5

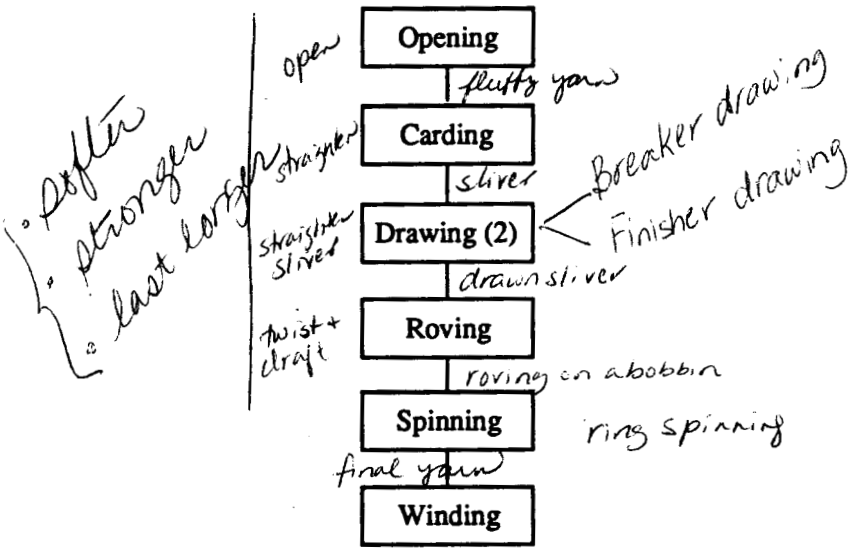
Short Staple Yarn Manufacturing

Characteristics Of Spun Yarns

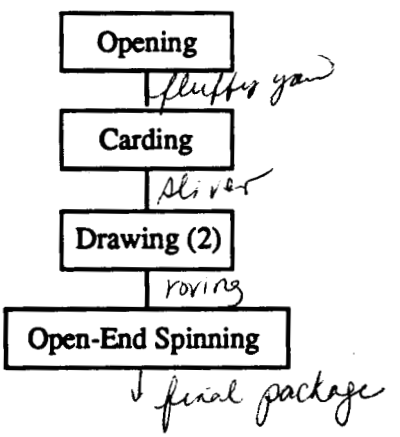
- Composed of short staple fibers
- Made from cotton, flax or wool staple fibers
- Made from natural or man-made filaments which are cut into filament staple
- Individual fiber lengths vary
- Fuzzy appearance and feel
- Uneven number of fibers throughout
- Range from soft, loose construction to hard fine twist yarn
- Thick and thin areas
- Highly twisted
- Fall apart when untwisted
- Dull or flat in appearance
- Rough to the touch
- Natural textural appearance and feel
- Bulkier to the feel
- Provide good covering power
- Snagging depends on fabric structure
- Pilling depends on fiber content

Material Processing On The Short Staple System

1. Carded Ring Spun Yarns



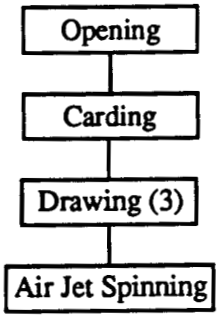
2. Open End Rotor Yarns



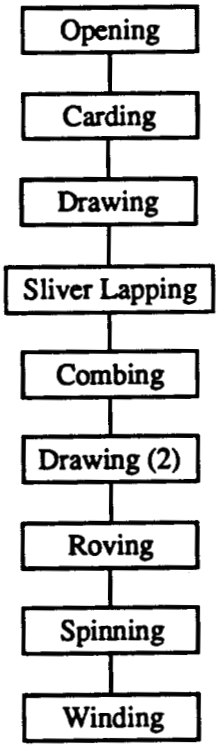
don't need separate winding or roving

Produced 7-9 times faster

3. Air Jet Spun Yarns



4. Combed Cotton Ring Spun Yarns



more expensive
. smooth looking fabric
. top & line

Functions Of The Opening Process

- Open
- Clean (natural fibers)
- Blend

Creating The Proper Bale Laydown

Coordination with Fiber Properties

- More variables in raw stock means more bales needed to laydown

- Must decide which variables have the greatest influence in yarn manufacturing.

Coordination with Fiber Inventory

- Laydown should be a "mini" representation of the warehouse inventory.

- . Laydown should be as consistent as possible from day-to-day, week-to-week, and month-to-month.

Blending

Blending is a process involving

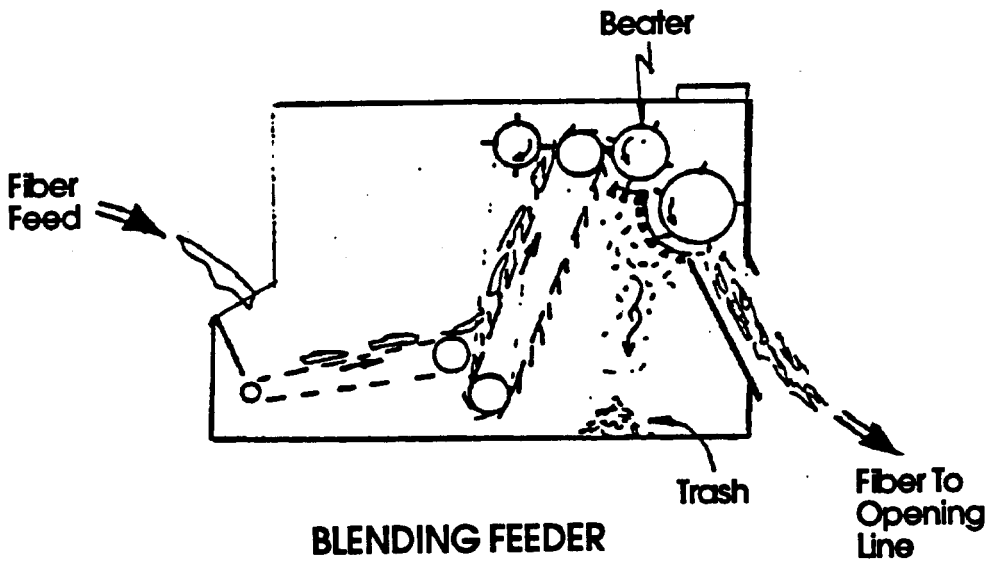
- Measurement of the important fiber properties of length, fineness, strength, grade, color, etc.

- Proportioning and combining these properties under controlled conditions and in such a way that the physical properties of resultant blend can be predicted, are known, and are reproducible.

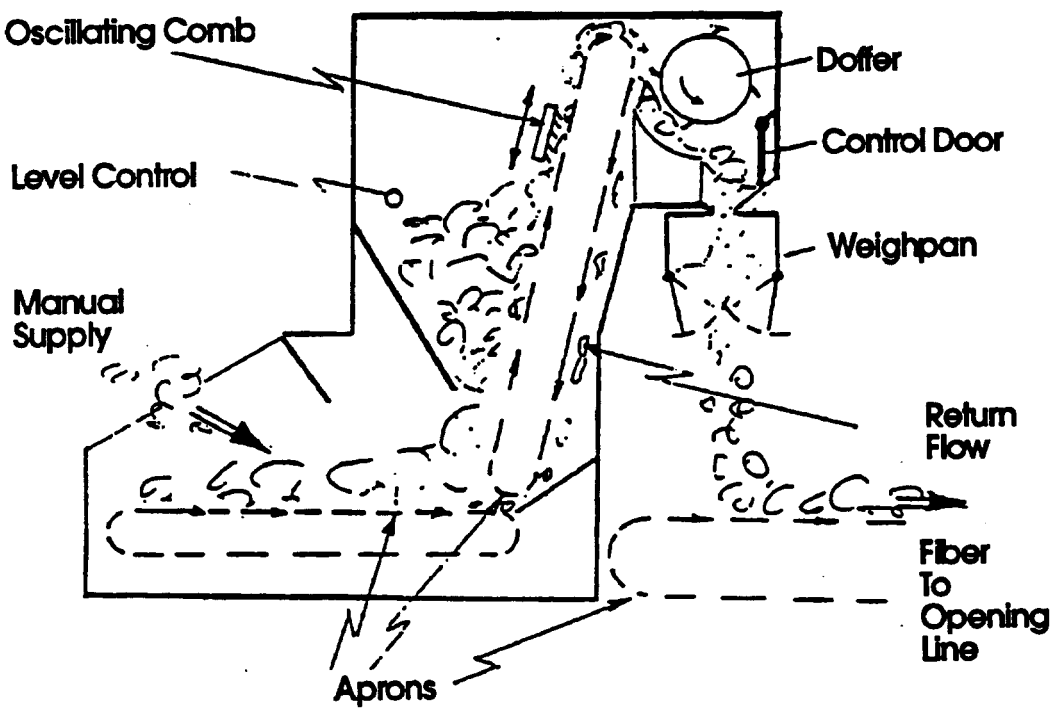
Fiber Opening And Cleaning

- Why fiber must be opened
- Principles of opening
- Why cotton must be cleaned
- Principles of cleaning

Figure 5-1 Blending and Weighpan Feeder

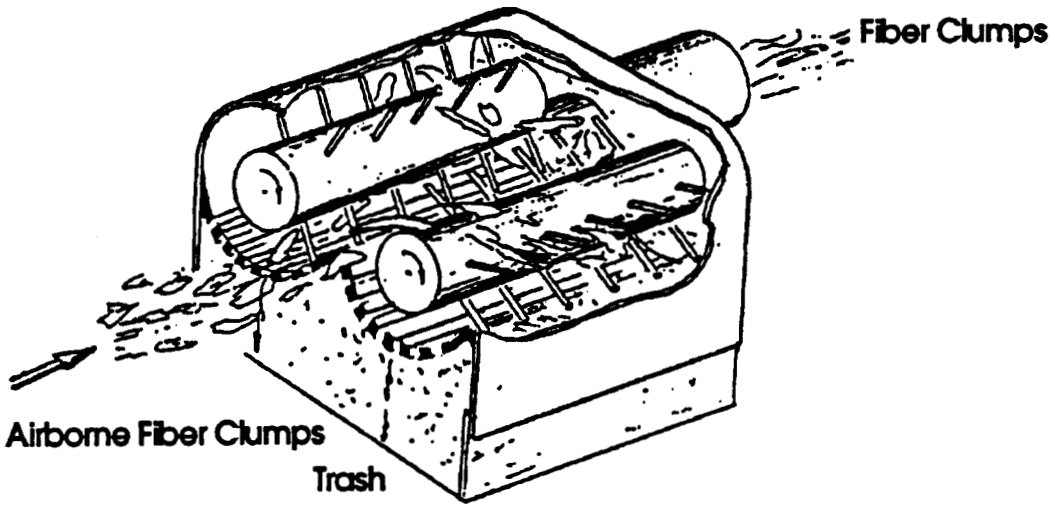


BLENDING FEEDER

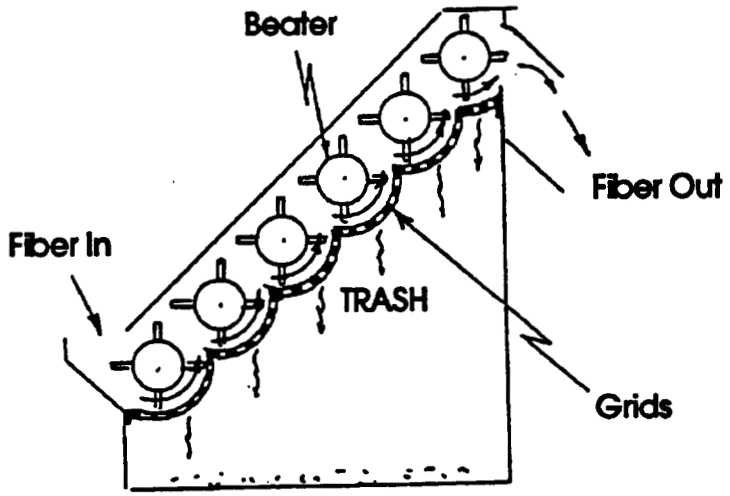


WEIGHPAN FEEDER

Figure 5-2 Axial Flow Cleaner And Incline Cleaner



AXIAL FLOW CLEANER



INCLINE CLEANER

Carding

Materials Processed

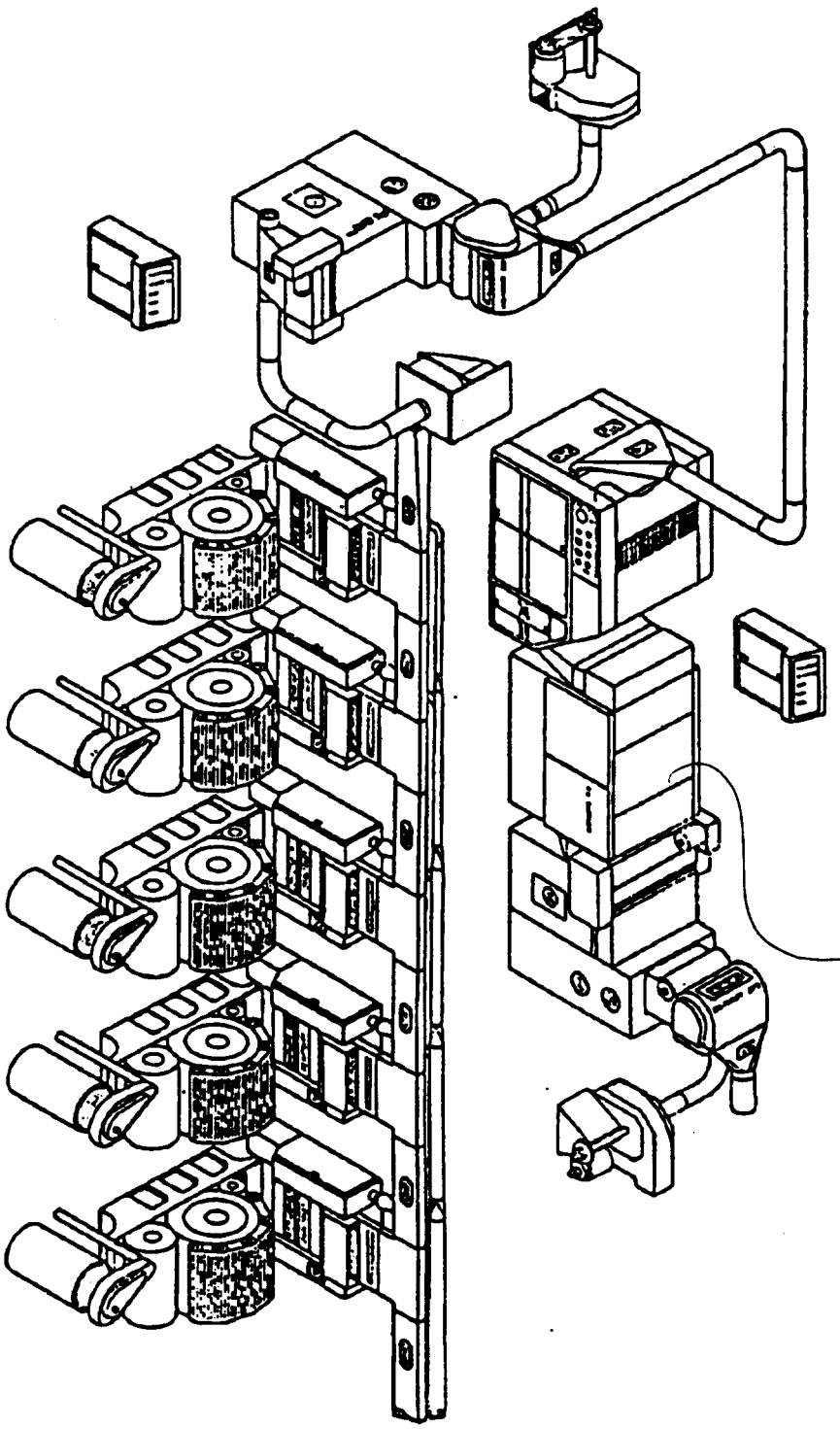
Input - mat of fiber

Output - card sliver, measured in grains per yard (1lb = 7000 grains)

Objectives of the Process

1. Open
2. Clean
3. Straighten - main function.
4. Blend
5. Draft
6. Package

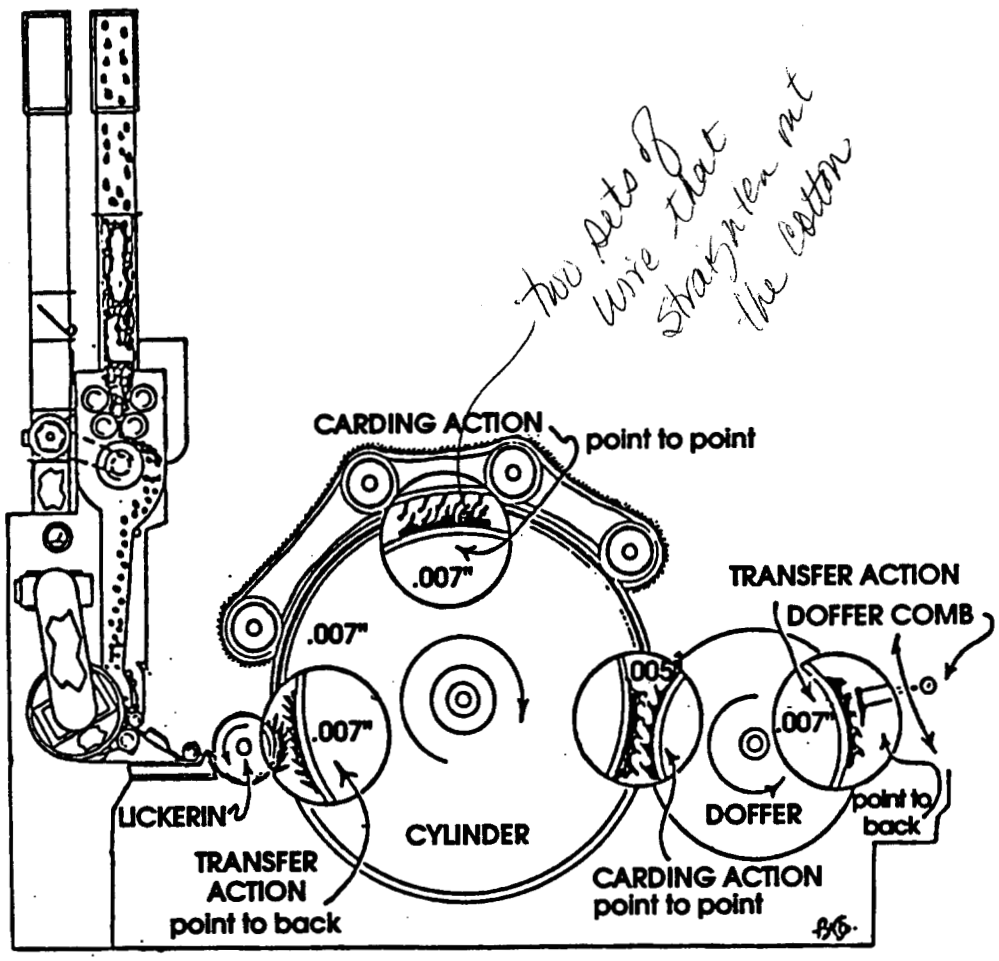
Card Feeding Systems



A Typical Card Line

opening/cleaning equipment.

Figure 5-3 Revolving Flat Card



for poly sliver - wire use a different wire not as aggressive as for cotton.

Drawing

Material Processed

Input - Card sliver

Output - Drawn sliver

Objectives of the Process

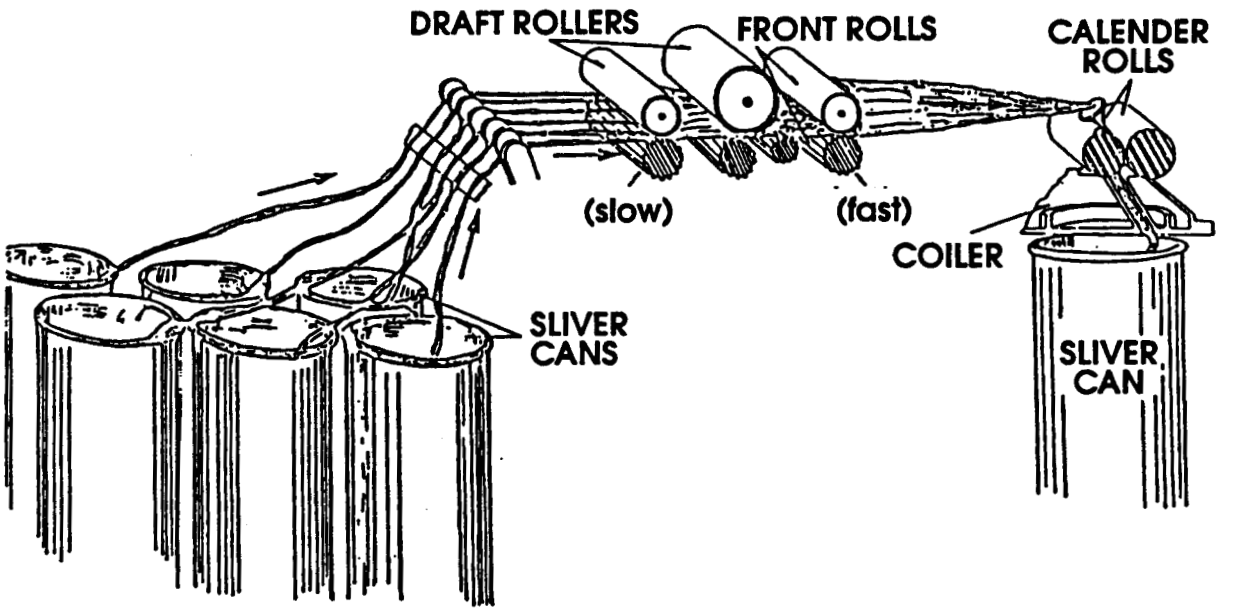
1. Improve sliver uniformity
   A. Doubling

2. Straighten fibers
   A. Drafting

3. Package sliver

Some General Definitions

Figure 5-4 Drawing Frame



The Combing Process

Purpose of Combing Remove short fibers, trash, and neps (②)

Comber Preparation

Combining Organization

Basic Operations of Combing

1. Feeding the stock from a prepared lap.

2. Combing out short fibers, foreign particles and neps; parallelizing fibers.

3. Detaching the combed fibers from the lap.

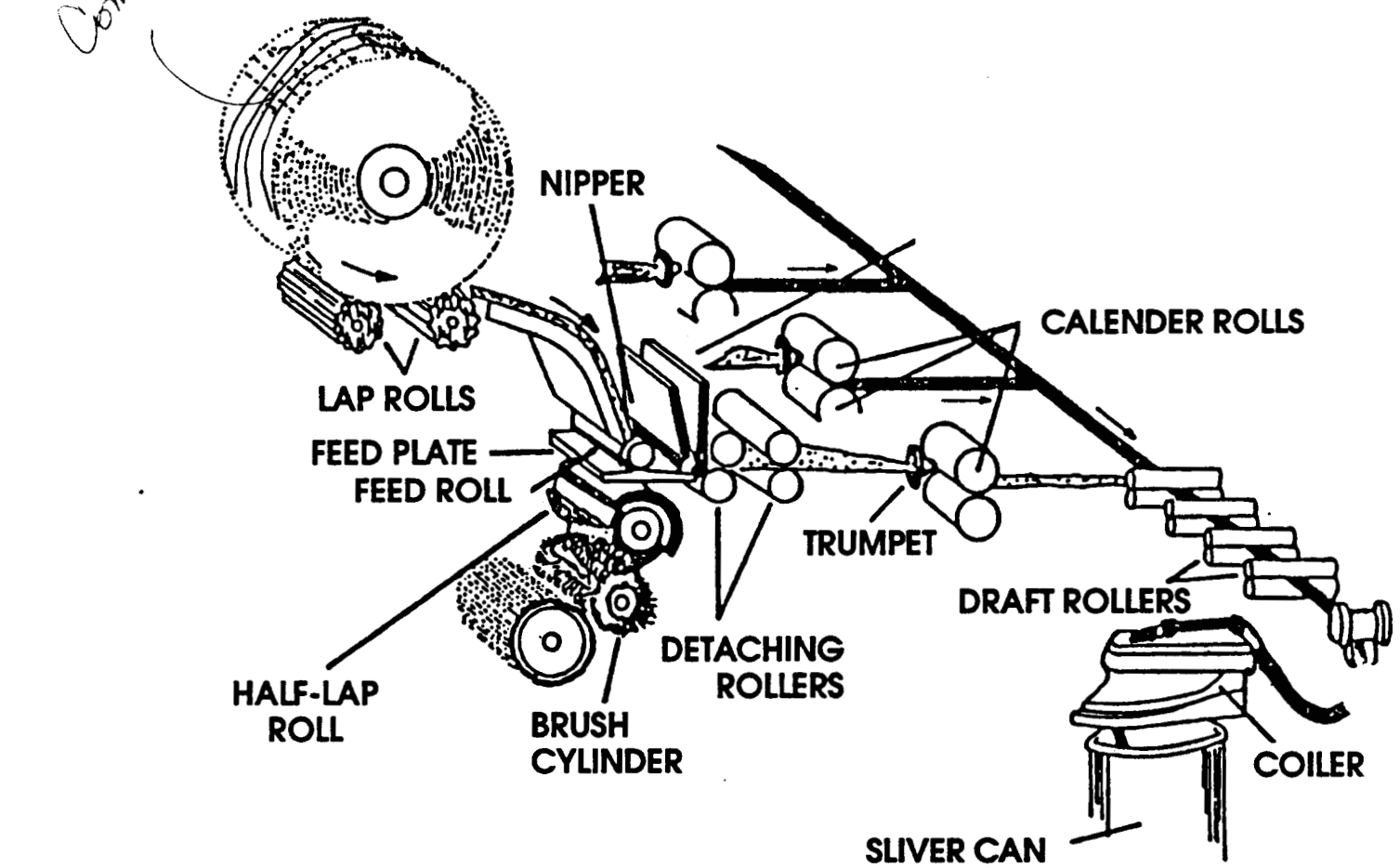
4. Piecing up the fleecy tuft of combed fibers with the fibers in the returned web.

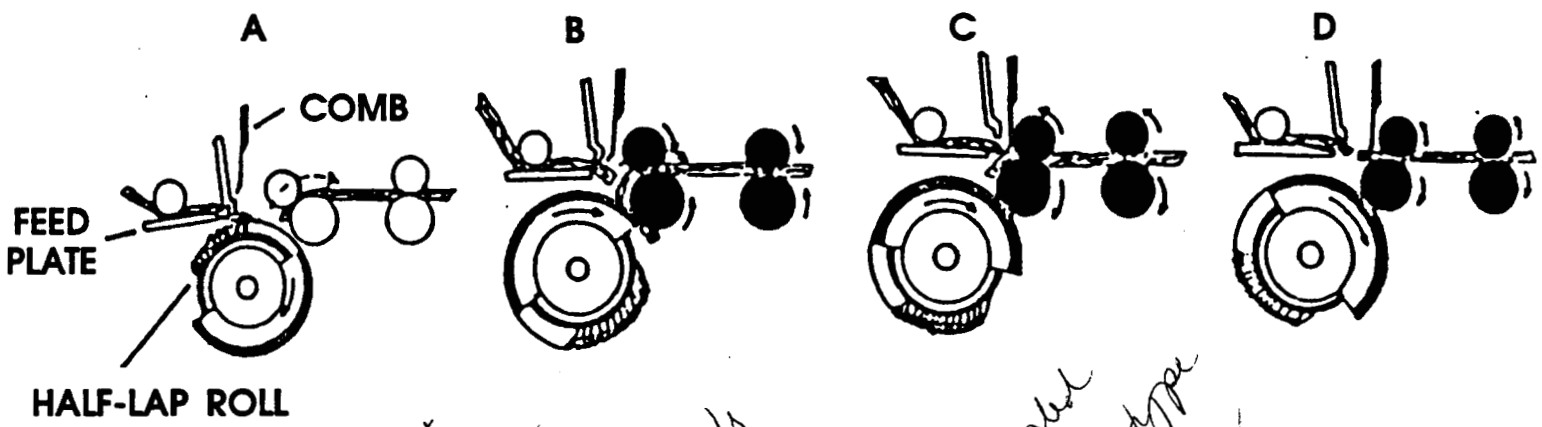
5. Condensing the combed web into sliver and doubling the sliver on the table.

6. Drafting the doubled slivers through the draw box.

7. Calendering and packaging the combed sliver into a container for further handling and processing.

Figure 5-5 Combing





Roving

Materials Processed

Input - drawn or ~~card~~ combed sliver

Output - roving on a bobbin

Objectives of the Process

1. Draft

2. Twist

3. Package

Operations on Roving Frame

1. Drafting

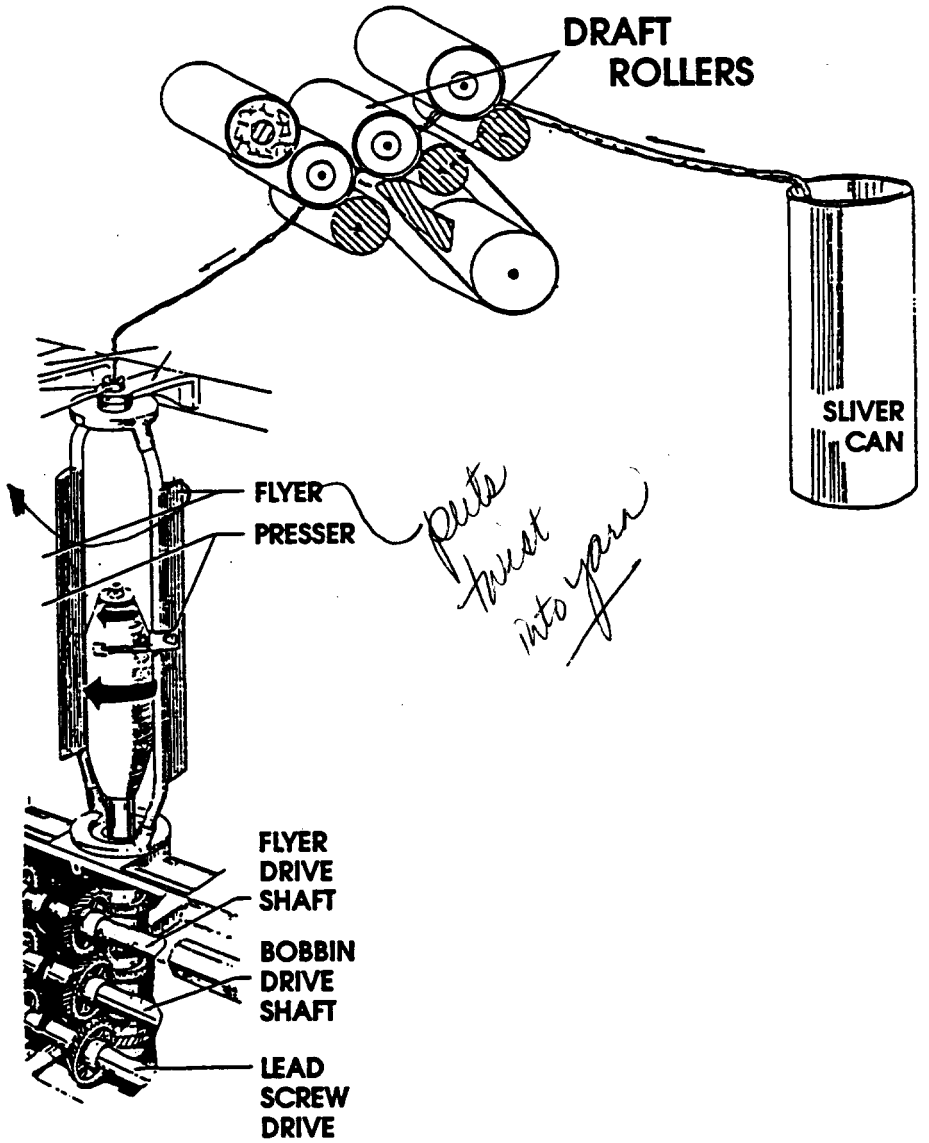
2. Twisting

3. Laying

4. Winding

5. Building

Figure 5-6 Roving



Ring Spinning

MATERIAL PROCESSED

INPUT -

OUTPUT -

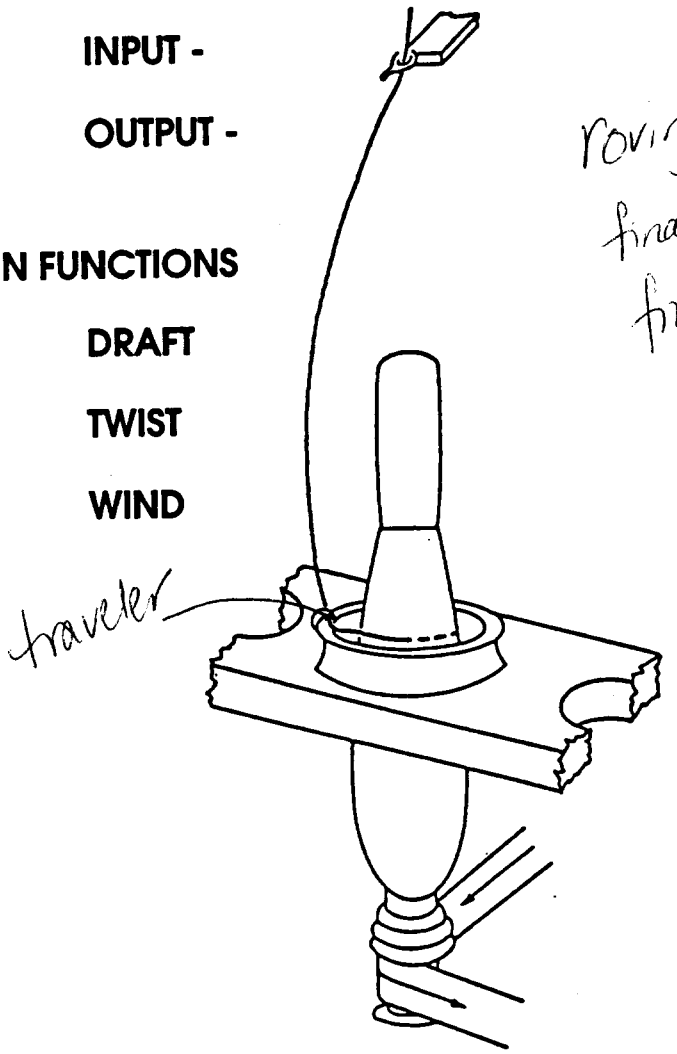
roving
final yarn
final twist
but not
final package

MAIN FUNCTIONS

DRAFT

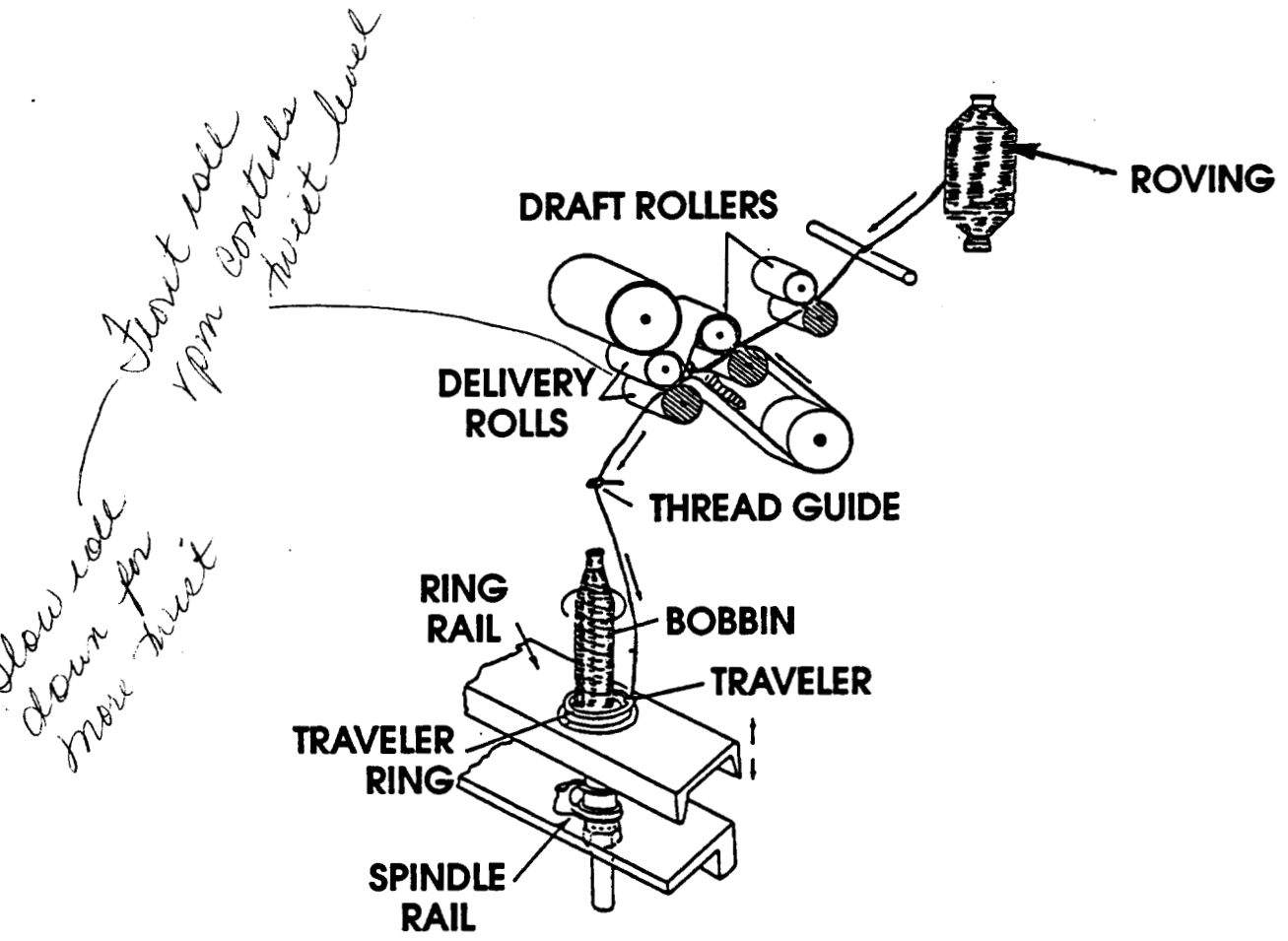
TWIST

WIND



yarn is threaded through traveller

Figure 5-7 Ring Spinning



Rotor - Type Open End Spinning

Material Processed

Input - sliver

Output - final yarn package

Objectives of the Process

1. Open

2. Draft

3. Align

4. Twist

5. Wind

Figure 5-8 The Principal Of Open-End Spinning

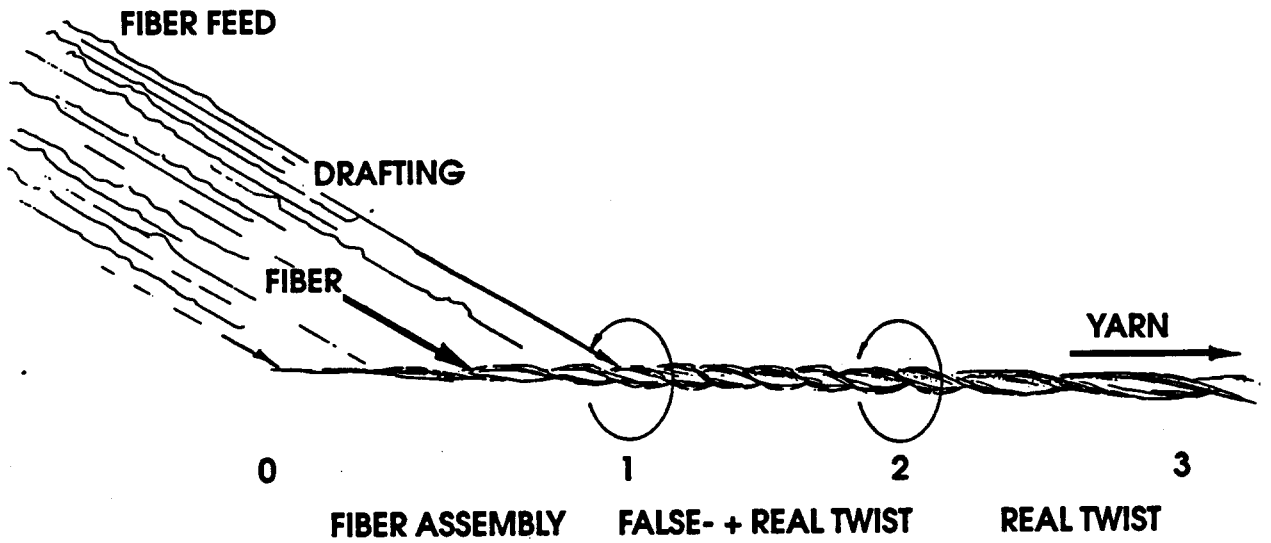


Figure 5-9 Schematic Diagram - Open End Spinning

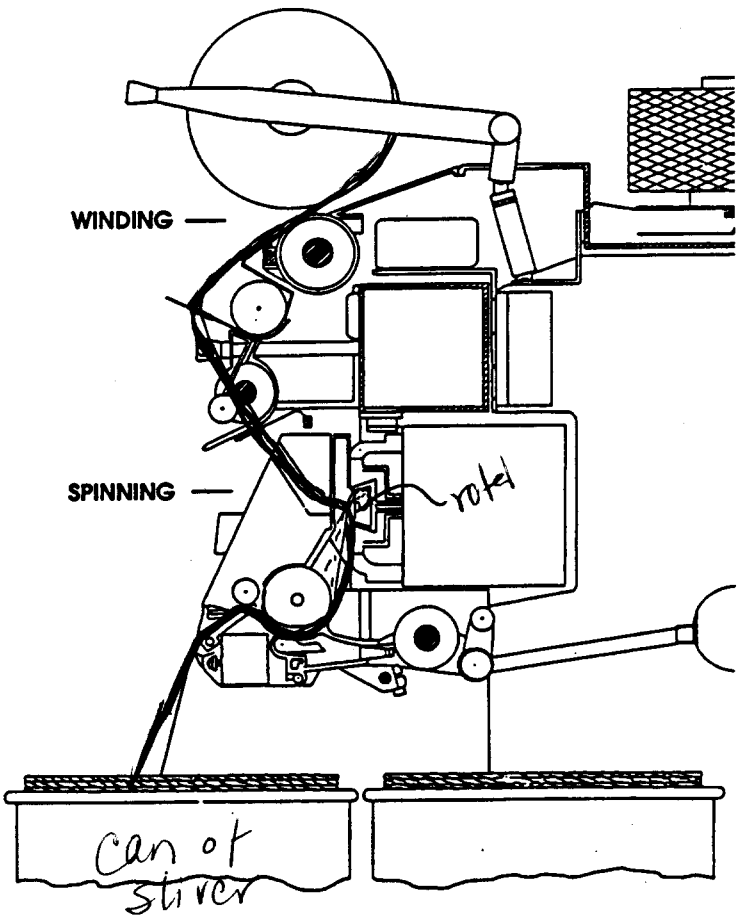


Figure 5-10 A Typical O.E. Machine

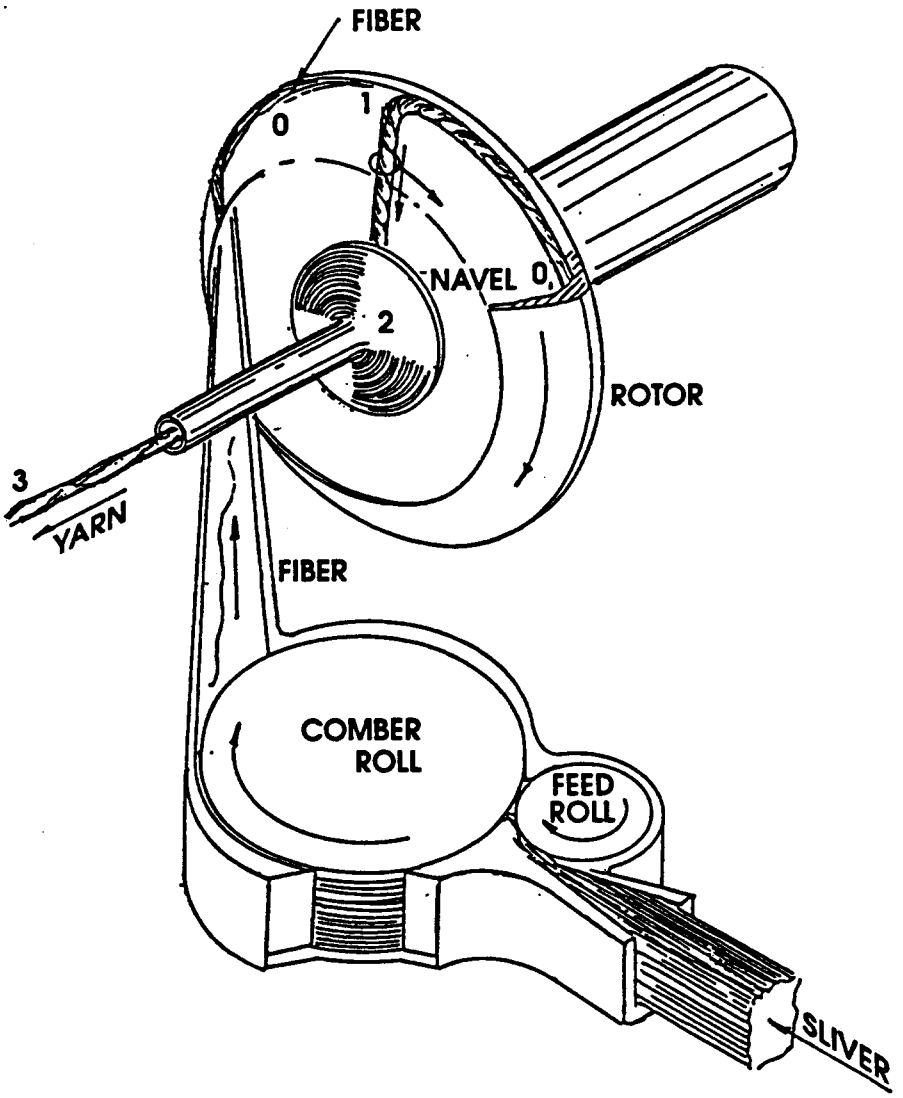


Figure 5-11 Yarn Formation: Ring vs Open End

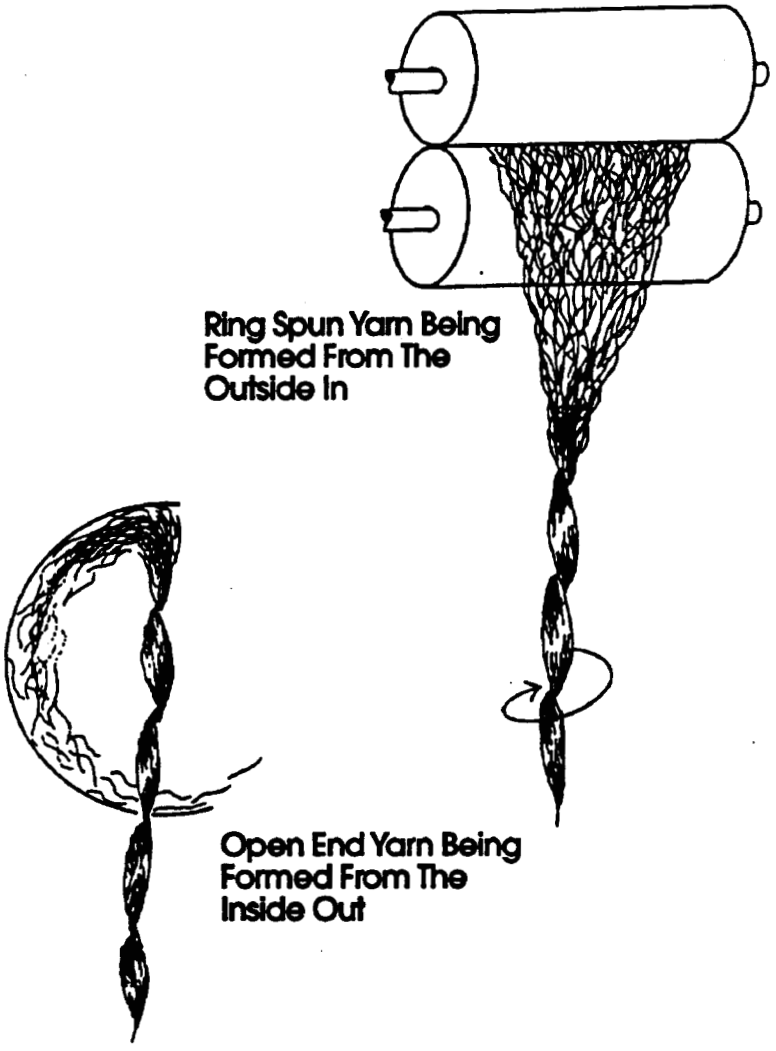
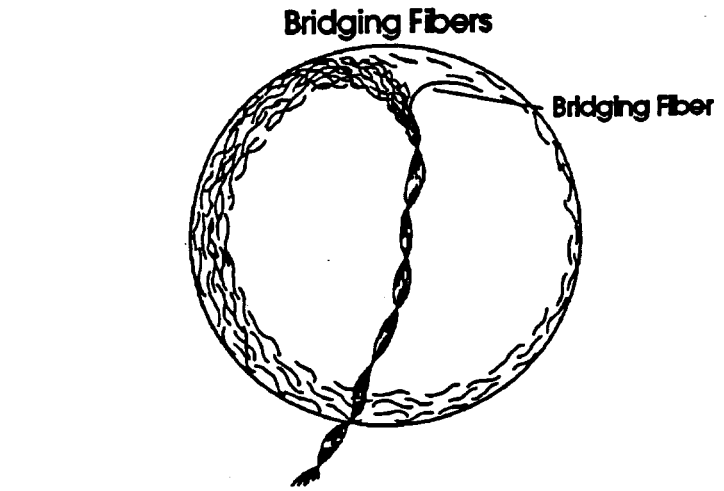


Figure 5-12 Surface Characteristic Differences of Ring and Open End Yarns



Formation of Bridging or Wrapper Fibers on the Surface of Open End Yarn

Ring Spun

Open End

Table 5-1 Comparisons of Properties Ring Spun vs Open End

	Ring Spun	Open End
Evenness		+
Strength	+	
Strength Uniformity		+
Elongation		+
Slubs, Thick, & Thin		+ fewer
Twist		Higher
Liveliness		+
Fiber Orientation	+	
Hairiness	More	
Luster	More	
Handle	+	
Count Range	Finer	40's
Diameter		Thicker
Absorption		+
Cost/Productivity		+

Figure 5-13 Formation And Structures Of Air Jet Spun Yarns

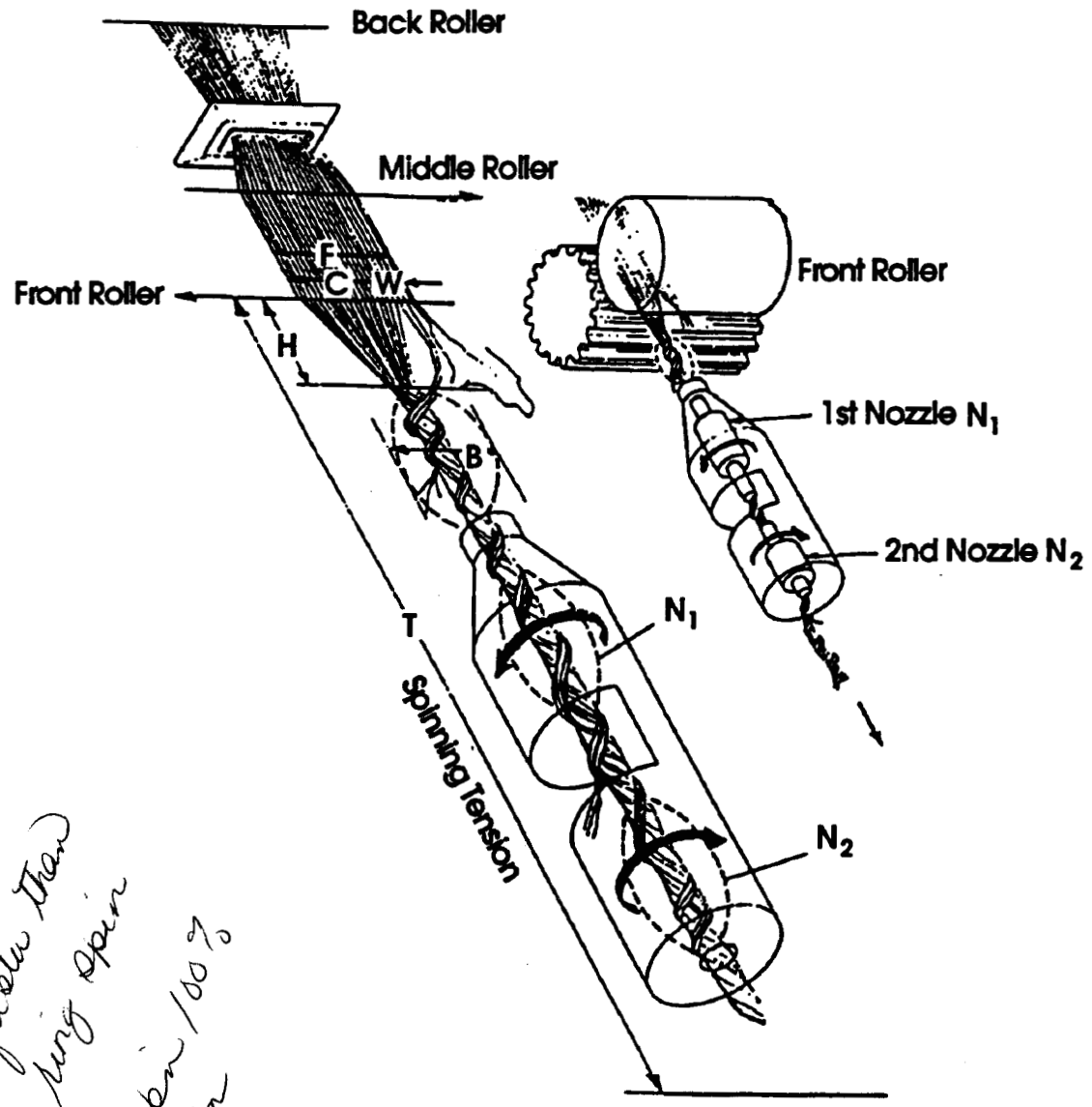
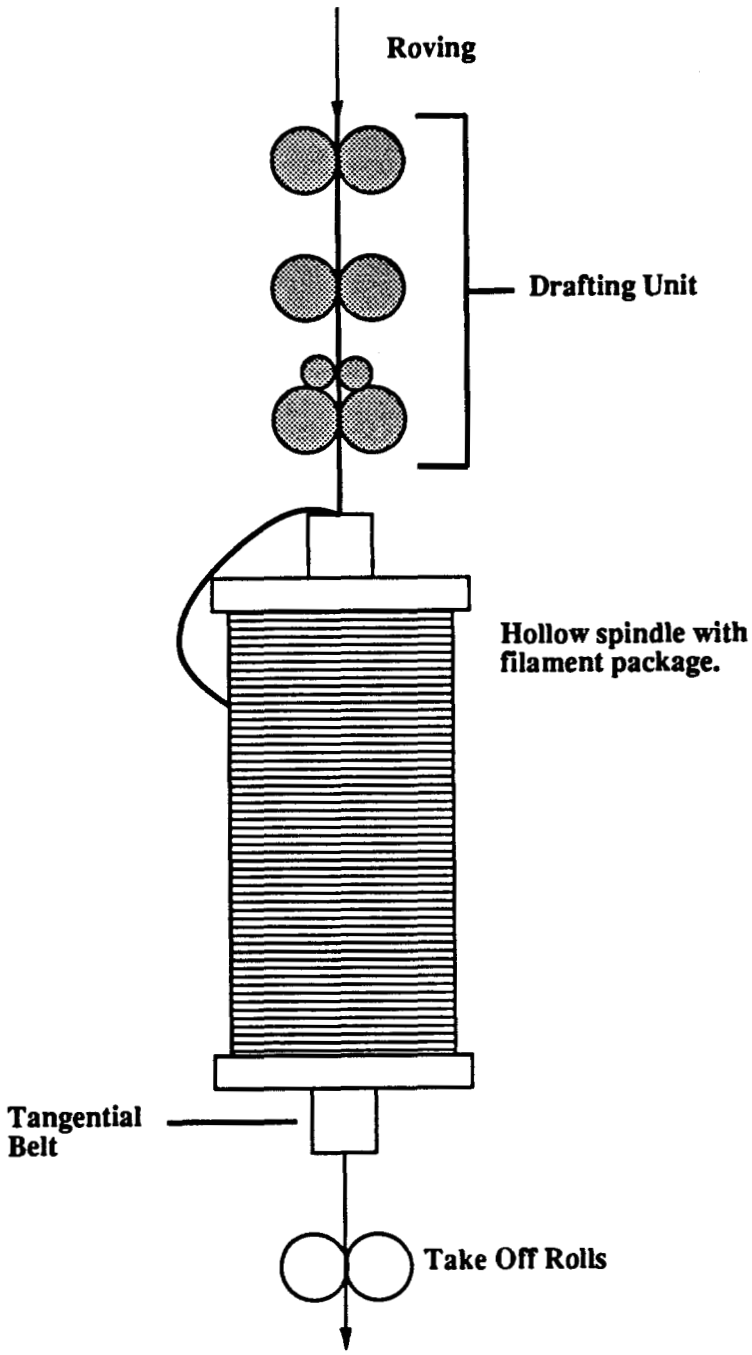
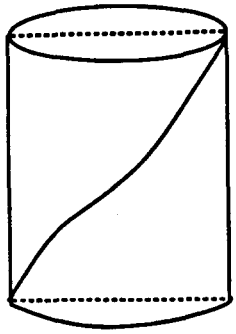


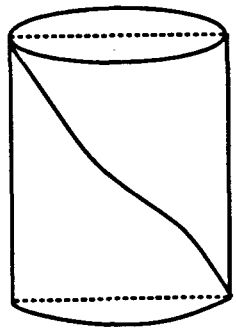
Figure 5-14 Wrap Spinning Process



Methods Of Expressing Twist



Z Twist



S Twist

Spindle rotating **clockwise** produces **Z Twist.**

Spindle rotating **counter-clockwise** produces **S Twist.**

Spun Yarns

Singles use T.M.
Ply use T.M. and T.P.I.

Filament Yarns

Use T.P.I.

$T.P.I. = T.M. \sqrt{Count}$

For Cotton Yarns

Knitting T.M.	2.2 to 3.5
Filling T.M.	3.5 to 4.2
Warp T.M.	4.2 to 5.0
Voile & Crepe T.M.	5.0 to 7.0

Effects Of Twist On Yarn And Fabric Properties

Degree of Yarn Twist Affects the Yarns

- Diameter or fineness
- Contraction
- Softness or hardness (hand)
- Bending behavior
- Absorbency
- Covering power
- Permeability
- Tensile strength
- Elastic performance/Extension and recovery
- Resistance to creases and abrasion
- Pilling behavior
- Luster

Degree of Yarn Twist Affects the Fabrics

- Hand
- Appearance
- Texture
- Drapability qualities
- Performance expectations
- Durability
- Serviceability

Plied Yarn

Yarn Is Plied To

- Introduce different fiber yarns
- Combine spun and filament yarns
- Add to or increase the strength of single strand yarns
- Utilize multi-strands of fine yarns to produce a thick strand
- Produce a smoother yarn
- Produce a yarn with uniform diameter
- Introduce textured or novelty yarns
- Add color interest

Characteristics of Plied Yarns

- Thicker and heavier
- Coarse
- Differ in count
- Less flexible than single yarns
- Affect drapability quality of fabric
- May be constructed with no twist at all
- May be highly twisted
- May differ in tension and direction of twist

Figure 5-15 Novelty Yarns