
- Length of cotton fibers.
- Trash present in the cotton.
- Ginning preparation.

All the above parameters can be found out using HVI (High Volume Instrument). Separate HVI modules are available to test colour, trash, length, fineness etc.,
All the parameters can be tested in less than one minute.

Cotton grading method followed in India as follows.

- Extra super fine
- Super fine
- Fine
- Fully good (Medium)
- Good (Coarse)
- Fully Good Fair (Coarse)

GRADING OF INDIAN VARIETY OF COTTON

Type of Cotton	Colour	Length in mm	Trash %	Grading
SUVIN (OR) EGYPTIAN	Pure White	37 – 40	1.5 – 2	Super Fine
DCH 32	White	32 – 35	3 – 4	Fine & Fully Good
MCU 5 SHANKAR 4	Cream	25 – 27	5 – 6	Good
JAYADHAR & DESI	Soil	17 – 20	7 – 8	Fully Good Fair

BLOWROOM

MIXING AND BLENDING

There are two important processes to produce the required quality of yarn and fabric, which is comfortable for the user and available at the affordable prices.

Mixing and Blending lead to minimising the investment on raw materials and maximising the profit on the end product by satisfying all concerned constraints.

MIXING

Mixing refers to the combination of different types of cotton fibers in required proportion.

The different fibers are mixed in order to,

- Reduce the cost of raw material as well as production cost.
- To produce the required end product
- To maintain the consistent quality product thro' out the year.
- To improve the processing performance.

The cottons such as DCH 32, MCU 5 and other varieties will be mixed together to spin 60s Ne yarn.

Other mixings are as follows,

- DCH 32 + MCU 5 + J 34
- Shankar 4 + MCU 5 + Varalakshmi.
- Shankar 4 + Jayadhar + Desi

BLENDING

Blending refers to the combination of different types of fibers such as cotton, polyester, viscose, modal etc,. (Like P/C, P/V, C/V, P/V/C, etc,)

Blending is based on the measurement of important fiber properties such as length, fineness, maturity, strength etc, quantitatively proportioning and combining the compatible properties in such a way that the physical properties of the resultant product can be predicted and reproducible.

Blending can improve the running characteristics of the material at every stage of processing from carding to dyeing and finishing.

OBJECTS OF BLENDING

1. To produce the consistent quality products for a longer duration.
2. To improve the processing performance.
3. To meet the functional properties required for the end product.
4. To reduce the cost of raw material and production.

When two different types of fibers are blended, the properties of both the fibers will be blended together and make the end product more comfortable for the user.

In addition, the cost on the material can also be reduced without sacrificing the quality standard of the end product.

The common blends which are normally used are,

- Polyester – cotton - (P/C) - 67 : 33 (Ratio)
- Polyester – Viscose - (P/V) – 50 : 50
- Cotton – Viscose – (C/V) – 58 : 42.

New Blends → Silk + Modal fiber – 65 : 35 and 50 : 50

FIBER PROPERTIES TO BE CONSIDERED BEFORE BLENDING

Essential Properties	**Desirable Properties**
1. Length	1. Crimp
2. Strength	2. Elasticity
3. Flexibility	3. Cohesion
4. Fineness	4. Porosity
5. Uniformity	5. Colour
6. Spinnability	6. Lustre

TYPES OF BLENDING

1. Hand stock Blending (or) Sandwich Blending (or) Blow room Blending.
2. Draw frame Blending.

1. HANDSTOCK BLENDING

Here the fibers are selected to meet the compatible properties with reference to length, strength, fineness, maturity etc,. The required quantity will be blended by superimposing alternatively the layers one above the other. This stock will be allowed for conditioning and finally processed on Blowroom. This blending will give more homogeneity and effective results at all the stages of processing.

2. DRAWFRAME BLENDING

Here, the fibers required to be blended are processed separately through Blowroom and card. Then the card slivers are doubled at draw frame at required proportion.

MIXING BY MACHINERIES

Owing to the production and quality, now-a-days the mixings are being carried out by machines.

MULTI – MIXER (Trutzschler MPM)

The multi mixer MPM meets the requirements for producing a homogeneous blend. The multi mixer MPM is constructed with 6, 8, 10 and 12 hoppers each 500 mm long, depending upon the requirements for blending and capacity.

The bales are opened and pre-mixed by hand-fed or automatic bale openers. Weighing hoppers are recommended for the production of strictly proportioned blends.

This blend is blown from the previous machine by the material transport fan and conveyed into the feed duct above the hoppers. The conveyor air is ducted through perforated plates in the upper part of the hoppers into exhaust ducts on the side and from there into the blending channel below the opening rollers. The hoppers are closed against the feed duct by pneumatically operated flaps, apart from the first hopper in the direction counter to the material flow.

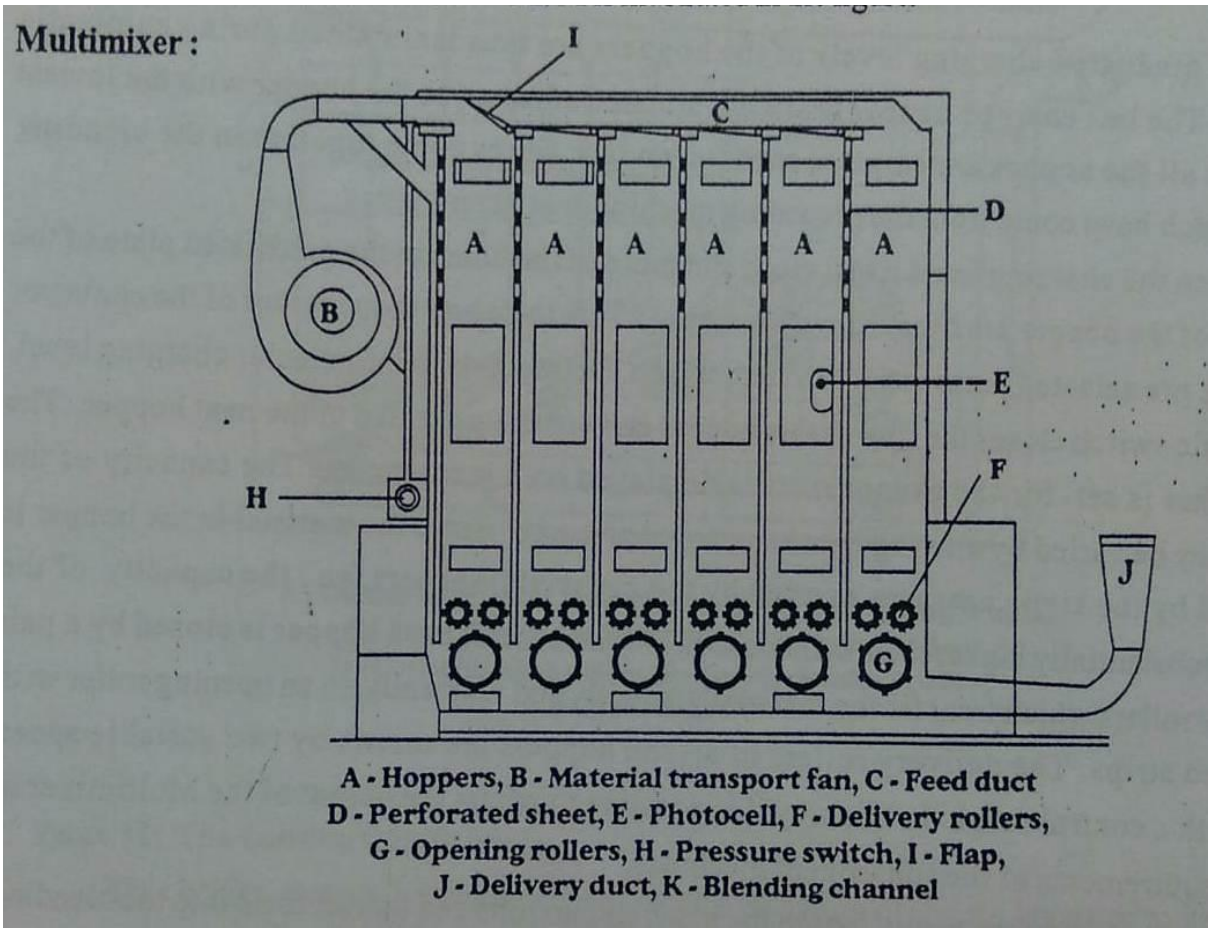
Operational Sequences

The charging of the multimixer at the beginning of a blend lot starts with the first hopper at the end of the feed duct. It is filled only to just below the photocell situated in the adjacent hopper which governs the minimum charging level during automatic operation. Then the closing flap of the second hopper is opened by push button operation. The second hopper is charged to a rather higher than the first. The charging level of the hopper rises uniformly up to the last hopper which is fully charged.

Whilst the last hopper is being charged, there is a changeover to automatic operation and the material transport is switched on. The column of material in the hoppers starts to drop. When the last hopper is full, the closing flap shuts automatically.

Charging restarts with the first hopper as soon as the level of the second hopper has dropped below the photocell. The multimixer is also available with automatic preliminary charging.

The graduated charging levels of the hopper are thus maintained during automatic operation. The last charged hopper is always situated adjacent to the hopper with the lowest charge. As all the hoppers are emptied simultaneously, fibers come together in the blending channels which have come from the previous machine at different times.



When the charging level rises, more and more of the holes in the perforated plate of the upper part of the hopper are blocked with material. This increases the pressure of the conveyor air. Once a pre-selected pressure is reached, which corresponds to a particular charging level, an electronic switch closes the flap of this hopper and opens up the flap of the next hopper. The pressure that is set for the changeover is displayed on a monometer. The capacity of the hoppers may be varied by altering the changeover pressure. Since the material in the hopper is condensed by the static pressure exerted by the material transport fan, the capacity of the hopper is substantially higher than with loose fill. The base of each hopper is closed by a pair of delivery rollers which transfer the material gradually and uniformly, to an opening roller with six toothed strips. The delivery rollers of all the hoppers are driven by two variable speed motors with a control range. In this way, it is possible to adjust the output of the multimixer to the feed requirements of the subsequent machines.

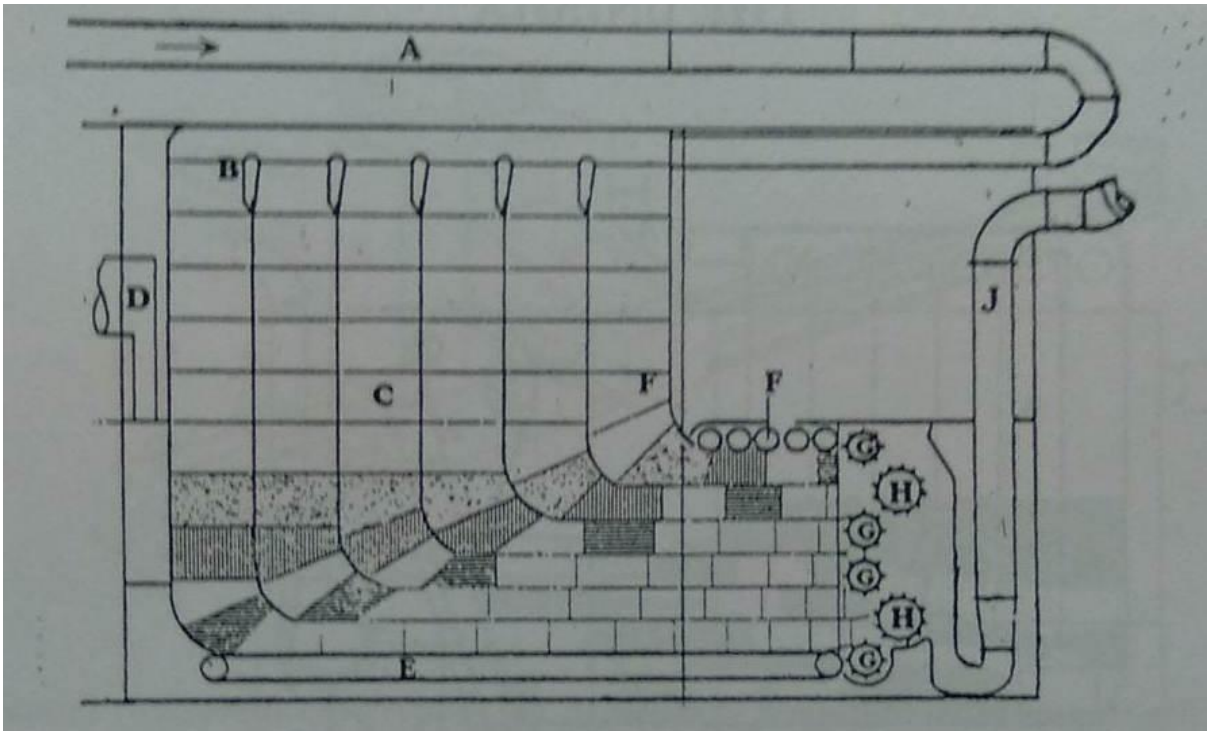
The opening rollers gently loosen the material into tufts and deliver them into the blending channel from which they are sucked by the subsequent condenser.

When the blend lot is changed, the multimixer MPM must be emptied.

AERO MIX

The Aero mix is capable of producing perfect and homogeneous blend. This helps to reduce the number of doublings of slivers and rovings between the cards and ring frames.

The Aero mix consists of four zones.
Zone – I – Storage Section
Zone – II – Condensing Funnel
Zone – III – Opening Section
Zone – IV – The Driving Arrangement.



Zone – I – Storage Section

This consists of the material distributing duct (A) into which the tufts are blown. Over the adjustable separating noses (B), a relevant turbulence is formed which creates a thorough instantaneous blending action. The six vertical filling trunks (C) of varying heights arranged in the direction of the flow of the material simultaneously receive portions of all the constituents of the blend. The conveying air current effects a first stage of condensation of the horizontal layer and then escapes through the perforated side rolls into a duct (D) leading to the filter installation.

Zone – II – The Condensing Funnels

This brings about a 2 – 3 fold mechanical condensation of the six layers of material. In this way, an effective holding capacity of about 350 kgs is obtained. A conveyor belt (E) together with the conveying rollers (F) carries the material to the delivery. The speed is adjusted in accordance with the desired output by means of infinitely variable gearings.

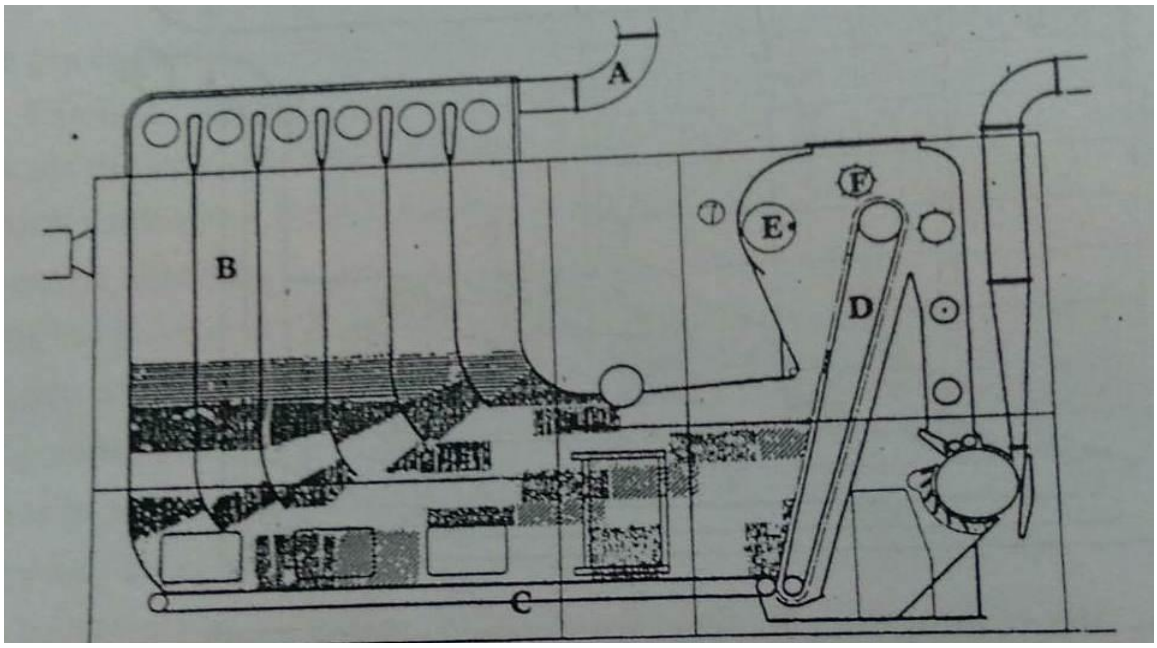
Zone – III – Opening Section

This directs the flow of material to two pairs of consolidating rollers (G) and the corresponding rollers (H). Owing to the different stretches to be travelled the constituents comprising the mixing, which have been fed simultaneously to the trunks, arrive at the delivery (J) only at a widely spaced intervals.

Zone – IV – Driving Arrangements

This comprises all driving motors and control elements. The material is sucked-off by the subsequent machine.

THE UNI MIX



The machine is made up of 3 zones.

Zone I – A Storage Section, Zone II – An intermediate chamber and
Zone III – A delivery section

Flocks are fed pneumatically and simultaneously into six chutes (B) arranged one behind the other in the storage section.

A conveyor belt (C) leads the stock through the intermediate chamber to the take-off unit. The material column is thus diverted out of the vertical into the horizontal. In addition to a condensing effect, this 90° bend in the material flow also produces a shift in the timing and spatial distributions of transport of the fiber packets from the first to the last chute. This in turn results in good long term blending. Thereafter, as in a blending opener, material is extracted from the intermediate chamber and subjected to a further opening step between an inclined spiked lattice (D) and an evener roller (F).

An optical sensor ensures that only a small quantity of fiber stock is held in the mixing chamber (E). After the spiked lattice there is either a simple pneumatic suction feed to the next machine. Both blending and cleaning machines are thus provided by a single piece of equipment.

BLOW ROOM

Blow room is the first machine after ginning to extract the major proportion of impurities present in cotton and also to open the material into smaller tufts.

The main object of blow room is **Opening & Cleaning** and **Lap Formation.**

Need for Opening:

The material either cotton (or) MMF supplied in the form of bales is of bigger tufts and it has to be opened into smaller tufts in order to produce uniform lap. The distribution of fibers across the width and length of lap should be uniform and these results in good quality of sliver and yarn in the next stages. Hence, the material has to be opened to a fibrous stage in blow room.

OBJECTIVES OF BLOWROOM

1. To open the compressed layer of cotton (or) any staple fiber such as polyester, viscose etc., with minimum damage to the fibers.
2. To remove the impurities like sand, leaf bits, crushed seeds etc., by beating and opening action with minimum loss of spinnable fibers.
3. To achieve homogeneous blending of fibers to produce uniform quality lap.
4. To convert the mass of fibers into uniform thick sheet both longitudinally and transversely known as ‘LAP’

TYPES OF OPENING

- Opening by the action of spikes between the inclined spiked lattice and evener roller.
- Opening by beating action by the beater when the material is held by a pair of rollers.
- Opening by beating action when the material is flying in the air.
- Opening by the bladed beaters present in the scutcher unit of Blowroom.

DEGREE OF OPENING

1. Opening by the action of spikes is known as **“Preliminary opening”.**
2. Opening by the beaters when it is held by a pair of feed roller (or) in air is known as **“Intensive opening”.**
3. Opening by the action of beaters in the scutcher unit is known as **“Final opening”**

Opening and Cleaning in Blow room

The main object of Blow room is to open the material and also to clean the same by extracting the major portion of impurities present in it.

The opening and cleaning on Blow room is carried out by the action of different openers and beaters present in the line. The type of beaters and openers for a particular mixing will be selected based on the following factors.

- FQI (Fiber Quality Index) value of the material.
- Count to be spun.
- Trash present in the material.

Example:

More number of beating points is required for coarser varieties such as Jayadhar (or) Desi cotton because, the trash percentage is more and this has to be extracted. In case of finer varieties such as DCH 32, Shankar 6 and MMF, only one (or) two beating points are required, because trash is less and also to minimise the damage to the fibers.

Note:

The openers and beaters should be selected in such a way that the cleaning efficiency is maximum and fiber loss and fiber damage at minimum level.

LIST OF OPENERS AND BEATERS IN BLOW ROOM LINE:

1. Bale Plucker (Blendo-mat / Uni-floc)
2. Bale Opener (or) Bale Breaker.(MBO / HBB / HBO/GBR)
3. Step Cleaner (Ultra – Cleaner)
4. Mono –Cylinder / Axi – Flow Cleaner (AFC)
5. Mixing Chamber (Uni-mix / Aero-mix / Multi-mixer)
6. ERM Cleaner
7. RSB Beater / RN Beater.
8. Bladed Beaters (2BB / 3BB)
9. Kirschner Beater (KB)(Scutcher)

BALE PLUCKERS

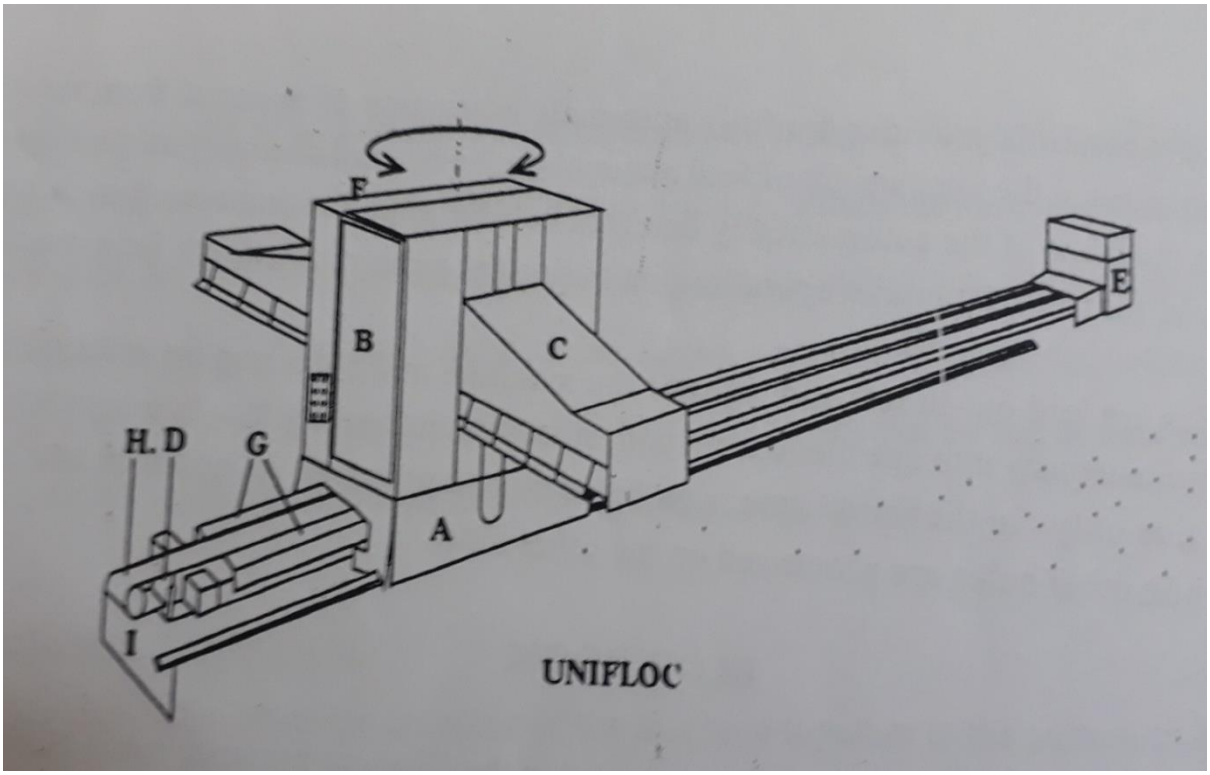
In concept, this is the most widely used type of machine today. Machines similar to the Uni-floc are Optimix (Hergeth Hollingsworth), Marzoli (b12) and Trutzschler (Blendo-mat) amongst other.

The Rieter Uni-floc enables processing of up to 70 bales arranged as four components (different bale types) per blend over a maximum layout length of 41.5 metres. The machine can process one blend or two blends simultaneously. The production rate is normally up to 750 kgs/hr, but in favourable conditions it can reach up to 1000 kgs/hr.

The feed duct (D) and the two guide rails (I) are secured to the floor. The chassis (A), which moves back and front on the guide rails, carries a turret (B) which is rotatable through 180° and supports a raisable and lowerable extracting assembly (C). The latter has individually replaceable double-tooth discs and changes its direction of rotation on reversal of the direction of movement of the chassis, so that material can be extracted in both direction of travel.

To right and left of the extracting roller there are retaining rollers that permit free extraction of material even from the last layer of bales.

A microprocessor is provided for fully automatic extraction of material from the bales. The bales are laid out to left and right of the machine and bales can be processed from both sides simultaneously.



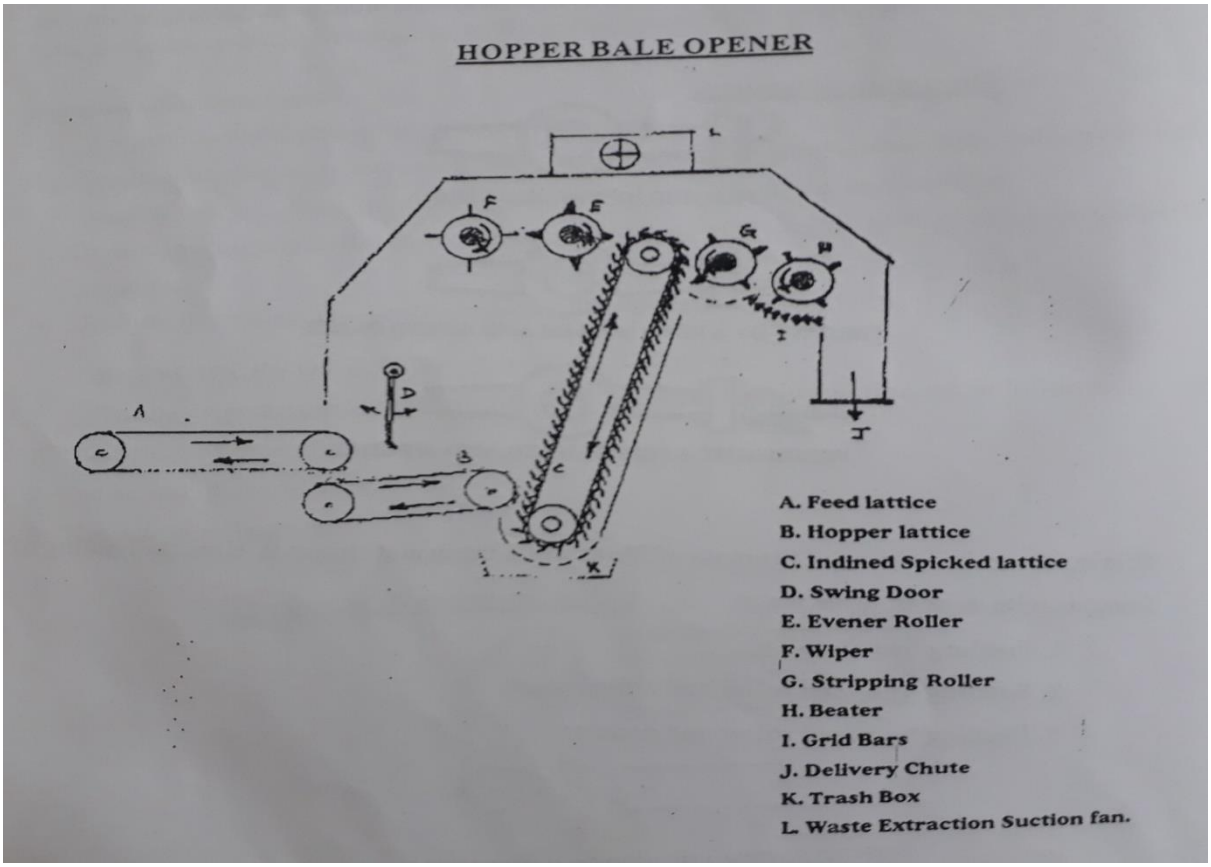
Rieter Uni Floc Bale Plucker Machine

HOPPER BALE BREAKER (or) HOPPER BALE OPENER

Bale openers are recognised as an essential unit of all modern mills. Its object is to give preliminary opening of the matted cotton as taken from bales and so prepare it for the better treatment in the subsequent machine. The cotton taken from the bale in the large layers is put onto an automatic feed lattice. By the movement of the feed lattice the cotton is fed to the hopper. Lattice from which it is conveyed against the spiked lattice which as a combing action and to the action of the evener roller, and large pieces of cotton which are insufficiently broken down being returned to the hopper. The relative speeds of the evener roller and the spiked lattice, the setting between the parts play an important role. A grid bar system used under the beater helps in the removal of heavy trash.

Feed Regulator

In order to provide the uniform feed of cotton to the spiked lattice, a swing door is provided which will keep always 3/4th full of cotton in the hopper. If it exceeds, the swing door will be pushed forward by the cotton inside the bin to the maximum extent which in turn declutches the drive to the feed lattice and hence the feed stops.



Beater Speed – 300 – 360 rpm

Stripper Roller Speed – 300 = 350 rpm

Spiked Lattice Speed – 200 – 250

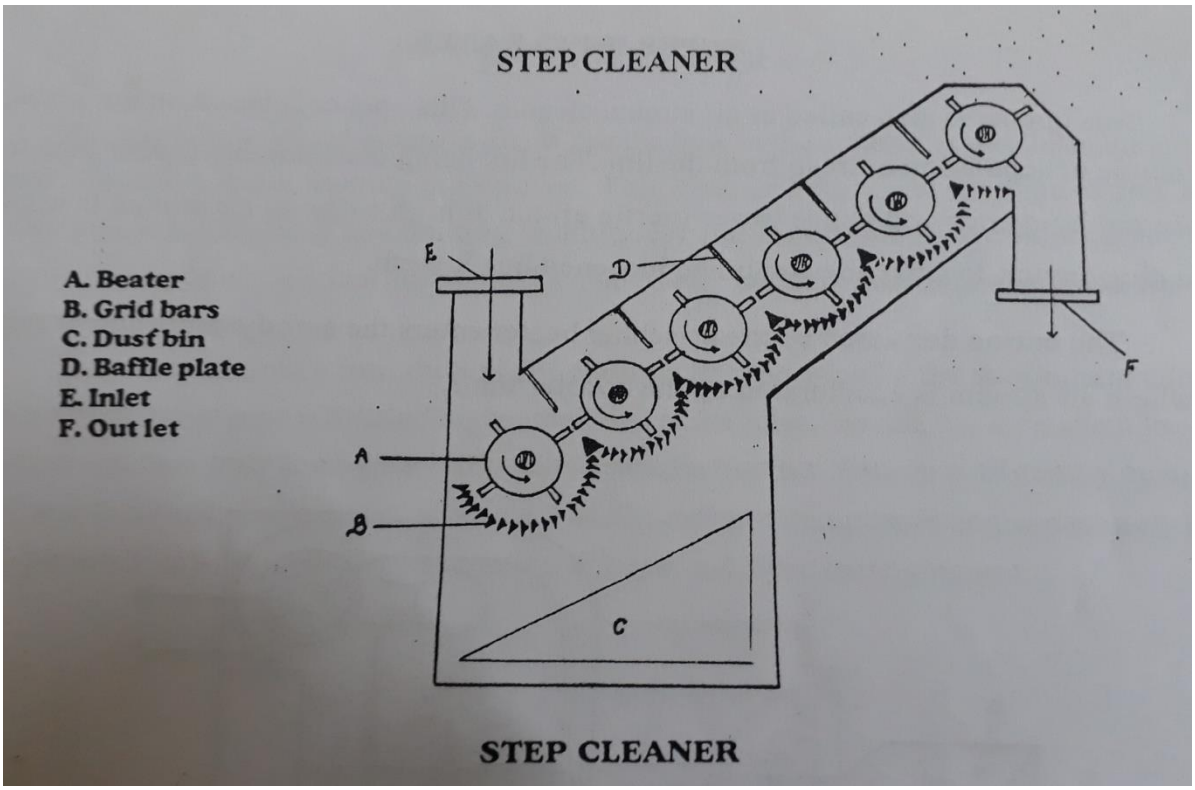
Evener Roller Speed - 110 – 240 rpm

STEP CLEANER (OR) ULTRA CLEANER

Step cleaner is one of the major and effective cleaning point in Blow room line. This cleaner will give around 18 – 20 % cleaning efficiency with minimum damage to fibers and minimum loss of spinnable fibers.

This cleaner is kept after one (or) two openers in Blow room line. The material from the previous machine comes under the action of 6 beaters, which are arranged at an angle of 45° take the material upwards, while removing the heavier impurities by centrifugal force in conjunction with the grids fitted under the beaters. Four rows of spikes are fixed to each beater surface. The beating noses is made up of elliptical rods which prevents fiber damage in spite of severe beating.

The beaters will be rotating at a speed of 320 rpm and their speed can go up to 550 rpm depending on the type of material to be processed. Beaters will effectively beat the material and remove the trash present in it. The baffle plate (D) will prevent the formation of circular air current (Eddy Current) and allow the material to go up for the beating action. Finally, the opened material will be conveyed on to the next machine by suction.



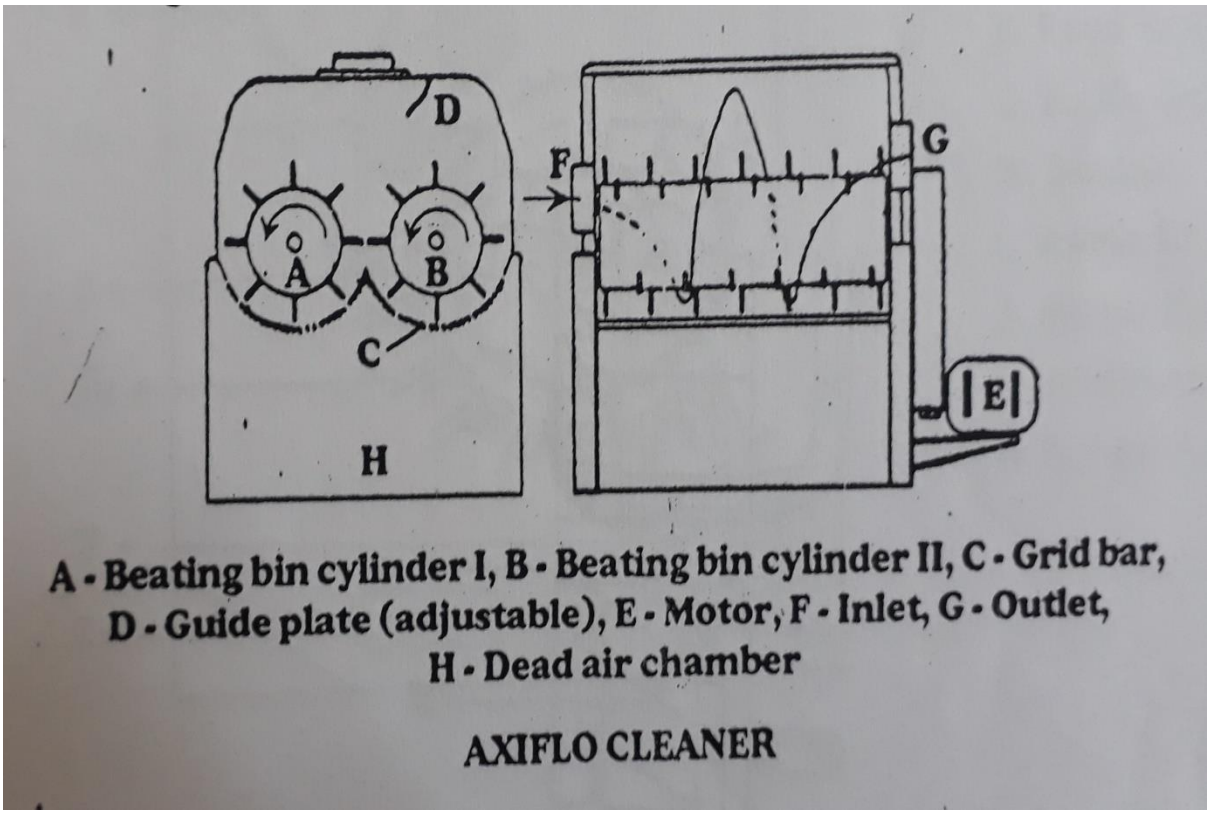
The cleaning efficiency of this cleaner is maximum with minimum loss of good fibers in the waste. Normally the Trash to Lint ratio is 80: 20. The cleaning efficiency increases as the beater speed increases and beyond 540 rpm, the loss of spinnable fibers will be more in the waste.

AXI – FLO CLEANER (or) SPIRO – CLEANER

The machine is named as the axi-flo, because the flow of the material is parallel to the axis of the beater. This is a loose feeding pin opener. This cleaner belongs to the type of free beating point. i.e. (Loose feeding and beating technique) and is suitable in the extraction of heavy impurities like seeds, broken seeds, husks, leaves etc. without excess loss of good fibers in the waste.

The material is drawn into this machine by means of air current and immediately falls to the action of spiked beaters A and B, which are rotating at a speed of 400 rpm. An adjustable guide plate (D) controls the angle at which the cotton tufts approach the beaters for effective opening. The pin beaters will beat the material against grid bars and release the impurities.

The out let pipe is made higher than the inlet pipe to draw only the opened fibers thro' the out let pipe. The trash will be collected in the trash chamber.



A - Beating bin cylinder I, B - Beating bin cylinder II, C - Grid bar,
D - Guide plate (adjustable), E - Motor, F - Inlet, G - Outlet,
H - Dead air chamber

AXIFLO CLEANER

ADVANTAGES

- Cleaning Efficiency is about 20 – 25 &%
- Reduced Maintenance
- Less power consumption
- Improved yarn strength.

MONO – CYLINDER CLEANER (AERO – DYNAMIC BEATER)

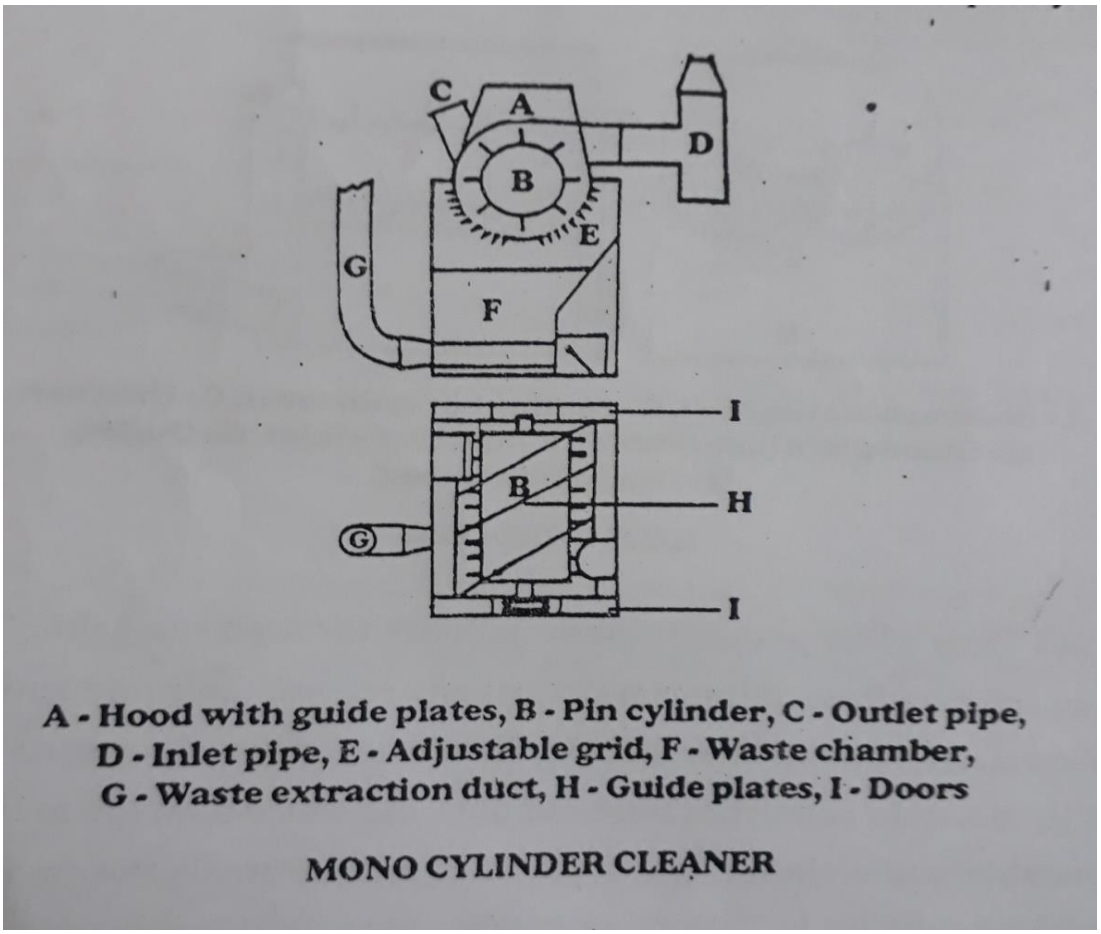
It ensures a high cleaning of the stock with considerable gentleness, because fiber tufts are processed only in free flight and never nipped. i.e. (Loose feeding and beating technique). The impurities, therefore, are never crushed and nep formation is very much reduced.

The cotton tufts well opened by the bale openers enters the machine at right angles to the beater (Pin cylinder) axis. A considerable proportion of the impurities is extracted right at the start by the collision with the pin cylinder and the acceleration in the opposite direction which immediately follows. The pin cylinder then guides the tufts over the grid. Since the tufts are turned over several times as they are flung up, they are brought into contact with the grid on all sides.

The entire cleaning process is repeated three times as the guide plates at an angle to the beater axis into the hood to compel every single tuft to fly around the pin cylinder following a spiral path.

The tangential arrangement of the outlet causes the tufts to emerge out. The hood with its three guide plates can be opened upwards for cleaning.

The cylinder has eight pins around its circumferences and six along its length, arranged spirally.



A - Hood with guide plates, B - Pin cylinder, C - Outlet pipe,
D - Inlet pipe, E - Adjustable grid, F - Waste chamber,
G - Waste extraction duct, H - Guide plates, I - Doors

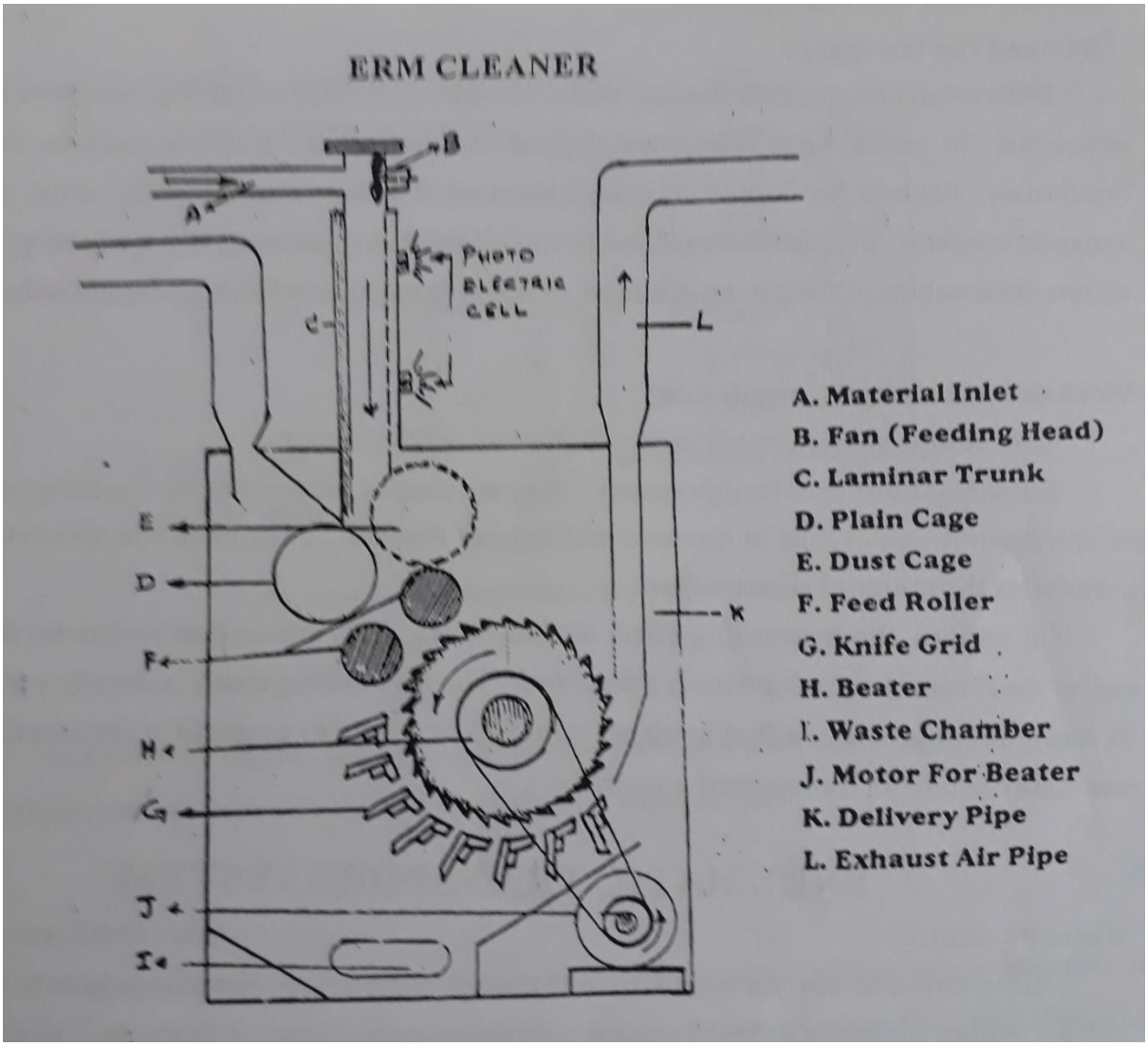
MONO CYLINDER CLEANER

ERM CLEANER

The machine is very simple in construction. The opening capacity of the ERM cleaner is very high due to the use of saw tooth wire (or) toothed disc on the beater. The beaters of different standards are available to permit the quick adaption for different types of raw materials, so that there is greater flexibility in its working.

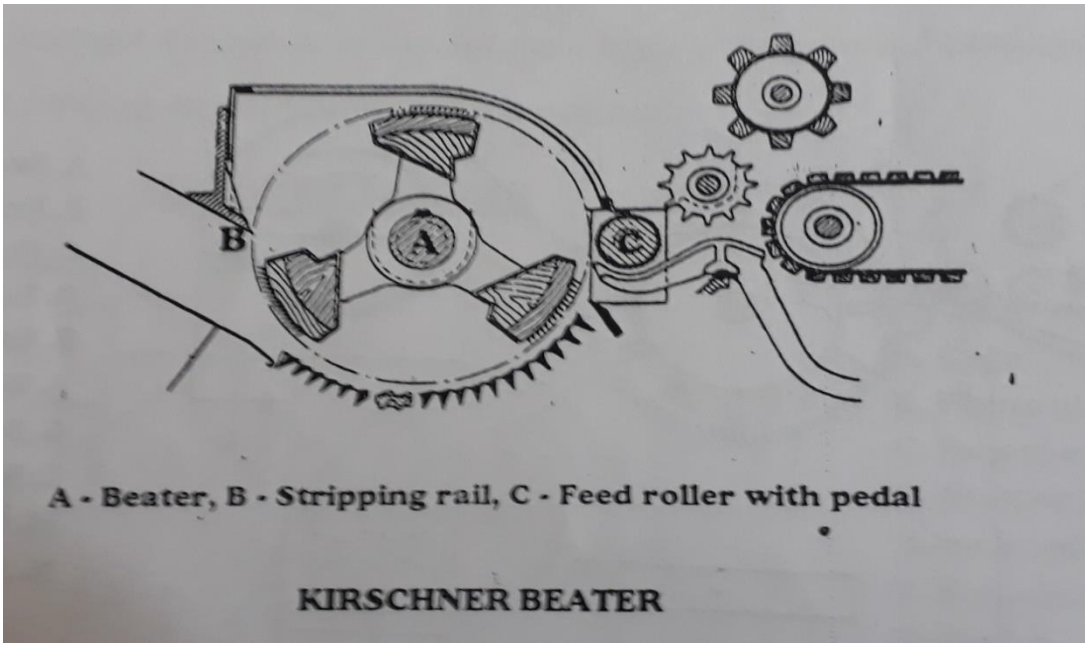
A fan (B) draws the materials by suction from the previous machine and ejects them into a filling chute (C). The rear wall of the chute consists of individual aluminium laminators with slot – openings through which the air can escape. The raw material remains in the chute, is condensed and is fed to the opening roller by means of filter drum (D), blind drum (E) and the feed roller pair (F). The opening roller is exchangeable and can be fitted with bladed discs or saw-tooth clothing.

The grid arrangement under the roller consists of eight blades. After the grid, the flocks are removed by suction. The transport air of the fan (B) escapes via the slotted chute, filer drum and duct (J).



KIRSCHNER BEATER

This type of beater is gained a lot of popularity with the advent of modern Blow room line though it has been available for many years. With the introduction of improved cleaners at the earlier stages of Blow room processing, the trash extraction has become more effective and more important to make a uniform and well textured lap at scutcher.



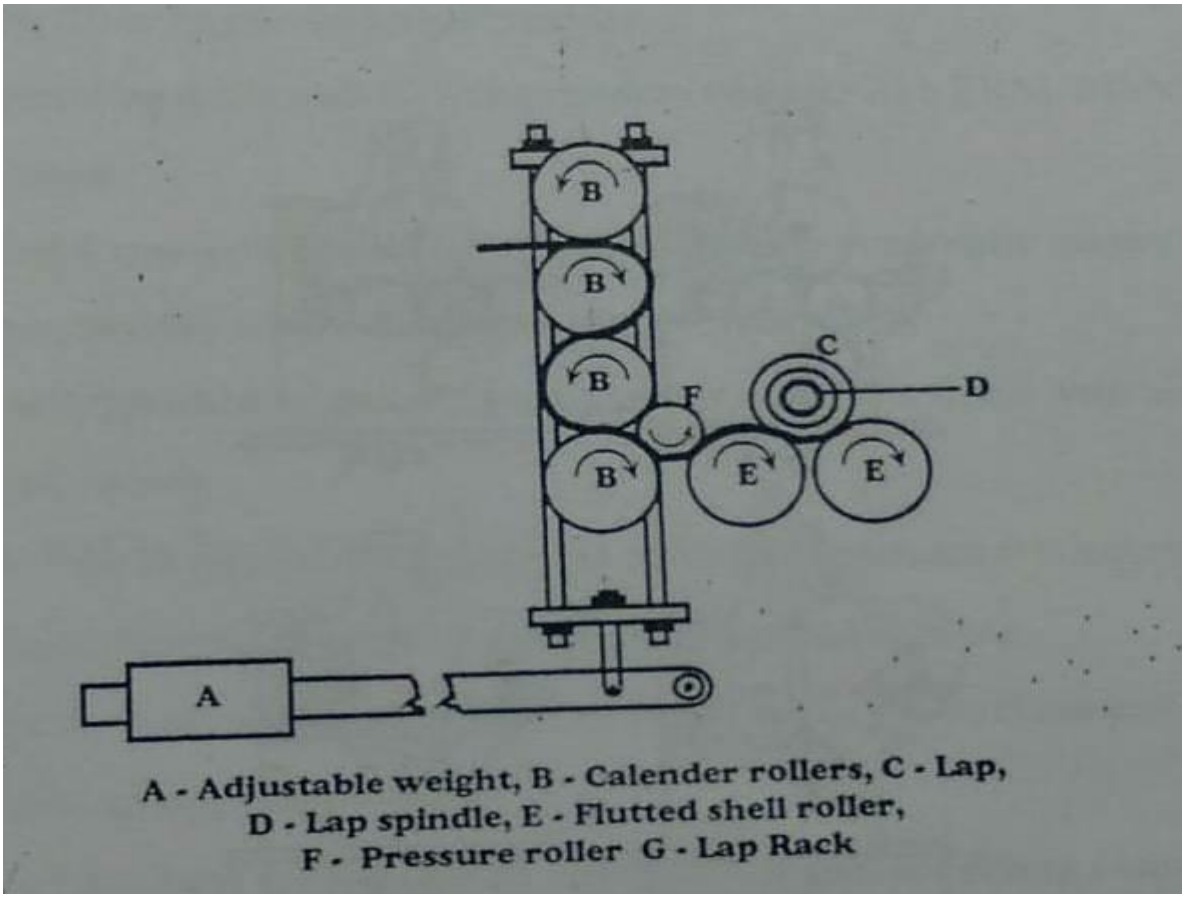
The "KIRSCHNER BEATER" consists of 'Three armed Spiders' mounted on a shaft with wooden lags. Firmly well pointed steel pins are arranged in staggered form to ensure adequate combing of the cotton across the whole width of the machine. Further, there is a slight taper in the wooden edges when mounted, the leading edge being thinner than the trailing edge. In other words, the radius from the beater centre to the points at the leading edge of each lag is less than the radius at the trailing edge. This has the effect of a graduated penetration of cotton fringe at each blow of the beater, minimising any tendency to pluck uncombed tufts from the fringe. Three types of 'Pinning' are available namely coarse, medium and fine.

The fine one is having finer and more pins. The medium is most commonly used and is suitable for cottons ranging from 1" – 1 3/4th in staple length. It is normally run at speeds around 700 – 750 rpm.

Lower speeds with fine pinning are recommended for long staple cotton. This type of beater is not considered to be a good cleaning machine. But it produces a smooth and well opened sheet of cotton for the card. This is a pre-requisite for good carding. The maintenance of pins is more important failing which causes nep formation and fiber breakage.

LAP FORMATION UNIT

As the cotton leaves the cages (in the scutcher unit after Kirschner beater), it is collected and lightly pressed by a pair of fluted feed rollers, which have the same surface speed as the cages and it then passes on to the calender rollers (B) of the machine as shown in the figure. There are four calender rollers made of highly polished cast iron, mounted in suitable slides, one above the other, and heavily weighed, a force up to 2 tonnes being applied by means of levers or by pneumatic means.



The cotton passes out between top and second calender rollers and then leaves between bottom and third calender rollers. After leaving the calender rollers, the sheet of cotton passes beneath a pressure roller (F), which helps to maintain the compacted condition of the sheet as it is delivered to the fluted shell rollers (E). Resting between the two shell rollers is the lap spindle (D), rotated by the shell rollers. The operative places the sheet between the lap spindle and shell roller and then applies pressure at each end of the spindle by racks. This initiates the formation of the lap on the lap spindle.

UNIT – II

CARDING

The Blow room process opens the compressed bale of cotton into small tufts. It also removes 65 – 75 % of trash present in the cotton. Due to its high rate of production, the fiber to fiber separation and complete removal of trash cannot be achieved in Blow room. The condition of fibers at this stage is not suitable for drafting and spinning. This necessitates additional processes like carding and drawing.

CARDING

Carding is defined as the process of reduction of an entangled mass of fibers into a filmy web by working between two closely spaced, relatively moving surfaces clothed with sharp wire points.

Blow room lap is the feeding material to card and the end product of card is known as 'sliver'. Carding is named as 'heart of spinning' and 'a well card is half spun'.

Major amount of trash present in the mixing can be extracted only by the combination of Blow room and card and also the quality can be improved at these two stages only. Hence care should be taken at all points of Blow room and card to get better quality products.

OBJECTS OF CARDING:

1. **Removal of trash present in the lap / Feed Material**
2. **Thorough mixing of fibers.**
3. **'Fiber to Fiber' separation.**
4. **Conversion of lap / Feed Material into 'SLIVER'.**

BASIC PRINCIPLE OF CARDING AND STRIPPING:

The carding surfaces have to perform two basic actions.

1. Carding action.
2. Stripping action.

CARDING ACTION:

Carding action takes place,

1. When two surfaces move in opposite directions with the wire points inclined in opposite directions.
2. When two surfaces move in same direction, but at different speeds.

In both the situations, point to point is common, but the intensity of carding action depends upon the following points:

1. The arrangement and density of wire points.
2. The setting between wire points.
3. The relative surface speed of the wire clothed surface.

STRIPPING ACTION:

For stripping action, the surfaces move in opposite directions with the wires inclined in the same directions. Stripping also occurs when the surfaces move in the same directions. In each case the faster moving surface will strip the other one.

INTRODUCTION:

There are two types of carding machines. They are:

1. Roller and clearer card – used mainly for fibers like Wool, Jute, and Flax and Waste cotton.
2. Revolving flat card – mostly used for fibers like cotton and synthetic fibers.

STUDY OF REVOLVING FLAT CARD: (DESCRIPTION OF A CARD)

FEED ROLLER:

The lap is gripped between the feed roller and the feed plate before it is subjected to the action of the teeth on the licker-in. the feed rate is about 20 cm per minute.

LICKER-IN (OR) TAKER-IN:

This is a roller of about 9'' (25 cm) dia., covered with saw teeth and runs at 700 – 1000 rpm and revolves towards the feed part of the machine. The function of the licker-in is to separate the tufts in the lap into smaller tufts, and also to clean the fibers from motes, dirt, seed and other foreign materials.

MOTE KNIVES:

Specially shaped knives to remove motes, seeds etc., placed below the licker-in. The motes refer to dust and other impurities attached to cotton fibers.

LICKER-IN UNDERCASING:

A screen placed below the licker-in consisting of a perforated metal cover with suitable grids in the middle, through which impurities fall.

BACK PLATE:

A metal plate which is used to cover the cylinder in the gap between licker-in and flats and to make the machine air tight so that no foreign elements can interfere with the cotton inside the machine. The setting between the back plate and the cylinder governs the quality of the web.

CYLINDER:

The metal drum of 50'' diameter rotating at 250 - 400 rpm. The outer surface of the cylinder is covered with metallic clothing. These are sharp wire points. The cylinder rotates towards the delivery end of the machine. The wire points on its surface also point in the same direction.

CYLINDER UNDERCASING:

Metal under casting for cylinder with grids at the middle similar to licker-in under casting.

FLATS:

Metal strips about 110 in number, connected in a chain on the top of the cylinder throughout the width of the machine.(size of flats 5 cm X 100 cm). The bars are covered with fillets with the usual knee bend. The working flats are made to move in the same direction as the cylinder wire points. The flats move at a very slow speed, about 3" – 7"/ min.

FRONT PLATE (OR) PERCENTAGE PLATE:

A metal plate put on the delivery end of the cylinder. By the setting of the front plate to the cylinder, the amount of cotton that will pass on the flats is regulated. Setting of this plate determines the amount of percentage of flat waste (flat strips). So this is called as percentage plate.

DOFFER:

A metal drum usually 27" dia., the surface of the drum is covered with metallic wire like that of cylinder. The doffer rotates towards the feed end of the machine, but it wire points towards the delivery that is in the same directions as that of cylinder wire points. The function of the doffer is to remove the fibers from the cylinder surface and get them condensed on to the doffer surface. The revolutions of doffer range from 20 to 50 rpm depending upon the desired rate of production.

WEB DOFFING DEVICES:

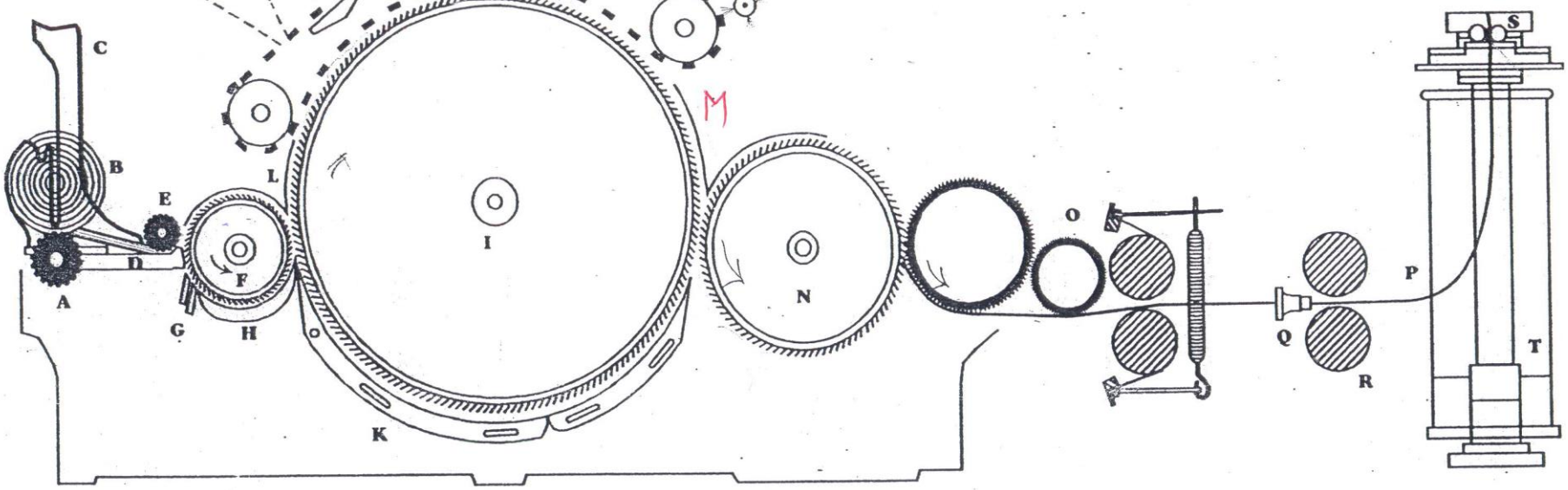
Either Cros Roll or India Roll arrangement is used to remove the web from doffer.

COILER UNIT:

The condensed web (sliver) is coiled in a can properly by the coiler unit.

PASSAGE OF MATERIAL THROUGH HP CARD:

The lap is unwound by lap roller by frictional contact. The fluted lap roller is made of either wood or aluminium. The sheet of cotton passes over the smooth surface of feed plate and fed by a weighted fluted feed roller. The surface of the feed plate is made polished for smooth flow of the material and the curved shape is made for the progressive penetration of licker-in teeth into the fringe of the material. Then the cotton sheet is presented to the action of a fast revolving licker-in roller. The feed plate is specially designed so as to give effective opening action with minimum fiber breakage. The fiber tufts are further reduced into smaller tufts and even to single fibers by the passage of the teeth on the licker-in so that the imprisoned trash can be released. The opened fiber tufts are carried by the licker-in against the mote knives and over the under grid. Due to the resistance of the mote knives, 'motes' (heavy vegetable impurities) and 'sand' are removed and the finer impurities (fly) fall down through the licker-in under casing.



A - Lap roller, B - Lap, C - Lap stand, D - Feed plate, E - Feed roller, F - Licker in, G - Mote knives,
H - Licker in undercasing, I - Cylinder, J - Flats, K - Cylinder undercasing, L - Back plate,
M - Front plate, N - Doffer, O - Doffing Device, P - Web, Q - Trumpet, R - Calender rollers,
S - Cioler calender rollers, T - Carding can

PASSAGE OF MATERIAL THROUGH HP CARD

The licker-in is set very close to the cylinder. The arrangement of wire points between the licker-in and cylinder is that of **'Point to Back'** arrangement. The cylinder is covered with metallic wire points that has several hundred points per square inch and the surface of these points pass within about 0.010" of the tips of the taker-in teeth. The surface speed of the cylinder is twice that of taker-in and coupled with air current that the cylinder carries round, the cotton fibers are stripped-off from the licker-in teeth by the cylinder and carried forward to the chain of flats.

The flats are clothed with flexible wire strips. The wire points are opposite to the direction of cylinder and set to 1/1000 inch. The cylinder and flats are moving in the same direction, but flats are moving very slowly, carding action (**Point to Point)** takes place between these two sets of wire points. The point to point action of wire points between cylinder and flats will individualise the fibers. (Fiber to Fiber separation). Now-a-days the flats are moving in the opposite direction to that of the cylinder. This technique is known as "FLAT REVERSAL" technique.

The individualised carded fibers are then transferred to the doffer which is running slower than the cylinder. It is covered with metallic wire points but has more points per square inch than the cylinder. The arrangement of wire points are of **'point to point'.** The doffer is set as close as 0.005" (4 - 5 Thou) to that of the cylinder. The wire points are inclined in the opposite direction to that of the cylinder and the transfer of cotton is facilitated due to the release of air current carried round with the cylinder when it meets the close gap between cylinder and doffer.

The layer of fibers, which are carried round with the doffer to the front of the card, where a rapidly oscillating doffer comb or any other web doffing device, like Cros-Roll (or) India-Roll operating close to the doffer surface, removes the fibers in the form of a thin sheet of cotton known as 'web'. This web is condensed together by passing through a trumpet into the form of sliver, and compressed by a pair of calendar rollers. The sliver is further compressed by a pair of coiler calendar rollers in the coiler box. It is then deposited in the form of coils in a can.

Parts	**Width (In Inches)**	**Speed (In rpm)**
Licker - In	9"	600 - 900
Cylinder	50"	300 - 450
Doffer	27"	15 – 40
Flats	-	3 – 5 IPM (Inches / Min)

DETAILED STUDY OF CARDING PROCESS

The detailed study of carding process can be studied under the following heads:

1. Feeding and Opening Zone.
2. Carding Zone.
3. Doffing and Condensing Zone.

1. FEEDING AND OPENING ZONE:

The main object of this zone is to unwind the lap without any uncontrolled stretching and also to extract the major portion of trash present in the lap fed.

The feeding zone consists of

- Lap stand
- Lap roller
- Feed plate
- Feed roller

The opening zone consists of

- Licker-in (or) Taker-in
- Mote Knives
- Licker – in Under casing

Lap stand is designed to keep one lap reserved to feed the same soon after the running lap is is exhausted. The lap roller will unwind the lap at a constant rate.

The feed roller is made fluted or saw toothed clothing in order to grip the material firmly against the feed plate to prevent the slippage and it is loaded by spring. The feed plate is highly polished for the smooth flow of material and its front edge is having a curved shape in order to bring progressive penetration of licker-in teeth into the lap fringe. The distance between the feed plate to licker-in should be set in such a way that there is minimum damage to the fibers and maximum trash extraction.

The opening zone consists of Licker-in (or) Taker-in roller, Mote Knives and Licker-in under casing. The taker-in zone will extract the maximum trash and transfer the opened fibers on to the cylinder surface uniformly for the carding action.

The taker-in (or) licker-in is a cast iron roller and it is clothed with saw toothed wires. This roller will be rotating at a speed of 600 – 900 rpm depending on the type of material processed. (i.e.) the speed is more for coarser cotton varieties and it is less for finer and blends and also for MMF (Man-made Fibers). The licker-in is of 9” diameter and it will open and beat the material against mote knives and licker-in undercasing to extract the trash present in it. The combination of licker-in, licker-in undercasing and mote knives will extract around 60 % of trash present in the lap.

The licker-in wires are available in two types namely positive rake angle and negative rake angle. If the front angle of wires is between 78 – 85° is known as positive rake angle wires. If the front angle of wires is between 90 - 95° is known as negative rake angle wires.

The positive rake angle wires are used Coarser, medium and Cotton blends, because the points per inch is more in order to open the material to extract the trash. Negative rake angle wires are used for synthetic and finer cotton because the points per inch are less to minimize the damage to the fibers.

RECOMMENDED SPECIFICATIONS OF LICKER-IN WIRE (ICC): (Indian Card Clothing)

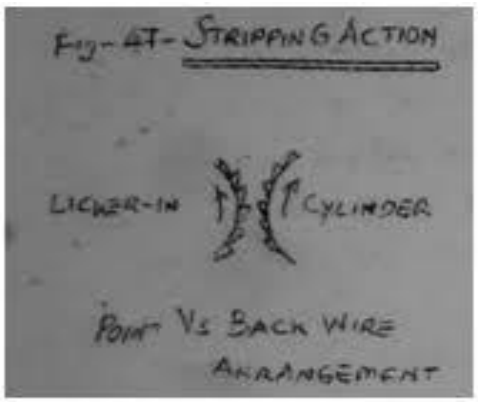
Material Type	**Height of wire (in mm)**	**Front angle (degrees)**	**Teeth/ inch**
Dirty , Low and Medium Cotton	5.5	78 – 80 (Positive)	4 – 5
Finer Cotton (Rich Cotton)	5.5	85	5
Synthetic (MMF)	5.5	95	3.3

Note: In the positive rake angle wire, the space between the wires is narrow and hence PI (Points per Inch) is more and in case of negative rake angle wires, the spaces between the wires is wider and hence PI (Points per Inch) is less.

TRANSFER OF FIBERS ONTO CYLINDER SURFACE

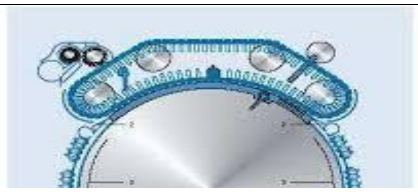
After the fibers are opened and trash is extracted at the licker-in region, the opened fibers will be transferred on to the cylinder surface and distributed uniformly on its surface for better carding action between cylinder and flats. In order to transfer the fibers completely from licker-in to cylinder, following factors assists.

1. Point to back action of wire points between licker-in to cylinder.
2. Close setting between licker-in and cylinder. (7 Thou = 7/1000” = 0.007”)
3. The surface speed of cylinder is double to that of licker-in.
4. Air current between licker-in and cylinder.



CARDING ZONE

Carding zone consists of cylinder and flats and both are clothed with metallic wires. The 'POINT to POINT' action of wire points between cylinder and flats will separate the fibers individually. (FIBER TO FIBER SEPARATION). The carding zone can be sub divided as

Pre – Carding Zone	
Flat Zone (Carding Zone)	
Post – Carding Zone	

Pre- carding zone will make the opened fibers to distributed uniformly on cylinder surface and prevent the combination of waste with good fibers.

In the flat zone, the main carding action takes place between the cylinder and flat wire points. (Point to Point). There will be around 106 to 110 flats and out of that 40 – 45 % (45-50 flats) will be in the working position at a time. The flat zone will individualize the fibers and also extract the waste and this waste is removed as 'flat strips' (Flat waste).

The post carding zone consists of percentage plate, central cylinder stripping door and bottom plate. The percentage plate will determine the flat strip extraction, central stripping door to strip the cylinder whenever required and bottom plate prevent the entry of live air to prevent the combination of waste with good fibers.

The post carding segment also assists to transfer the individualised fibers on to doffer surface. The cylinder speed is around 350 rpm in the modern cards and if the speed is increased, there are chances of increasing of flat strip, generation of short fibers.

CYLINDER CLOTHING:

The cylinder is made of cast iron and is clothed with metallic wires and having 50" diameter. The following parameters are considered before clothing the cylinder, namely

- Point density (Points / Sq. Inch)
- Inclination angle (angle of wire)
- Height.

The density of wire points depends on the type of material being processed.

ANGLE OF WIRES AND DENSITY OF WIRE POINTS

Material Type	Cylinder speed	Points/sq. Inch	Angle of wire
Dirty , short coarse Cotton	350rpm	538	65°
Clean Cotton	350 rpm	717	65°
Long Cotton	350 rpm	860 – 990	60°
Synthetic (MMF)	350 rpm	Around 400	70°

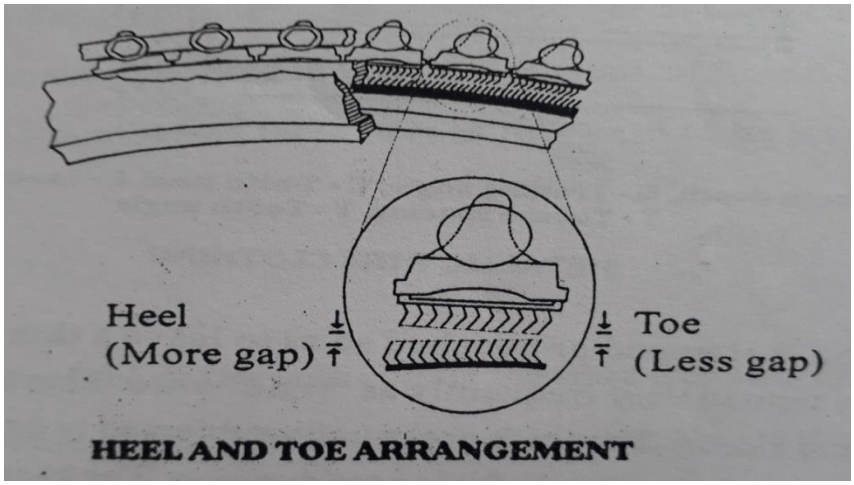
Note: The height of the teeth in the modern card is 2 mm.

FLATS:

The flats are 'T' shaped flat iron rod and is clothed with wire points. Flats are an important partner of cylinder to achieve carding action (**Fiber to Fiber Separation**). Because of the enormous difference between flat and cylinder speed, flats get loaded frequently and hence a separate flat cleaning brush is fixed to clean the flats. The flat speed is kept between 6 – 9 Inches/Min (150 – 230 mm/min) depending on the type of material and nep generation. The cylinder and flats are rotating in the same direction. (Cylinder – 2165 mm / min & Flat – 230 mm/min). The fiber to fiber separation is achieved because of the change of direction of wire points between cylinder and flats. The density of wire points on flats and its inclination as follows.

Material Type	Points/sq. Inch	Angle of wire
Short and Dirty Cotton	348	70°
Long Cotton	532	70°
Synthetic (MMF)	348	80°

HEEL AND TOE ARRANGEMENT



The back end of the bearing surface of the flats is slightly raised. This tilts the working surface of the flats in such a way that the fibers enter each cylinder – flat zone, through a wider gap. As the fibers move through each flat, the distance between the flat wires and cylinder wires progressively narrows. Thus, if the front end is set at 0.254 mm the back end is raised to 0.685 mm. This arrangement is known as "**Heel and Toe**", the **heel** being the leading portion. This avoids any sudden carding action, because the fibers, while being carried by cylinder wires at a relatively very high speed are gradually brought from initial wider space to the final narrow setting.

Small masses or entanglement are beneficially treated in this way, and eventually reduced to isolated fibers by the continued action from flat to flat. Since, each flat is designed and set in the same manner, the gradual penetration is provided at all the flat wire surface in their working position. It may be noted that, the usual setting between cylinder and flats is 0.001" (10 Thou). However it is carried out at "**heel**" and the distance at the **"toe"** being automatically obtained by heel and toe arrangements.

DOFFING AND CONDENSING ZONE

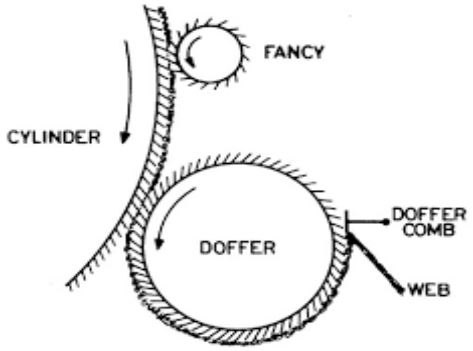
Doffing and condensing zone consists of Doffer, Doffer Comb (or) Web Purifying Unit, Table Calendar Rollers (TCR), Coiler Calendar Rollers (CCR) and Sliver Cans.

Doffing and condensing region convert the material to a thin filmy web and later this web is consolidated and made into sliver by calendar and coiler calendar rollers. Finally, the sliver will be laid in the can in the form of coils.

Factors assisting the transfer of fibers from cylinder to doffer:

The material from carding zone is transferred on to doffer surface due to the following factors:

- Close setting between cylinder and doffer. (4 Thou = 0.004")
- High surface speed of cylinder (Centrifugal Force)
- Release of air current at the point of transfer between cylinder and doffer.



The doffer is a cast iron roller and clothed with metallic wires. The speed of doffer varies from 10 – 90 rpm (20 mts/min to 190 mts/min) from conventional to present day cards. The doffer wire point density and angle of wire is as follows.

Material Type	Points/sq. Inch	Angle of wire
Coarse Cotton	400 - 600	60 - 65°
Long Cotton	800 – 1000	
Synthetic (MMF)	350 - 500	

Note: The wire density and angle of wires on doffer is selected in such a way that the neps are minimized and uniform web is produced.

The doffer comb (or) web purifying unit will strip the fibers from doffer at higher rate of production and convert in to a thin film web form. The web gets consolidated into sliver when it passé through Table calendar rollers (TCR). The surface speed of the table calendar roller (TCR) is higher than the surface speed of doffer to maintain tension between doffer and TCR to hold the web. Finally the sliver passes through coiler calendar roller (CCR) and laid in the can in the form of coils.

AUTO-LEVELLER

NEED FOR AUTO-LEVELLER:

The yarn manufacturing process by nature is such that it is impossible to produce 100% even yarn that is it the inherent inability of the manufacturing process. The yarn count variations affect the quality of the fabrics as well as the efficiency of the machines. In earlier days, doublings and some manual controls were the other means during the manufacturing process to maintain consistency in quality.

Recent developments such as high production cards, chute feeding to the cards and the general shortening of the whole spinning process have focused attention on the subject of automatic control of product regularity.

So, sliver auto-levelling system on cards and draw frames became a basic requirement for keeping the sliver and yarn count constant. Also, the revolution in microelectronics field made it possible to develop more compact, reliable and precious auto-levellers.

Auto-leveller is an online monitoring device and it has become an integral part of card and draw frame. This is an electronic instrument fixed at card and draw frame to monitor the quality of sliver during the running of the machine.

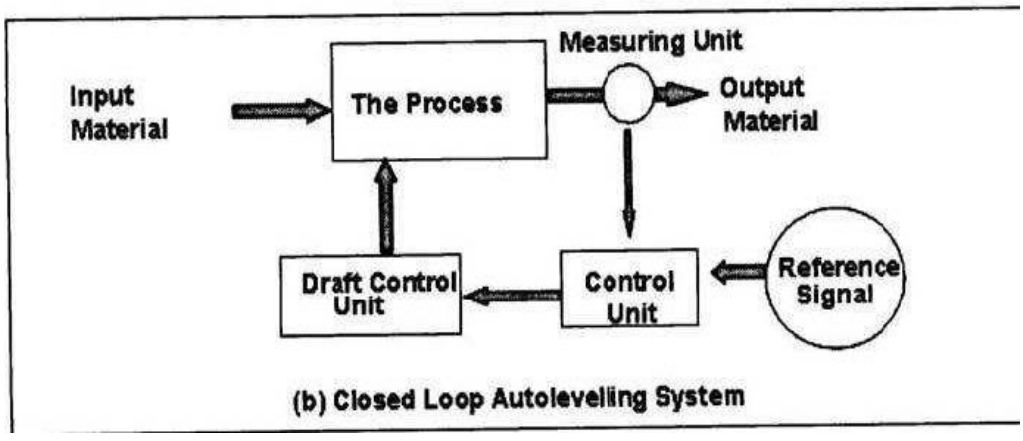
Auto-leveller will minimize the variations exists in the sliver during running and maintain the CV% and U% of sliver within the desired level.

Auto-leveller is an essential instrument on the present day card and draw frames. With the help of this instrument and other quality measures, it is possible to produce the yarn with required quality. Almost all the present day card and draw frames are equipped with auto-leveller. Hence they are named as ‘Auto-leveller Card’ and ‘Auto-leveller Draw frames’.

There are 2 types of Auto leveller, namely

1. **Open loop type. (For Draw frames)**
2. **Closed loop type. (For Cards)**

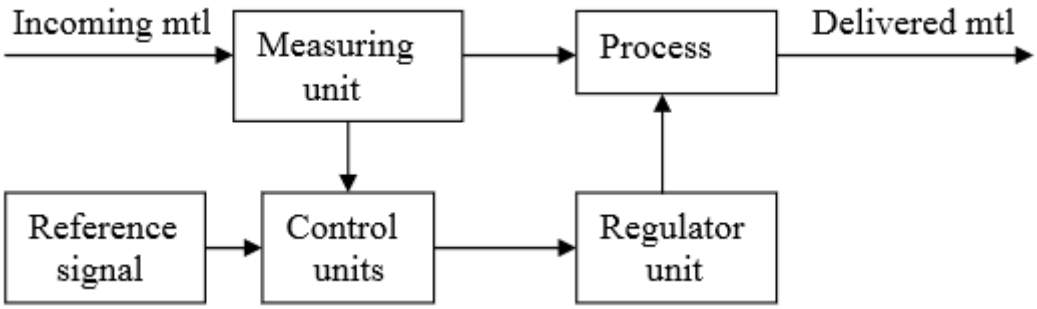
Normally closed loop type is preferred at card, where the circuit is connected between feed roller and calendar roller. Here any thick material passing between feed roller and feed plate is sensed and this signal is transferred on to calendar roller and this in turn reduces the speed of feed roller. (i.e) after the variation is sensed, it is corrected. (**Sensing before correction**).



(b) Closed Loop Autoleveling System

In the closed loop system, the sensing and measurement is made following the corrective zone, generally, they have medium to slow response and correct medium and long term variations.

OPEN LOOP AUTO-LEVELLERS



In this, the sensing element makes the measurement before the correcting zone. In this open loop system, the input is measured and the measurement is stored in a mechanical or electrical delay system for sufficient time until the measured cross section of the sliver or the variation reaches the drafting zone, where the corrective draft change occurs by changing the speed of the input, or the output roller.

In case of draw frame, it is fixed in the drafting system between back to front roller. Open loop system is preferred here. Here the variation is corrected first and later it is sensed. (i.e) "**Correction before sensing**".

Advantages of Auto-levelling:

1. All variations are corrected.
2. Count C.V. % will be consistent & good, hence the yarn will be suitable for Knitting.
3. Thin places in the sliver, hence in the yarn quality will be low.
4. Ring frame breaks will come down; hence pneumafil waste will be low.
5. Fluff in the department will be less; therefore Uster cuts will be less.
6. Fabric quality will be good because of lower number of fluff in the yarn.
7. Labour productivity will be more.
8. Machine productivity will be more.
9. Idle spindles will be less.
10. RKM c.v. % will be low, because of low number of thin places.
11. Workability in warping & weaving will be good, because of less no. of thin places & lower end breaks in spinning & winding.
12. Low sliver U%, hence yarn U% will be good. (U% - Uniformity %)
13. Production will be more accurate in auto-leveller draw frame compared to non-auto-leveller draw frame.
14. Variation in Blend percentage will be very less, if both the components are auto levelled before blending, hence fabric appearance after dyeing will be excellent.

CARD SETTING

(SETTING OF DIFFERENT PARTS OF CARD)

The setting is defined as the distance between the parts of a card. Normally the settings in card are expressed in **"THOU". (1 Thou = 1/1000" = 0.001").**

The settings of different parts at card are very important to get the required quality of sliver with minimum loss of spinnable fibers. There should not be slack or tight setting between the parts as this will lead to loading of wires, poor carding action, cloudy web, irregular sliver etc,. The settings of different parts are carried out using "Multiple Leaf Gauges" and cylinder to flat setting is done by "flat or Trowel Gauge".

Multiple leaf gauges are hardened narrow steel strips ground to accurate dimensions of 5, 7, 10, and 12 Thou. (0.127mm, 0.178mm, 0.254mm, 0.31mm). These gauges will be used alone (or) together depending on the setting between the parts.

NORMAL SETTINGS OF CARD

PARTS	FUNCTION	SETTINGS
1. Feed plate to Licker-in	- To detach the lap fringe at a constant rate. - To minimize the damage to fibers.	9 – 12 Thou (0.228 – 0.31 mm)
2. Licker- in to Mote Knives	- To extract maximum trash - Minimize damage to the fibers	10 – 15 Thou (0.254 – 0.38 mm)
3. Licker-in to Cylinder	- To transfer the opened fibers onto cylinder surface uniformly (Point to Back action of wire points)	7 Thou (0.007" = 0.178 mm)
4. Cylinder to Flats	- For effective carding action to achieve fiber to fiber separation. (Point to Point action of wire points)	10 Thou (0.001" = 0.254 mm
5. Cylinder to Doffer	- To transfer the carded fibers onto doffer surface to convert into thin web and uniform sliver.	4 – 5 Thou (0.004" – 0.005") (0.11 mm – 0.127 mm)
6. Flat to Flat cleaning brush	- For effective flat stripping	32 Thou (0.032")

CHANGE OF SETTING ON SLIVER QUALITY:

The settings of different parts of card are set considering the fiber length and quality of sliver and yarn required. Proper setting between the parts results in

- Optimum cleaning efficiency
- Minimum fiber loss and damage
- Effective carding action
- Minimum loading of cylinder and flats.
- Uniform web and sliver
- Higher production.

STRIPPING AND GRINDING

These are the operations required for better up keeping of the wire clothed parts for their efficient functioning. During carding action, the fiber tufts are opened, individualised and cleaned by the action of wire points. However, some of the fibers along with vegetable originated impurities get embedded into the wire clothing. The wire points themselves get worn-out as they work on cotton tufts. It is, therefore, necessary to reform the state of the wires so as to make them function better.

STRIPPING:

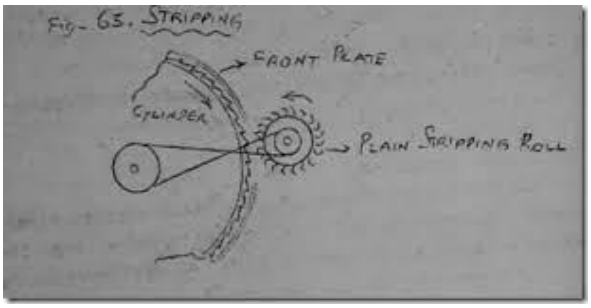
During carding process, the fibers and impurities become embedded in the cylinder and doffer wire points. (I.e. cylinder and doffer loading). If these are not removed from wire points, the quality of sliver will be affected.

The process of removing the embedded fibers and impurities from cylinder, doffer wire points is known as “STRIPPING”.

Stripping frequently depends on the type of material processed. The stripping is done once in 24 hrs (in a day) for coarser and medium varieties and twice in a day for finer varieties and blends.

PLAIN ROLL STRIPPING:

In this method, the stripping roller clothed with wire points is kept at brocket provided at card will be rotated at a higher surface speed. The stripping action of wire points is “point to back”.



GRINDING:

During carding process, the action of fibers, dusts etc. gradually wear the wire points of cylinder, flats and doffer and later these become the poor carding units and adversely affect the quality of sliver. Hence, in order to make them more effective carding units, the bent wires should be straightened. The process of straightening and sharpening the wire points is known as “GRINDING”.

The medium used for grinding is emery fillet (emery roller) having granular formation.

There are two types of grinding, namely

- Long roller grinding – for flats
- Traverse wheel grinding – for cylinder and doffer.

HOOKED FIBER THEORY (FIBER HOOKS)

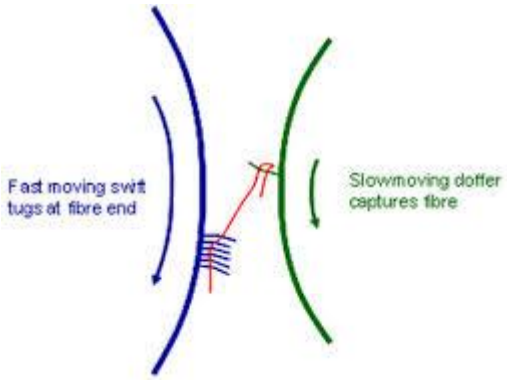
The bulk of fibers leaving the doffer in the form of web, have their end hooked. About 50 – 55 % of the hooks are in trailing direction (major hooks) while about 20 – 25 % are in leading direction (minor hooks). Ideally, the yarn forming process requires all the fibers well parallelized, aligned along the axis of the main strand and quite straightened. The hooking of fibers thus reduces the total fiber length. Increasing the cylinder and doffer speed has profound effect on the proportion of hooks. With higher cylinder speed, the trailing hooks are known to increase, while higher doffer speed leads to increase in leading hooks. Since the yarn quality of ring frame largely depends on both the direction and number of major hooks in the fed material, their reduction in the process prior to the final spinning and subsequent to carding is of greater importance.

Trailing Hooks	
Leading Hooks	
Hooks on both sides	
No Hooks (or) straight fibers	

FORMATION OF FIBER HOOKS

The hook fibres are mainly generated at the interaction or fibre transfer point of the cylinder and the doffer. During fibre transfer, the projecting ends are caught by the clothing of the doffer and taken up. So most fibres remain hanging as trailing hooks on the teeth of the doffer (A). Thus the majority of the fibres remain as trailing hook formed in the carded sliver.

As the cylinder have a much higher surface speed than the doffer, some of the fibres remain caught at one end by the teeth of the cylinder. When these fibres condensate on doffer due to centrifugal force the result is leading hook fibre which is minority hooks.



DRAFT

Draft is the degree in which the material is attenuated (or)drawn out.

In carding, 28 – 35" width of lap should be condensed into a rope form (i.e.) wider width of a thick lap is drafted into sliver.

Draft is just a figure (or) number and does not have any units.(i.e.) if the draft is 50, means, the material has been drafted up to 50 times. (Length increases and thickness reduces).

TYPES OF DRAFT IN A CARD

1. Actual Draft.
2. Mechanical (or) Machine Draft.
3. Tension Draft.
4. Negative Draft.
5. Total Draft.

Machine Draft consists of ,

- Main Draft (Md)
- Tension Draft (Td)
- Negative Draft.(Nd)

The Total Draft (TD) of the card can be calculated as the product of the above three.

Total Draft (TD) = Md x Td x Nd

The Actual Draft (AD) can be calculated as,

$$\text{Actual Draft (AD)} = \frac{\text{Hank of the Sliver Delivered}}{\text{Hank of the Lap fed}}$$

(Or)

$$\text{AD} = \frac{\text{Weight of the lap fed}}{\text{Weight of the sliver delivered}}$$

The Mechanical Draft (MD) can be calculated as,

$$\text{Mechanical Draft (MD)} = \frac{\text{Surface Speed of the Delivery Roller}}{\text{Surface Speed of the Feed Roller}}$$

Note: Actual draft (AD) is always higher than the Mechanical Draft (MD).

The main draft exists between Feed roller and Doffer, tension draft between Doffer and Table Calendar Roller (TCR) and TCR (Table Calendar Roller) and CCR (Coiler Calendar Roller).

$$\text{Main Draft (Md)} = \frac{\text{Surface Speed of the Doffer}}{\text{Surface Speed of the Feed Roller}}$$

$$\text{Tension Draft (Td)} = \frac{\text{Surface Speed of the TCR}}{\text{Surface Speed of the Doffer}}$$

$$\text{Tension Draft (Td)} = \frac{\text{Surface Speed of the CCR}}{\text{Surface Speed of the TCR}}$$

The Total Draft (TD) of the card can be calculated as the product of the above three.

$$\textbf{Total Draft (TD) = Md x Td x Td}$$

Note:

If the value of the Draft is less than 1 (<1), it is known as Negative Draft and this usually exists between lap roller and feed roller to prevent any uncontrolled stretching of lap.

The relation between Actual Draft (AD) and Mechanical Draft (MD) in card is,

$$\textbf{AD} = \frac{\textbf{MD x 100}}{\textbf{100 - Waste}}$$

Note:

Actual draft (AD) is always greater than the Mechanical Draft (MD) in card because of waste extraction.

The Total Draft (TD) of the card varies from 80 – 120.

MODERN DEVELOPMENTS IN CARD

The modern developments in a card have taken place and taking place to achieve the following.

1. To increase the quantity of production in order to deliver the goods well before time.
2. To improve the quality of the product.
3. To reduce the wastage of good fibers.
4. To compete well in the market.

In order to achieve the same, the developments have taken in all the regions of the card and these are as follows.

DEVELOPMENTS IN FEEDING AND OPENING ZONE

CHUTE FEED SYSTEM

The elements of the chute feed system are,

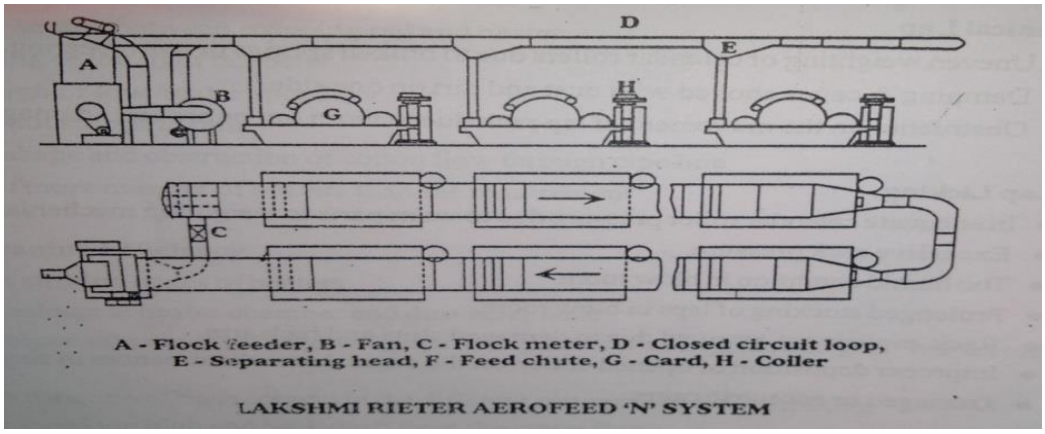
a) A conveyor system to carry the material from Blow room to a group of cards with the help of air.
b) Proper control of air pressure in the conveyor system for smooth flow of material.
c) A mechanism to feed the material at uniform weight per unit length and width.
d) A delivery system to feed the material to the card feed roller.
e) A sensing mechanism at chute to keep a certain amount of material as reserve and also to control the feed of material to the chute.

CHUTE FEEDING OR AERO FEED SYSTEM - How it works

LAKSHMI – RIETER AEROFEED 'N' SYSTEM

A condenser, sucks the material from the Blow room, and delivers it to the flock feeder (A), by way of the filling trunk. The flock feeder opens up the stock into the desired size tufts. Surplus material returning through the duct is united with the fresh material coming from the Blow room. A fan (B) blows the tufts into the horizontal closed circuit loop (D) situated above the cards.

The separating heads (E) incorporated in the duct divert part of the tufts from the air current into the vertical feed chutes above the card inlets. The feed chute (F) ensures a uniform supply of material over the full working width of the card. The installation is controlled by flock meter (C) and a three point regulator which is located in the aero feed panel board.



LAKSHMI RIETER AEROFEED 'N' SYSTEM

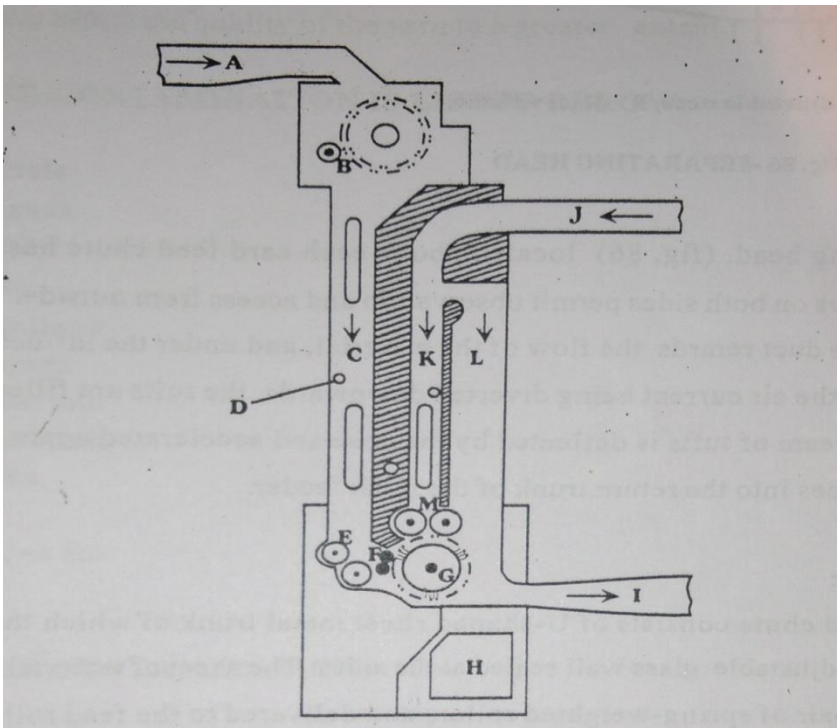
Chute feed is a system of feeding small tufts of cotton fibres directly from blow room to a series of cards, arranged in a circuit through pneumatic pipe. A condenser in the pneumatic pipe sucks the material from blow room and delivers it to the flock feeder through pneumatic pipe by way of the filling trunk.

Photo electric cell in the filling trunk regulates the supply of material from blow room. From here, the material is fed to the Kirschner beater by way of two ridged roller and two feed rollers. Krischner beater opens the cotton into desired size tufts.

A fan blows the tufts from the Kirschner beater into horizontal c closed circuit loop situated above the cards. The return trunk has the duty of returning the surplus material(after the supply to last card) to the beater that also of uniting well opened material with supply of fresh material thus delivering it directly to the horizontal duct again.

The separating head arranged in the horizontal closed circuit loop divert the part of tufts from air current into vertical feed chutes above the card inlets. Vertical feed chute ensures a uniform supply of material over the full working width of the card. Uniform separation of the tufts from the air current is achieved by adjusting the nose in the separating head. Raising the leading edge produces more separation and vice versa.

The weight of the card feed per meter depends on the static excess pressure in the installation. This drops practically linear from separator to separator by about 2mm head of water. The weight of the feed per unit length must be adjusted in accordance with this drop by increasing or deducting the distance between the glass front and the rear wall of the feed chute. The weight per meter ranges between 600 to 700 gms.



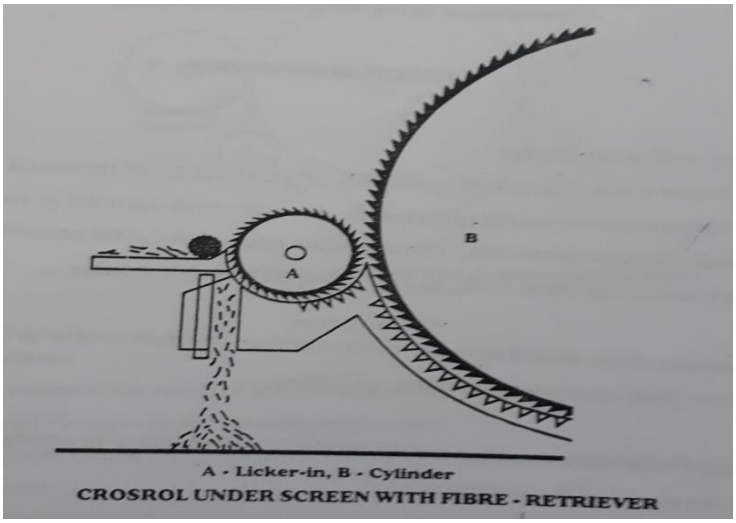
A - Material in flow, B - Condensor, C - Filling trunk, D - Photo cell,
E - Transport roller, F - Feed roller, G - Krischner beater,
H - Beater motor, I - Material delivery to fan,
J - Material return from ring line, K - Excess material,
L - Return air, M - Return feed rollers

FLOCK FEEDER

FIBER RETRIEVER

Fiber retriever is one of the modifications made in a card under the licker-in region to minimize the loss of spinnable fibers in the waste.

The nose of the fiber retriever deflects the heavier trash particles downwards away from the licker-in while the relatively lighter fibers are hardly influenced by centrifugal forces and remain in the air stream round the licker-in.



A - Licker-in, B - Cylinder

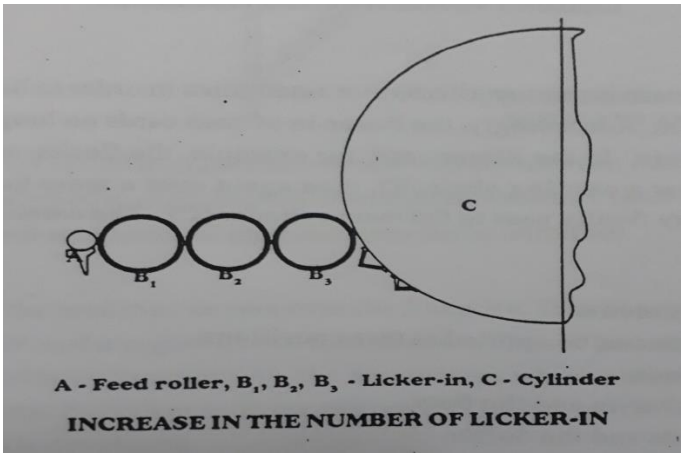
CROSROL UNDER SCREEN WITH FIBRE - RETRIEVER

Air drawn in by the fast rotating licker-in is channelled between the baffle plates of fiber retriever. So that the trash particles fall downwards in the up current of air, which detaches any spinnable fiber entangled with the trash particles and carries the good fibers back to the licker-in. it is claimed that as much as 1% waste is reduced.

INCREASE IN THE NUMBER OF LICKER-IN

The standard card has only one licker-in, for a long time attempts have been made to increase this number and thereby to increase the opening effect. With the introduction of modern high production cards, several manufacturers again saw this approach as one way to increase performance. Various card designs therefore now incorporate multiple licker-in. (optional).

The clothing are arranged in the doffing disposition relative to each other, and the speeds must be increased in the through flow direction, for example from 600 rpm (first licker-in) via 1200 rpm to 1800 rpm (third licker-in)

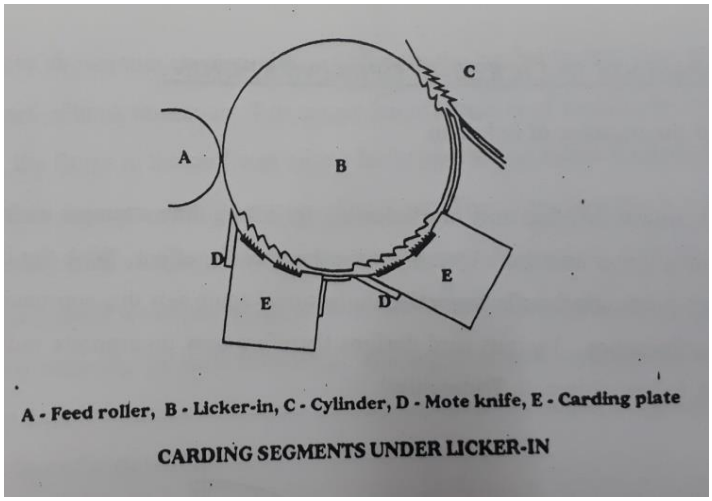


A - Feed roller, B_1, B_2, B_3 - Licker-in, C - Cylinder

INCREASE IN THE NUMBER OF LICKER-IN

CARDING SEGMENTS UNDER LICKER-IN

Elimination is very intensive and takes place under the taker-in with the aid of special devices. The classic cleaning assembly consists of 1-2 mote knives and a grid, one half of which was made of slotted sheet and another half of perforated sheet. In this arrangement, elimination of foreign matter took place exclusively by scraping off on the mote knives. The grid sheets tend to serve as fiber guide and holding-back devices, i.e. they prevent additional fiber losses that could arise from ejection.



A - Feed roller, B - Licker-in, C - Cylinder, D - Mote knife, E - Carding plate

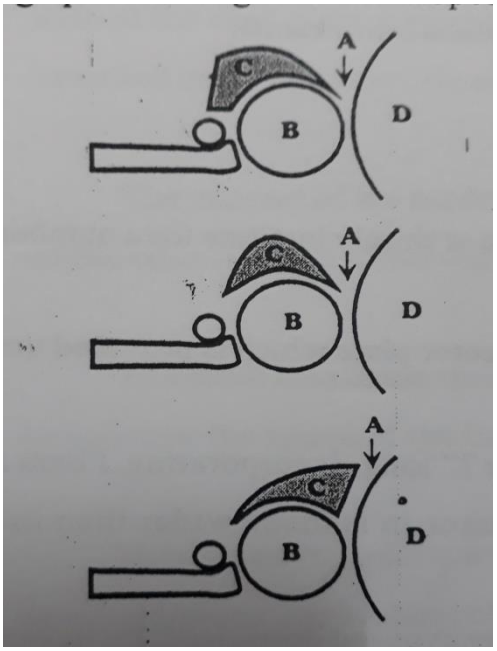
CARDING SEGMENTS UNDER LICKER-IN

High- performance cards require alternative assemblies in order to be able to deal with the high material through put. Accordingly, the licker-in of such cards no longer operate with grids but with carding segments. In the Rieter card, for example, the flocks are first guided over a mote knife (D) then over a carding plate (E), then again over a mote knife and again over a carding plate, before they finally pass to the main cylinder (C). the carding segments are fitted with special clothing.

HI - DOMES

Hi-domes are the modified covers over the licker-in. It is observed that a relatively high pressure is developed in the region above the licker-in. this is because at a point immediately past the licker-in / cylinder junction (A), the air currents which escaped from being carried by the cylinder, try to enter the licker-in and the top cover. The gap at A is very small, and hence the high pressure region is developed.

A – Licker-in / Cylinder Junction
B – Licker-in
C – Hi – Domes
D - Cylinder



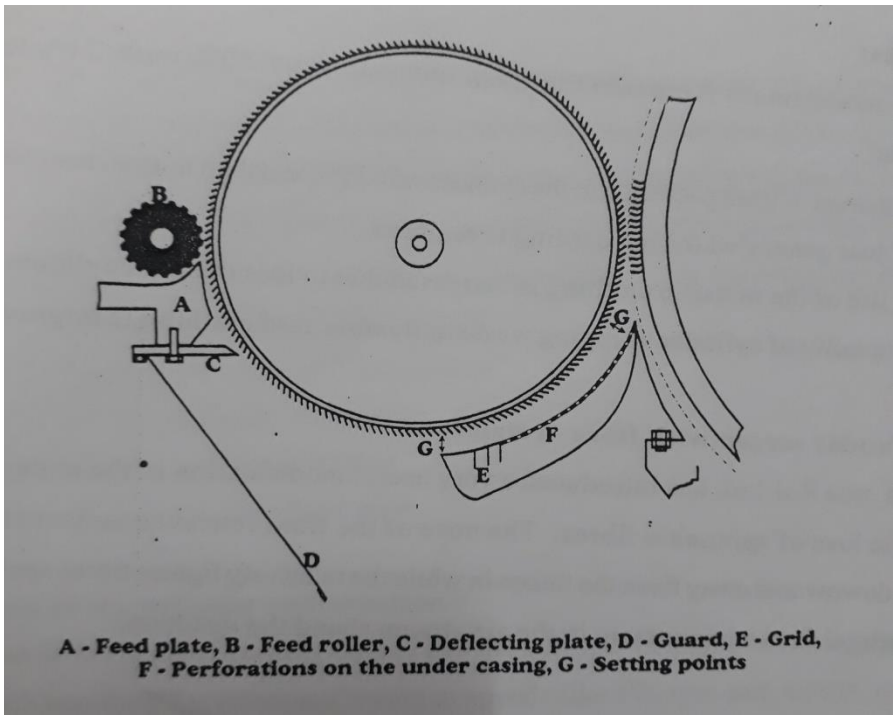
The results on the use of Hi=domes clearly show that through the droppings under the licker-in are unaffected, the trash content in the droppings is increased and the lint is significantly reduced.

SHIRLEY MODIFICATIONS

This modification is the result of intensive research done at Shirley institute for a number of years. The essential changes in the cleaning region are;

1. The replacement of conventional mote knives by a deflection plate which is provided under side of the feed plate.
2. The licker-in grid is replaced by a shorter grid usually 7" long, incorporating 3 bars and the normal perforations. The setting between grid and licker-in is made wider than in the conventional card.
3. A safety guard is fitted under the feed plate to cover the exposed portion of the licker-in.

All the above changes are shown in the figure.



A - Feed plate, B - Feed roller, C - Deflecting plate, D - Guard, E - Grid, F - Perforations on the under casing, G - Setting points

The success of modified licker-in arrangement depends very largely on the smoothness of the taker-in grid, otherwise chocking will occur.

To secure maximum trash extraction by the modified licker-in arrangement it is advisable to increase the speed of the licker-in.

This, however results in greater lint extraction. As the speed of the licker-in is increased above 600 rpm, the amount of lint rejected increases rapidly for this reason, it is suggested in practice that the licker-in speed is increased by 50% or up to 600 rpm whichever is lower.

Advantages:

1. This arrangement increases the trash extraction by 50% with 24% less lint than the conventional arrangement.
2. The amount of trash passed on to the cylinder was 31% less than the normal.
3. The dust generated during carding is reduced.
4. The life of the metallic clothing is increased due to less trash on cylinder.
5. The quality of cylinder stripping waste in flexible card clothing is improved.

DEVELOPMENTS IN CARDING ZONE / CYLINDER ZONE

The recent developments that have taken place in the carding region were aimed at,

(i). To prepare the tufts before the entry of flat region in order to increase the life of the flat clothing and even distribution of tufts on cylinder.

(ii). To improve the carding effect of the flats to match with heavy feed.

(iii). To improve parallelization and removal of further impurities before the transfer of fibers to the doffer.

(iv). To reduce the waste percentage

The important developments can be conveniently studied under the following heads.

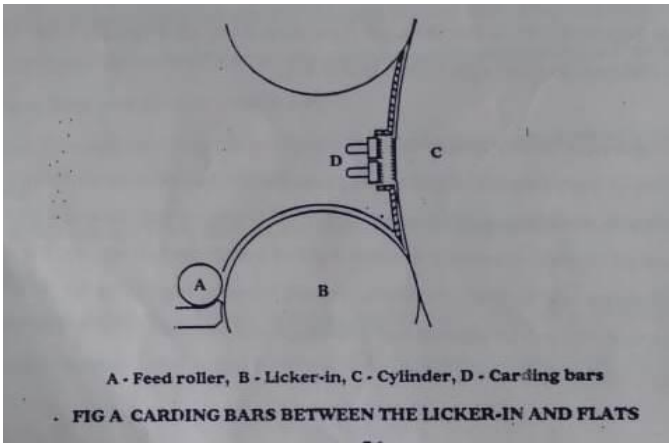
1. Improvements in the cylinder construction.
2. Developments in cylinder back zone.
3. Developments in cylinder – flat zone.
4. Developments in cylinder front zone.

1. Improvements in the cylinder construction

The cylinder is the heart of carding machine and in the cylinder in high production cards must be capable of withstanding the stress and strain ay speed like 600 rpm and also to with stand the extra weight added by the way of metallic clothing. In present day cards, cylinders are provided with ball bearings and dynamically balanced so that accurate settings can be achieved. The width of the cylinder is increased to 1.5 times makes like Ingolstadt to scope with the thick feed. But in Crosrol Varga MK 4 card, **dia of the cylinder is 20% reduced (40")** than the conventional cards to add stability and strength to cylinder and permit the cylinder to rotate upto 3 times faster than the conventional cards. This also improves dust ejection and carding effectiveness for high quality sliver.

2. Developments in Cylinder Back Zone

Pre – carding segments have become a standard adjust in all high production cards. The main object of this device is to increase the life of flat tops and also prepare the tufts for better carding at flat zone. The system offered by Viking is explained in detail, since most of the devices work more or less on the same principle.



A - Feed roller, B - Licker-in, C - Cylinder, D - Carding bars

FIG A CARDING BARS BETWEEN THE LICKER-IN AND FLATS

3. Developments in Cylinder Flat Zone

The 2 major developments aimed at this zone are,

(i). To increase the effectiveness of flats
(ii). To reduce flat waste.

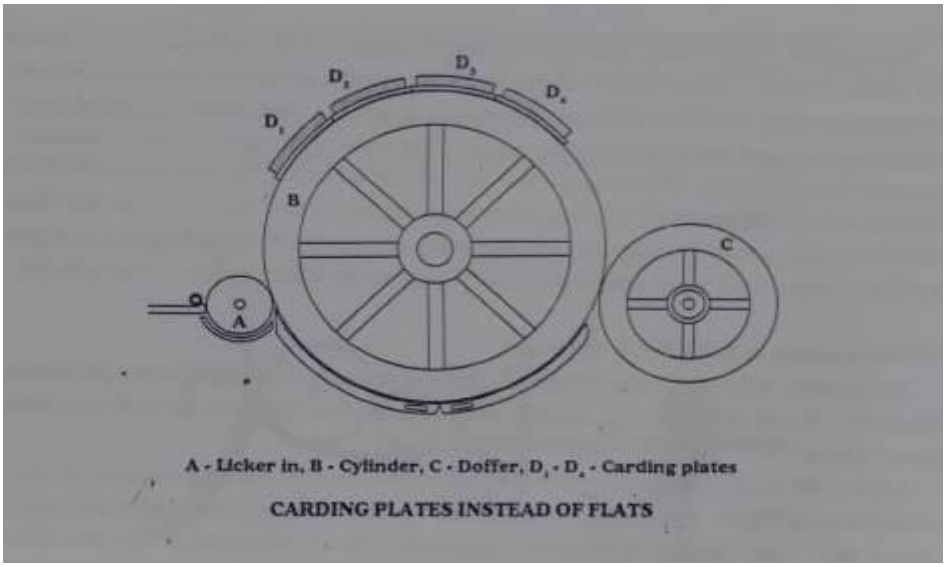
(i). Various phenomenal improvements have been introduced in clothing the tops with metallic wire clothing. The important innovation is **running the flat in the opposite direction** to the cylinder as developed by SACM, France. The following advantages are claimed due to change of direction of flats.

Thoroughly stripped, clean flats start their action at the delivery end of the cylinder. In this way the fibers are submitted to progressively cleaner flats, the final carding being performed by flats that have just been stripped. This results in more efficient carding than with flats loaded with wastes, particularly for the removal of the tiny impurities.

(ii). Many machinery makers had developed stationary carding surface instead of flats in order to reduce the flat waste. But this will be more applicable while processing synthetic fibers where the question of short fibers, trash content does not arise.

Carding Plates

M/s. John Hollingsworth has developed stationary carding plates in place of revolving flats under the trade name of 'CARD MASTER'.



A - Licker in, B - Cylinder, C - Doffer, D_1 - D_4 - Carding plates

CARDING PLATES INSTEAD OF FLATS

Stationary carding plates can be used as carding elements in place of moving flats. For example, the Hollingsworth Company fits 4 such plates above the main cylinder. The plates are in the form of curved sheets of aluminium provided on their internal surfaces with a special sheet clothing.

The plates are adjustable and replaceable. These plates, contoured to the shape of the cylinder, provide greater carding surface than revolving flats. Each plate is interchangeable in any position on a card and between other cards. The advantages claimed are (i) reduced maintenance due to lack of moving parts (ii) power saving of 4%, (iii). Provides maximum carding area, (iv). Reduced flat waste and (v). Longer life of the flats.

4. Developments in Cylinder Front Zone

The objects of the various developments at front zone are

(i). To improve the parallelization of fibers

(ii) To extract waste like, trash, micro-dust and fused fibers in the case of processing synthetic fibers

Almost all high production cards are equipped with post carding segment to improve parallelization of fibers. The Viking system offers a post carding segment under the trade name of Viking 400. This consist of 4 teeth segments with a total width of 128 mm and teeth density of 150 points /Sq.inch. This is mounted on the doffer side of cylinder. It produces remarkable improvement in yarn quality.

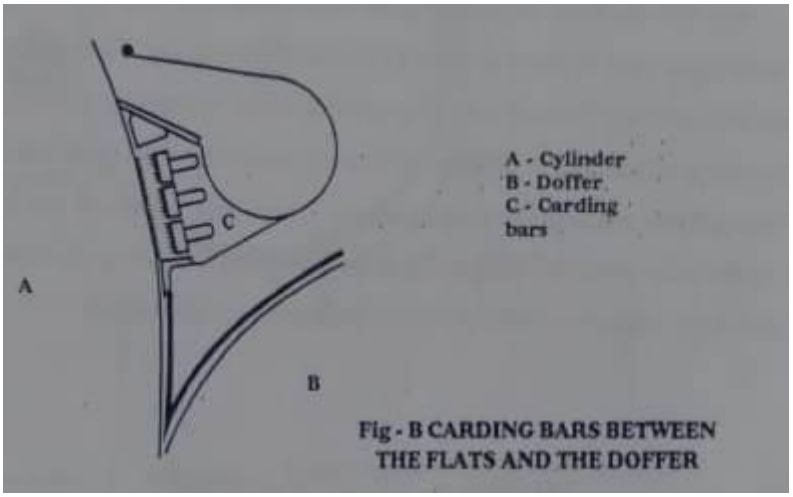


Fig - B CARDING BARS BETWEEN THE FLATS AND THE DOFFER

Trash Master TM 2000

To achieve the second objective, M/s Hollingsworth, Germany has introduced an attachment in the cylinder front zone namely Trash Master TM 2000.

This is a system for the removal of vegetable matter, pepper trash, short fly, sticky particles, micro dust and fused manmade fibers. A special knife is set to the cylinder wire according to the fibers to be processed. This knife, together with the centrifugal force and controlled air-current, eliminate the trash. The extracted particles are collected in the low pressure chamber and removed by the continuous suction cleaning.

The trash master 2000, which require 165 m^3 air or 2 millibar low pressure, can be connected to all suction cleaning systems of high production cards.

A carding segment known as card master improves parallelization of fibers before they reach doffer. The additional carding surface improves yarn quality.

The advantages claimed are:

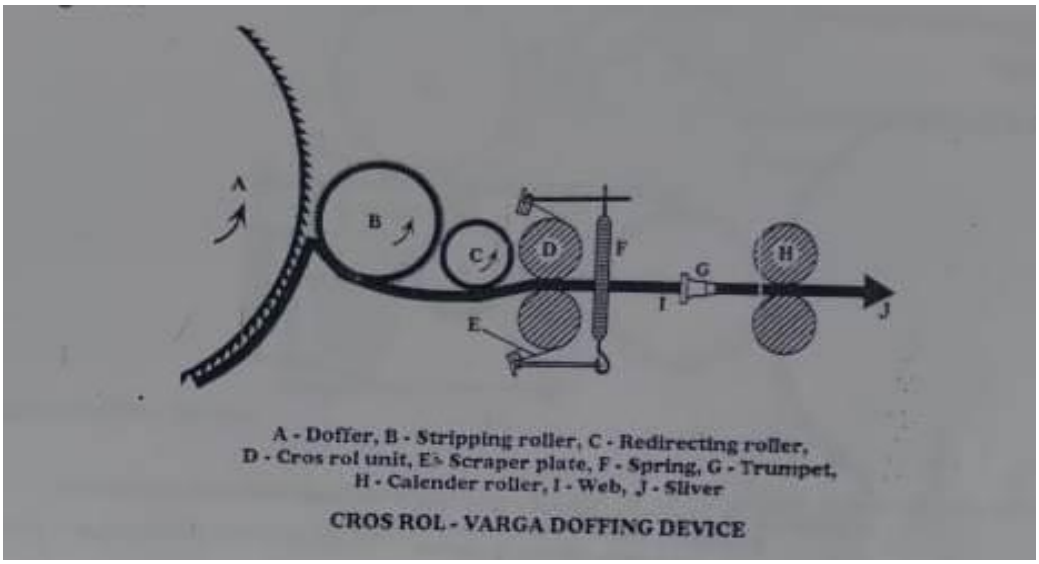
1. Optimum removal of trash, short fly micro dust and fused manmade fibers.
2. Improves yarn quality due to elimination of impurities by Trash Master and improved parallelization by Card Master.
3. Reduces cleaning of OE (Open End) spinning rotor.
4. Lowers room dust levels.

DEVELOPMENTS IN DOFFING ZONE / DELIVERY ZONE

WEB DOFFING DEVICES

It consists of a stripping roller and a redirecting roller, both covered with a specially designed metallic wire and clears the web from the doffer under positive control at any production rate. A clearer roller keeps the surface of the stripping roller clean and catches any web or flock that may travel on top of the stripping assembly. As the web is carried from the doffer into the nip of pressure rollers, it is given positive draft through the wires of the redirecting roller. This parallelizes the fibers giving better exposure of trash to the crushing action.

WEB PRIFYING DEVICES



A - Doffer, B - Stripping roller, C - Redirecting roller,
D - Cros rol unit, E - Scraper plate, F - Spring, G - Trumpet,
H - Calender roller, I - Web, J - Sliver

CROS ROL - VARGA DOFFING DEVICE

The patented Crosrol web purifier is the heart to the Cros Rol Varga Unit. Its pressure rollers crush impurities, and apply draft to the web, the trash which remains in the fibers at the end of the carding process falls out during subsequent processing. The web purifier consists of a pair of precision ground and hardened rollers, which are slightly off-set to ensure uniform distribution of pressure. Pressure is increased as the off-st is increased and vice-versa.

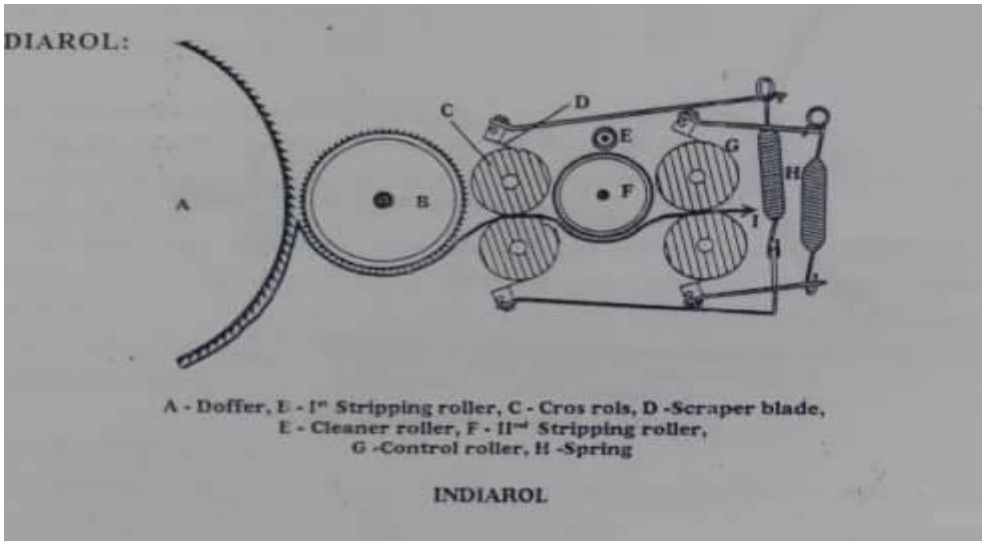
The amount of pressure applied by the web purifier can be varied according to the quality of cotton being processed and the rate of production of the card.

Both top and bottom crushing rollers are provided with adjustable and replaceable steel scraper blade which removes impurities and short fibers from the pressure rollers. A spiral groove cut into the surface of each Cros Rol prevents the accumulation of fly under the scraper blade by providing a cutting edge between itself and blade. Plain crush rollers are employed with nylon scraper blades for processing synthetics only. Positioning of the scraper blades relative to the crosrols is always the same irrespective of the off-set selected.

ADVANTAGES

1. Smooth, automatic doffing at any speed**.**
2. Improved yarn quality by the reduction of impurities and neps.
3. Reduction of end breaks at the ring frame.
4. Increased production up to 4 – 5 times than conventional card.

INDIA – ROL UNIT

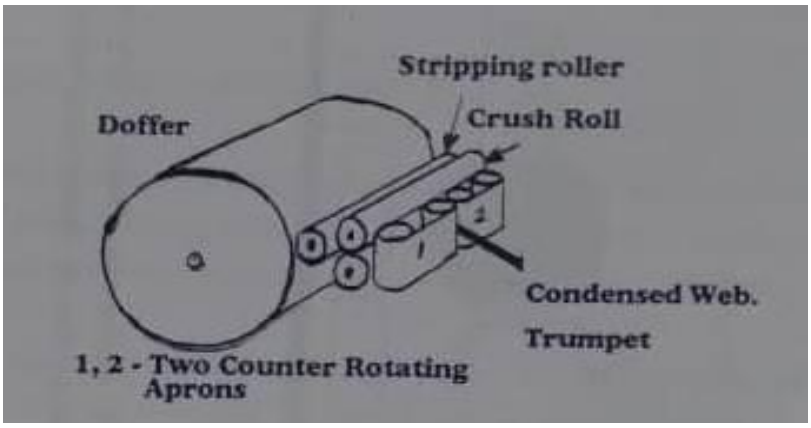


The India Rol consists of a rotating stripping roller covered with a specially designed metallic wire which clears the web from the doffer. The web is carried into the nip of the cros rollers. The crushing action, which can be varied to suit the type of fiber, results in better yarn appearance due to elimination of seed and leaf particles. A second stripping roller collects the web from the crush rollers and delivers the web to a pair of polished control rollers. The web coming out from the control rollers is considered and passed through the calender rollers. Here the Cros rollers have given pressure and the control roller does not have pressure, which prevents lapping of the material and improves quality and production.

ADVANTAGES

1. 3 to 5 times more production than the conventional cards.
2. Elimination of web sticking to the crush rollers.
3. Upgrading of dirty cottons by ironing the web.
4. Improves yarn quality and better appearance.
5. Higher efficiency at ring spinning.

ARRANGEMENT OF APRON DOFFING DEVICES



In order to collect the web perfectly without any loss, the delivered web is collected by two distinct apron arrangement as shown in the figure. This prevents loss of web and assist in easy removal of web.

TANDEM CARDING

To appreciate the function of Tandem carding, it is essential to know the limitations of single carding process.

LIMITATIONS OF SINGLE CARDING PROCESS

1. It has been established that in a single carding process, when a thick sheet of flocks and tufts are fed, over loading of some areas of the cylinder surface and of the flats cannot be avoided with the result that wire points fail to control and card the fibers effectively.

2. Most cottons contain skin and broken particles of cotton seed due to defective ginning. When the skins and seeds are crushed by the purifying rollers in high production cards, the liberated fibers remain entangled and unopened in the web as small fiber agglomerations results in uneven yarn appearance.

3. The levelling function of a single cylinder and doffer is not succeed sufficient to completely eliminate the uneven distribution present in the carded web.

Tandem carding system is essentially a double processing of the web to eliminate the limitations in a single carding process. The tandem carding system has two high production cards linked together so that the second card is able to do a finer job of separating every fiber as well as removing the crushed impurity passed on by the first card namely breaker card.

Tandem Carding

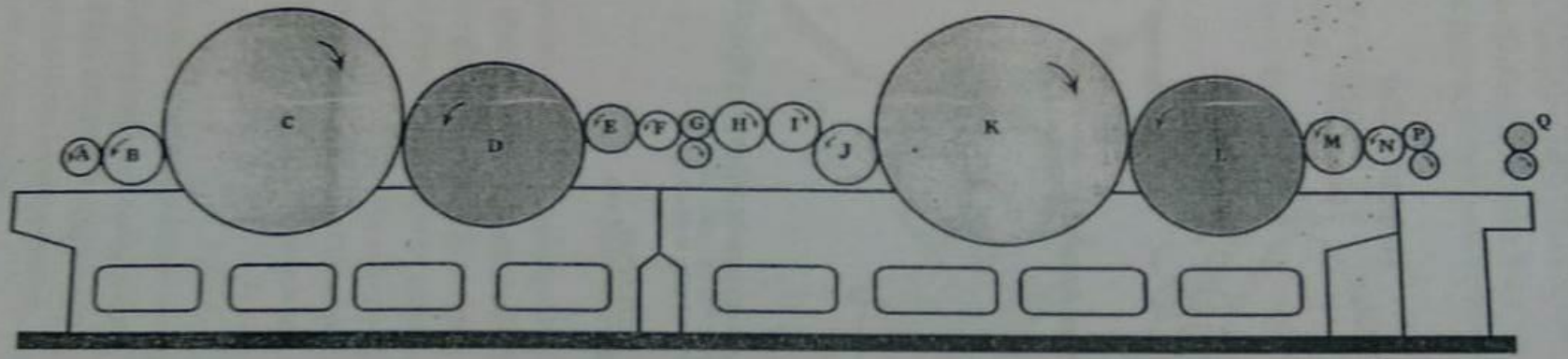
The tandem carding system has two high production cards linked together, so that the second card is able to do a finer job of separating every fiber as well as removing the crushed impurities passed on by the first card namely '**Breaker card'**. The second card is called as "**Finisher Card**". The card is fitted with a complete dust and fly extraction system.

After the first carding process, the stripping roller removes the web from the doffer and the redirecting roller assists in controlling the feeding of the web into the nip of the web purifying rollers. On emerging from the nip of the web purifying rollers, the web comes under control of the two transfer rollers which carry the web over the top, so that the quality of the web produced by the breaker card is exposed for inspection.

The web now passes through the finisher card which receives a fine film of fibers instead of the flocks that that were fed to the breaker card. In this finisher card, that the fiber entanglements are removed and matted fiber layers are freed completely of the seed particles and the fibers are separated from each other.

Any impurities, which may have been protected by the thick fiber layer when it is passed through the first pair of web purifying rollers now, have the chance to be crushed and eliminated in the doffing unit placed at the end of the finisher card.

The improved performance from tandem cards can be attributed to better fiber to fiber separation and enhanced cleaning efficiency. The levelling effect achieved in tandem card is higher than a single card. High quality yarns can be produced from low grade of cotton.



A - Feed roller, B - Licker-in, C - Cylinder, D - Doffer, E - Stripping roller, F - Redirecting roller, G - Cros rol, H - Transfer roller, I - Transfer roller, J -Licker-in, K -Cylinder, L - Doffer, M -Stripping roller, N - Redirecting roller, P - Cros rol, Q - Calender rollers

TANDEM CARD

LATEST INNOVATIONS IN CARD

RIETER CARD

CARD C - 50

Doffer Dia = 20”

Efficiency = 99 %

Delivery Speed = 171 mts / min

Production = 55 kgs / hour

Flat Speed = 228 mm / min

Sliver length / can = 4200 mtrs

Can changing = Every 22 mins

HYPER CARD C -51

Fiber length – up to 65 mm

Delivery Speed – 330 mts / min

Production – 74 to 98 kgs / hr

Cylinder Sped – up to 600 rpm

Sliver count – 0.16 to 0.12 Ne

Sliver of this card is suitable for Ring, Rotor and Air jet spinning.

Equipped with I.G.S. (Integrated Grinding System)

NEW GENRATION CARDS FROM LMW

1. New card LC 333 with fine chute feed.
2. Card LC 300 A with fine chute feed.

CARD LC 333 and CARD LC 300 A

Salient features

- Delivery speed – up to 470 mts / min
- Production – up to 120 kgs / hr
- Triple Licker - in arrangement (LC 333 card)
- Automatic waste extraction system
- Aluminium alloy Flats
- All varieties of Cotton, MMF and their Blends can be processed.

LATEST INNOVATIONS IN CARD

TRUTZSCHLER TC – 03 CARD

SALIENT FEATURES

1. All the machine areas are accessible in few seconds for cleaning purpose.
2. Centralized waste extraction.
3. Colour touch screen simplified fault elimination and here photographs, diagrams and drawing help the specialists of maintenance to eliminate the faults.
4. Optical sensor measures the composition of waste and if there are too much good fibers, the knife at the Ist licker-in can be set to minimize the loss of good fibers.
5. Multi-web cleaning system is adopted and by changing few elements of this system any natural (or) Man Made Fibers upto 60 mm can be processed. Multi-web clean elements can be fixed either in pre-carding (or) post-carding segments as per the requirements is. depending on the type of material. i.e MMF need more opening and hence the elements can be fixed at pr-carding and these can be fixed at the end for dirty cotton as the web need to be cleaned properly.

NEW CARD FROM RIETER C – 60

SALIENT FEATURES

- Cotton (or) MMF can be satisfactorily processed.
- High quality sliver.
- Production up to 240 kgs / hour
- Delivery speed up to 940 mts / min
- Efficient removal of trash.
- IGS adopted (Integrated Grinding System).
- Triple (or) single licker-in arrangement. (depends on the count of sliver)

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