

Short Staple Yarn Manufacturing

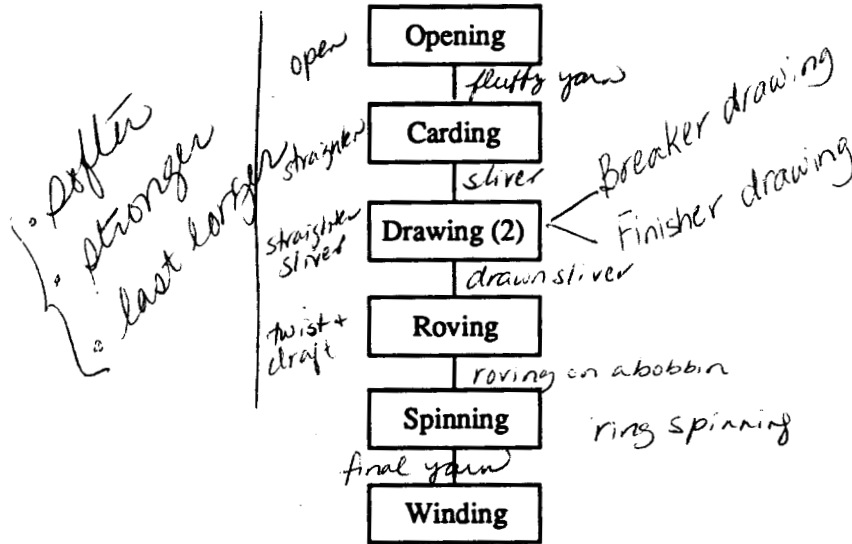


Characteristics Of Spun Yarns

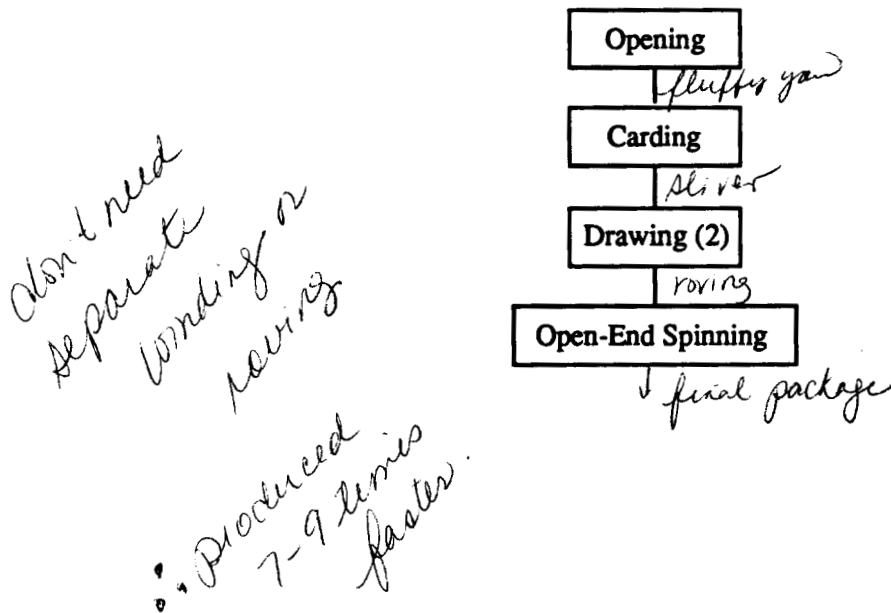
- Composed of short staple fibers
- Made from cotton, flax or wool staple fibers
- Made from natural or man-made filaments which are cut into filament staple
- Individual fiber lengths vary
- Fuzzy appearance and feel
- Uneven number of fibers throughout
- Range from soft, loose construction to hard 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

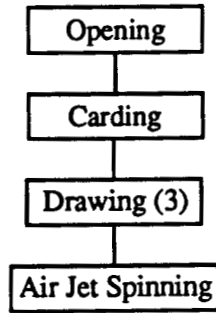
1. Carded Ring Spun Yarns



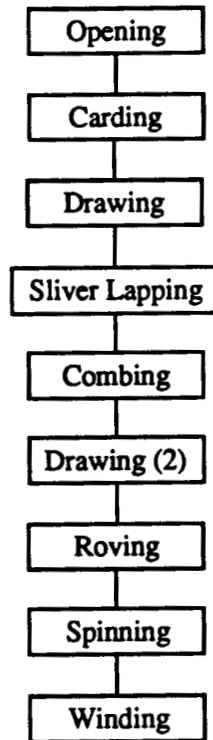
2. Open End Rotor Yarns



3. Air Jet Spun Yarns



4. Combed Cotton Ring Spun Yarns



*more expensive
smooth looking
fabric
top of line*

Functions Of The Opening Process

- Open) *open fibers to get the fluffiness, usually is a tangled mass*
- 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

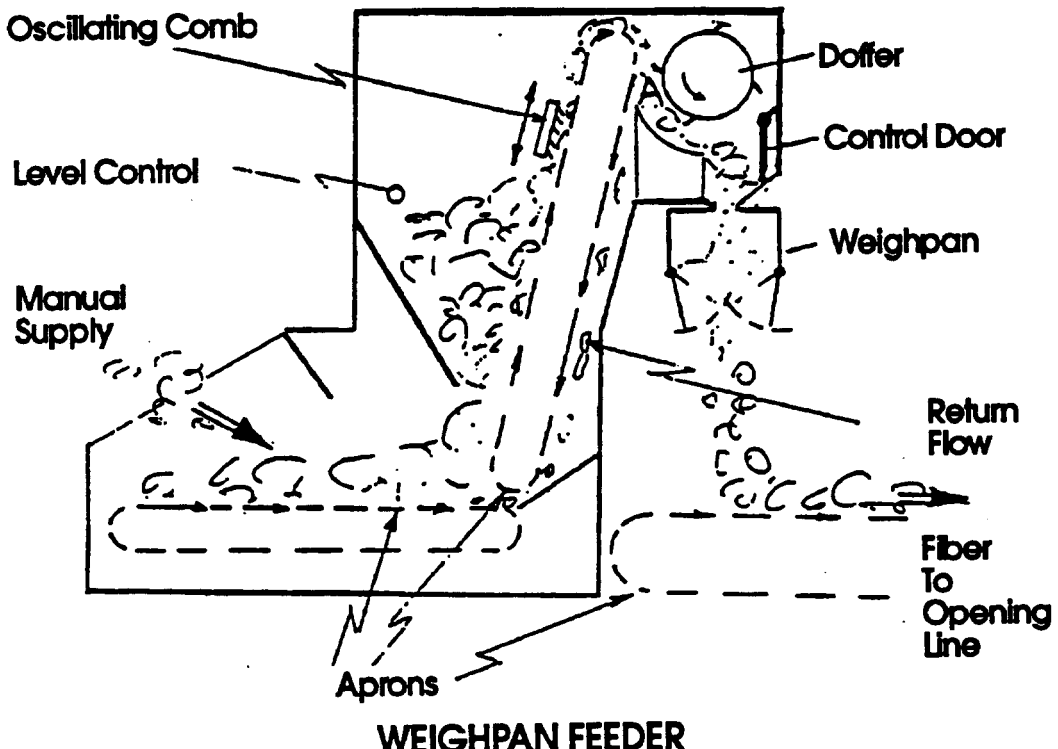
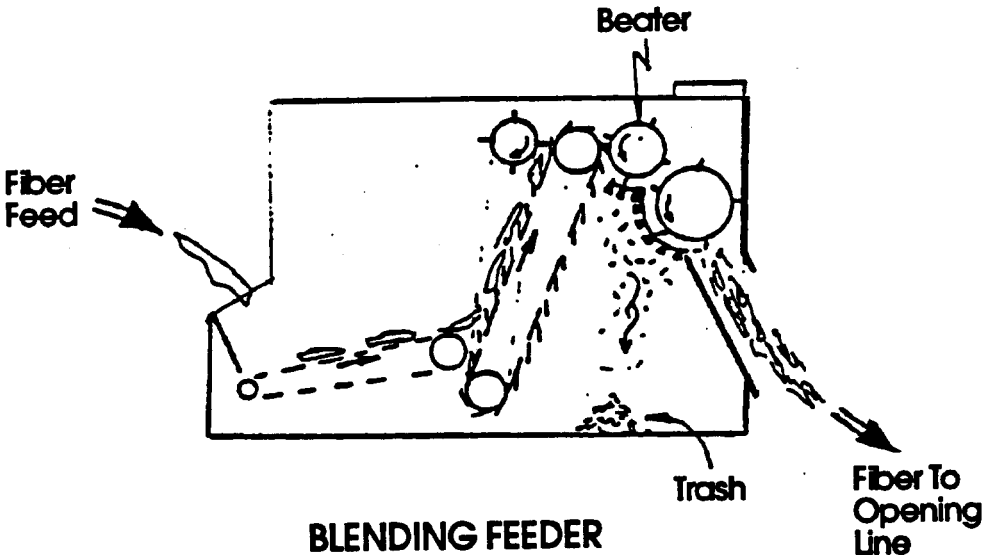
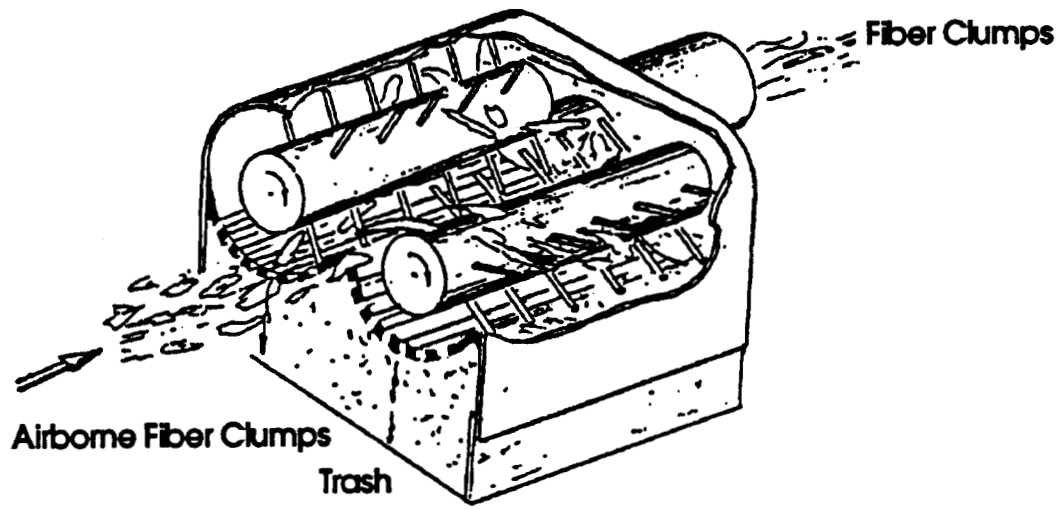
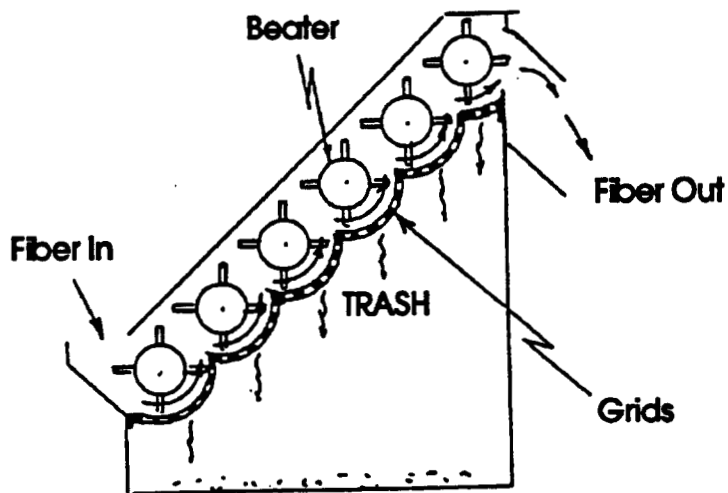


Figure 5-2 Axial Flow Cleaner And Incline Cleaner



AXIAL FLOW CLEANER



INCLINE CLEANER

Carding

Materials Processed

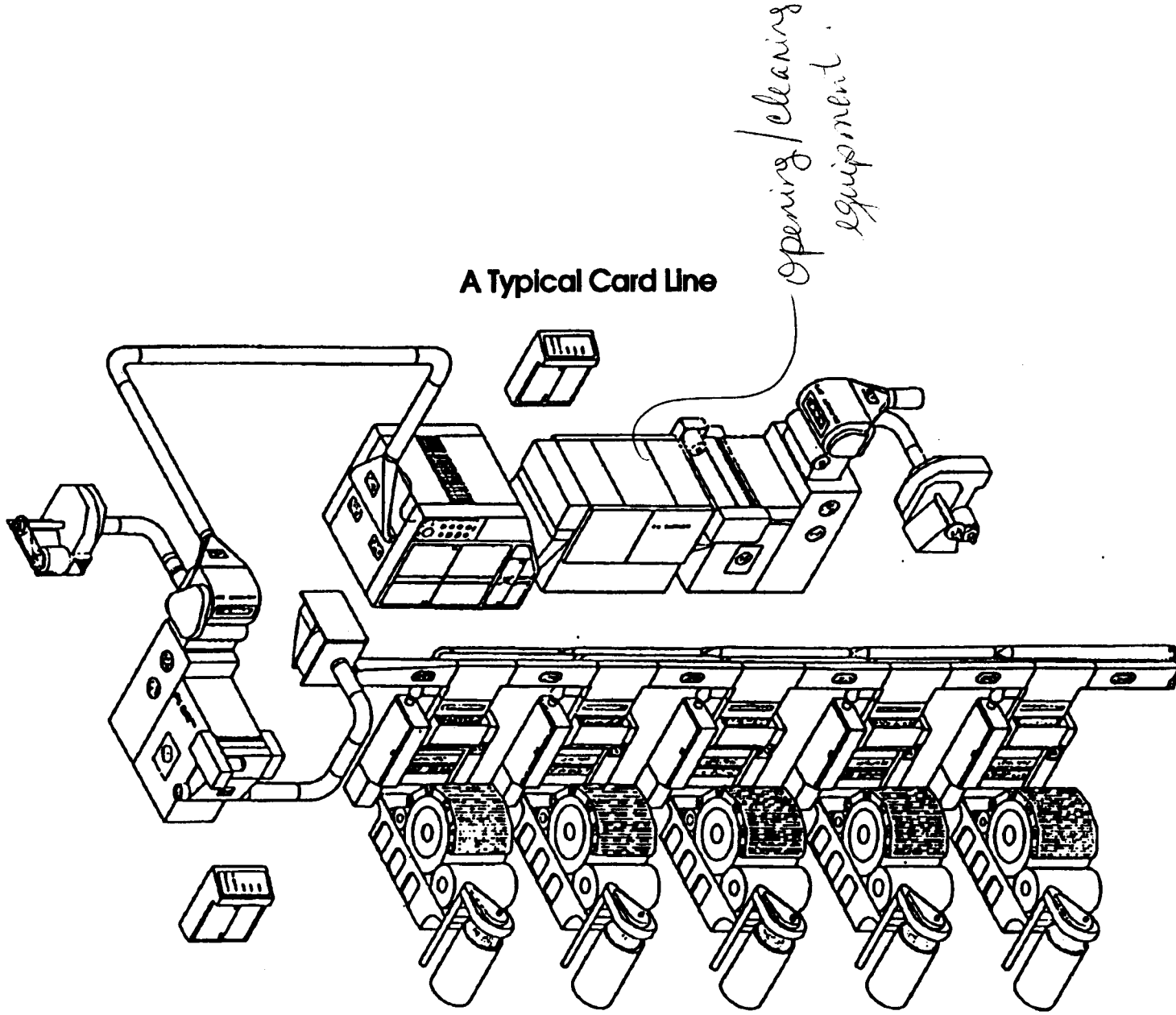
Input - Mat of fiber

Output - Card Sliver, measured in grains
per yard (1 lb = 7000 grains)

Objectives of the Process

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

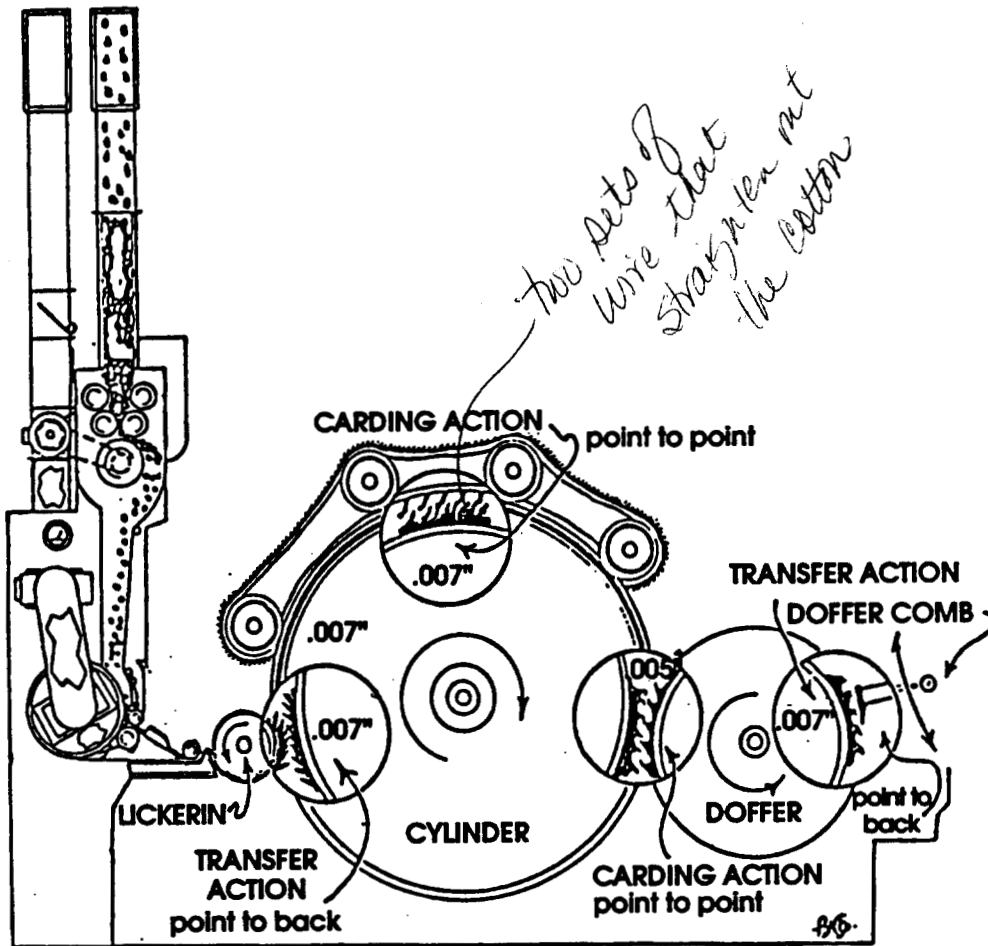
Card Feeding Systems



A Typical Card Line

*opening/cleaning
equipment.*

Figure 5-3 Revolving Flat Card



*for Poly
shorter - wire
use a
different wire
not as aggressive
as for cotton.*

Drawing

Material Processed

Input - *Card sliver*

Output - *Drawn sliver*

Objectives of the Process

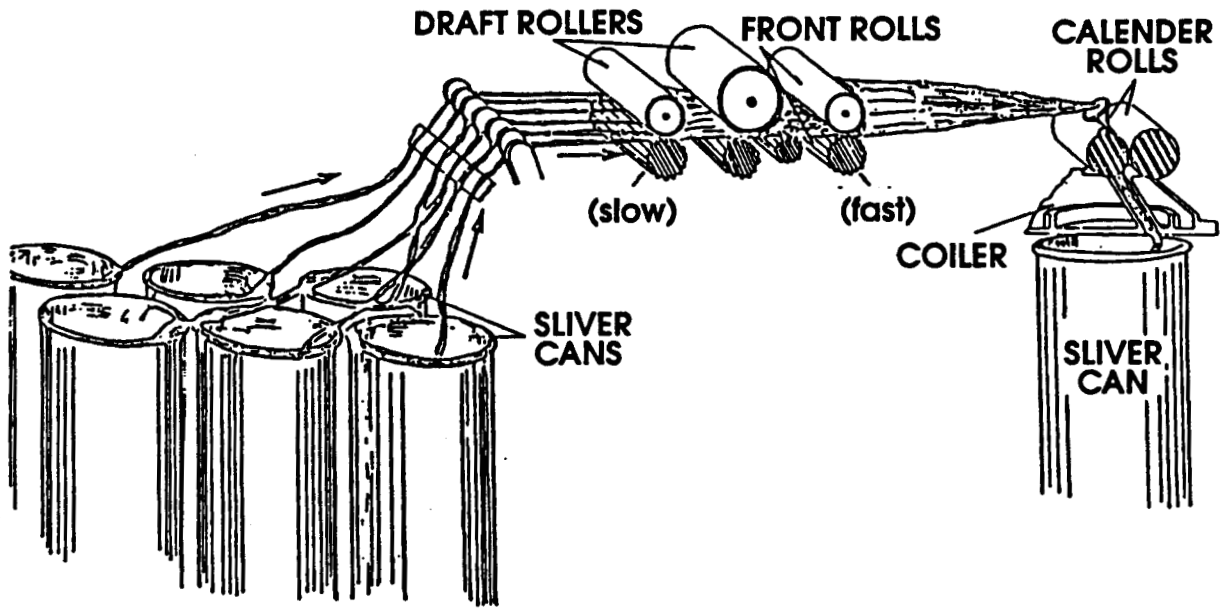
1. Improve sliver uniformity
 - A. Doubling

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 (⊙)

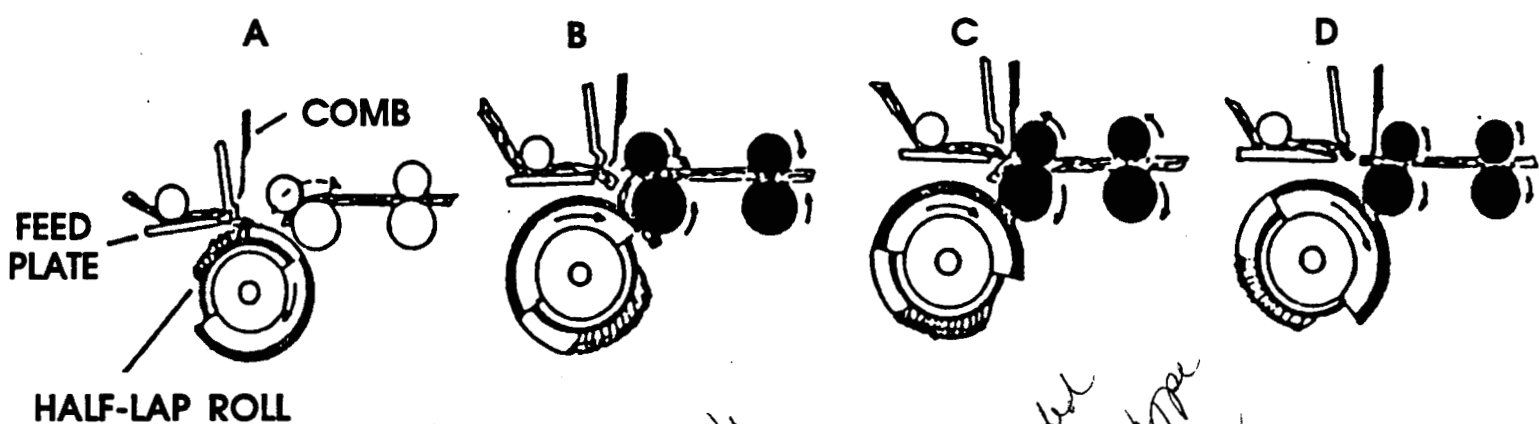
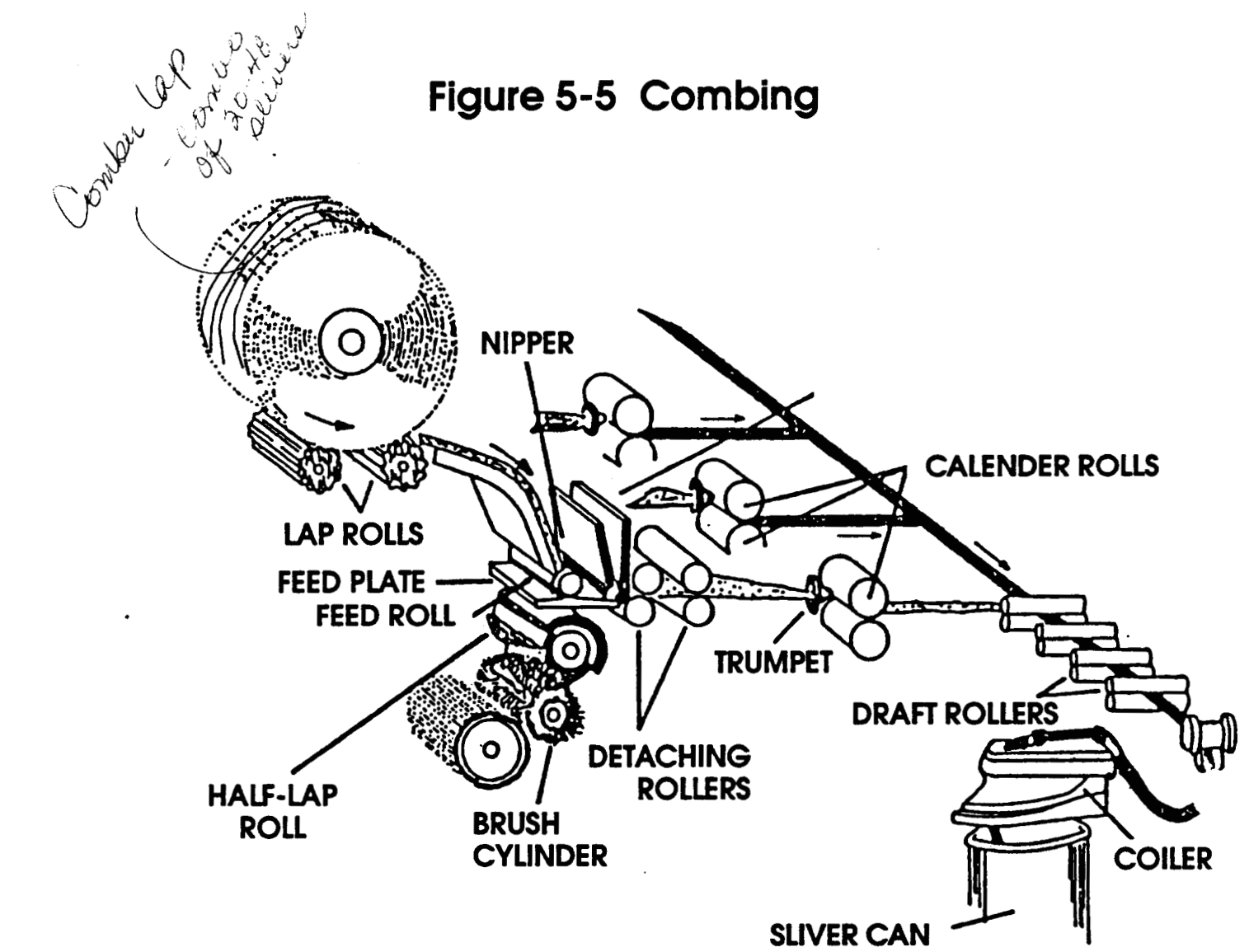
Comber Preparation

Combing 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



*fibers that are combed out are called comber noils
6% - 22% → it recycled into another type of yarn*

Roving

Materials Processed

Input -

drawn or ~~card~~ combed slivers

Output -

roving on a bobbin

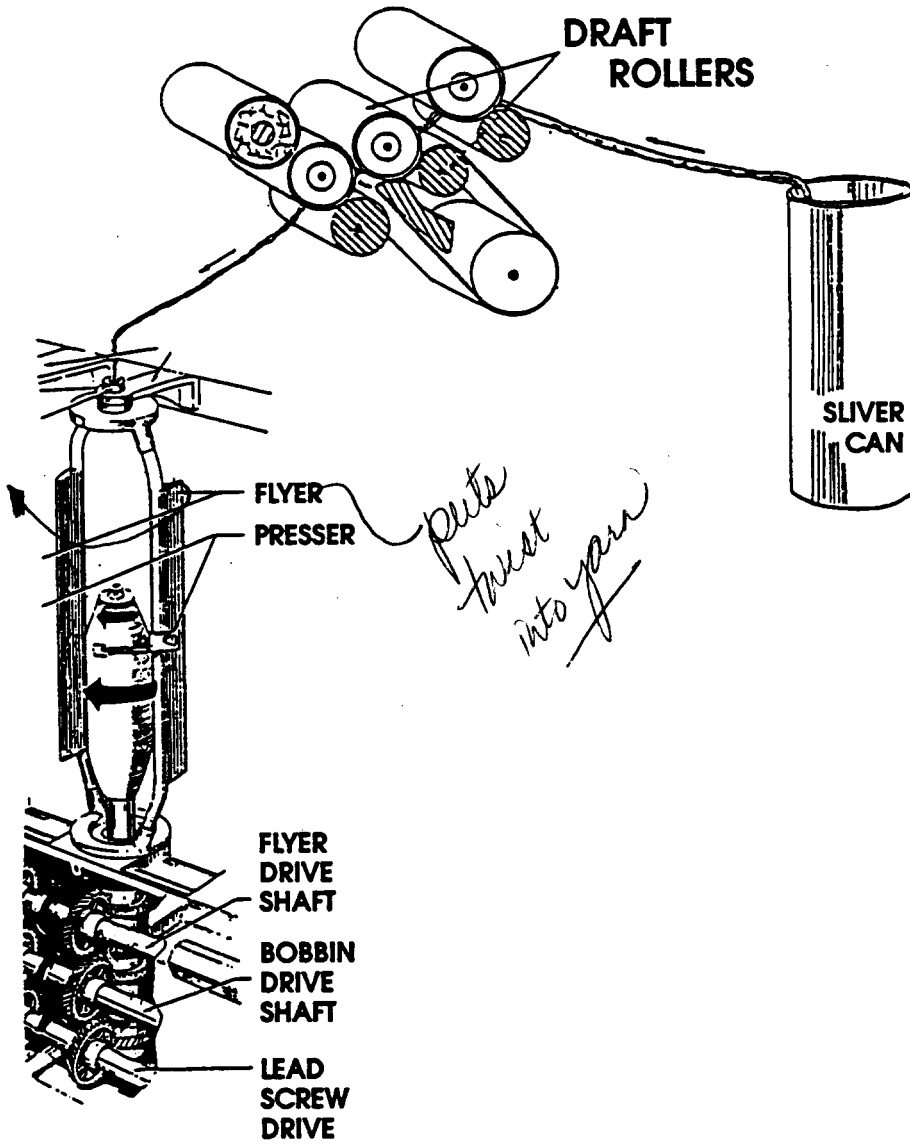
Objectives of the Process

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 -

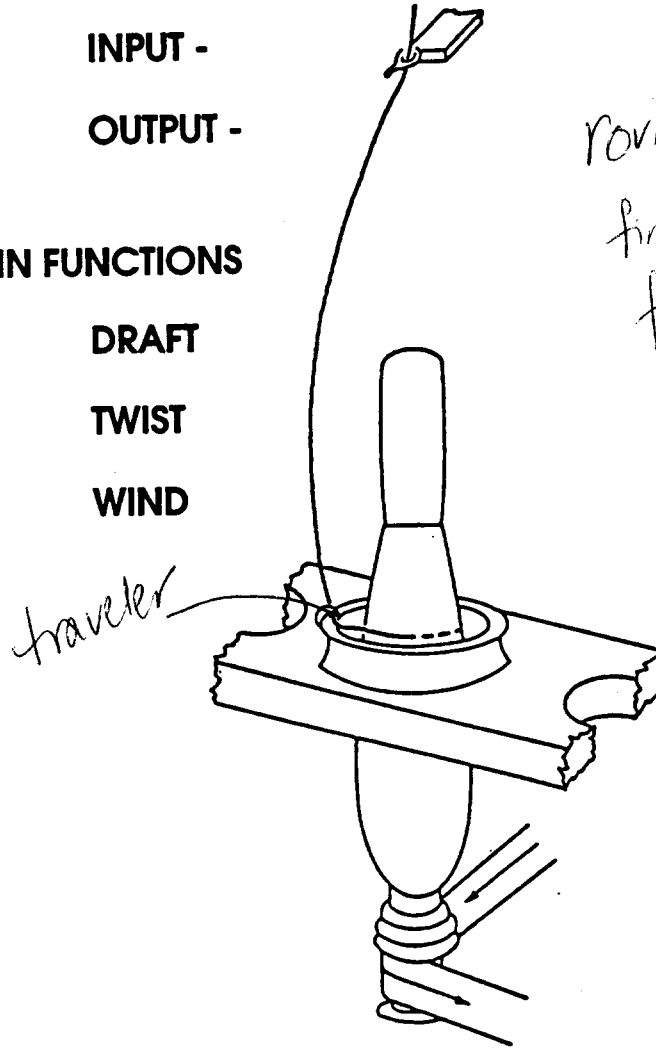
OUTPUT -

MAIN FUNCTIONS

DRAFT

TWIST

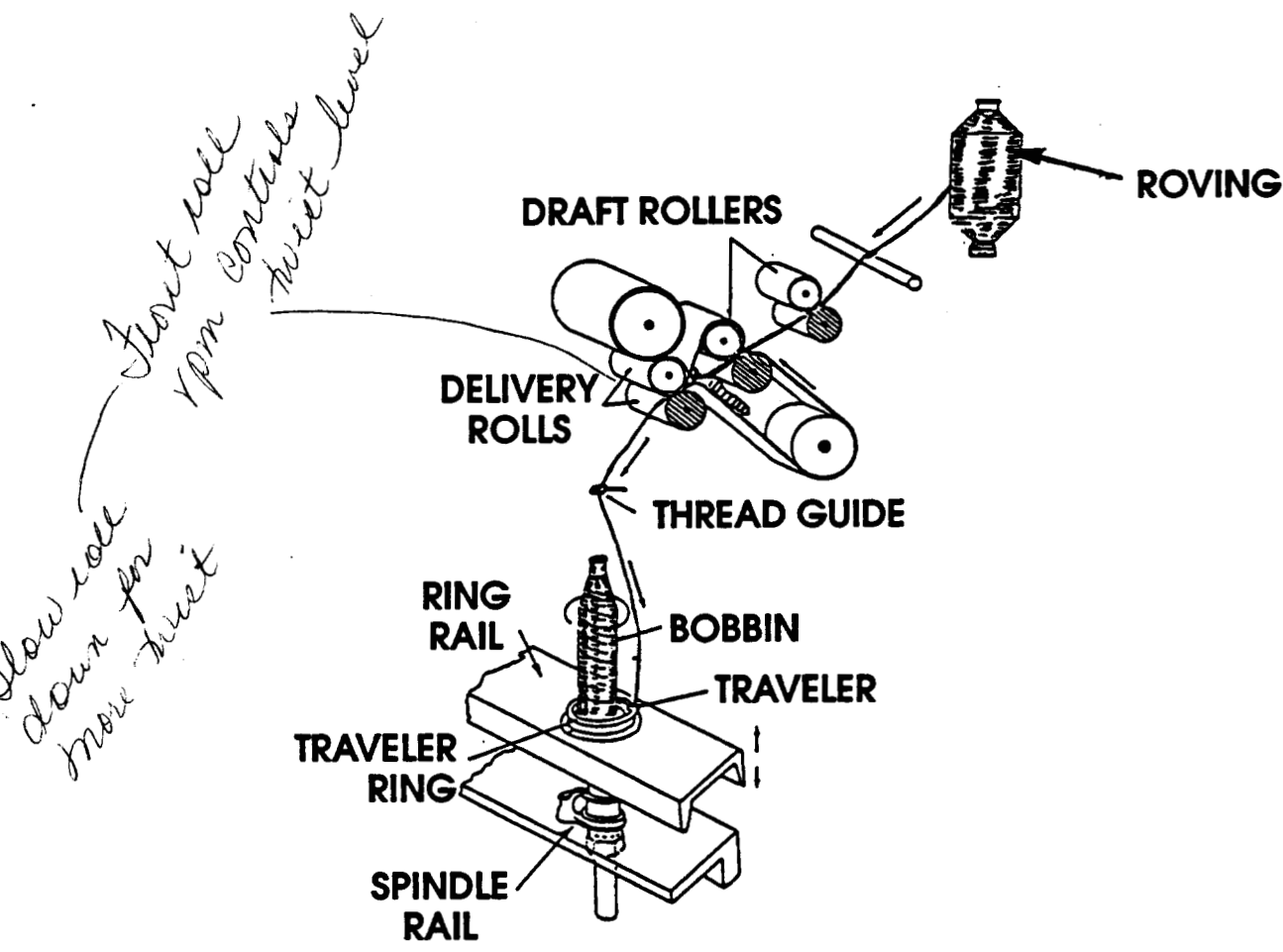
WIND



*Roving
final yarn
final twist
but not
final package*

*yarn is
threaded
through
traveler*

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

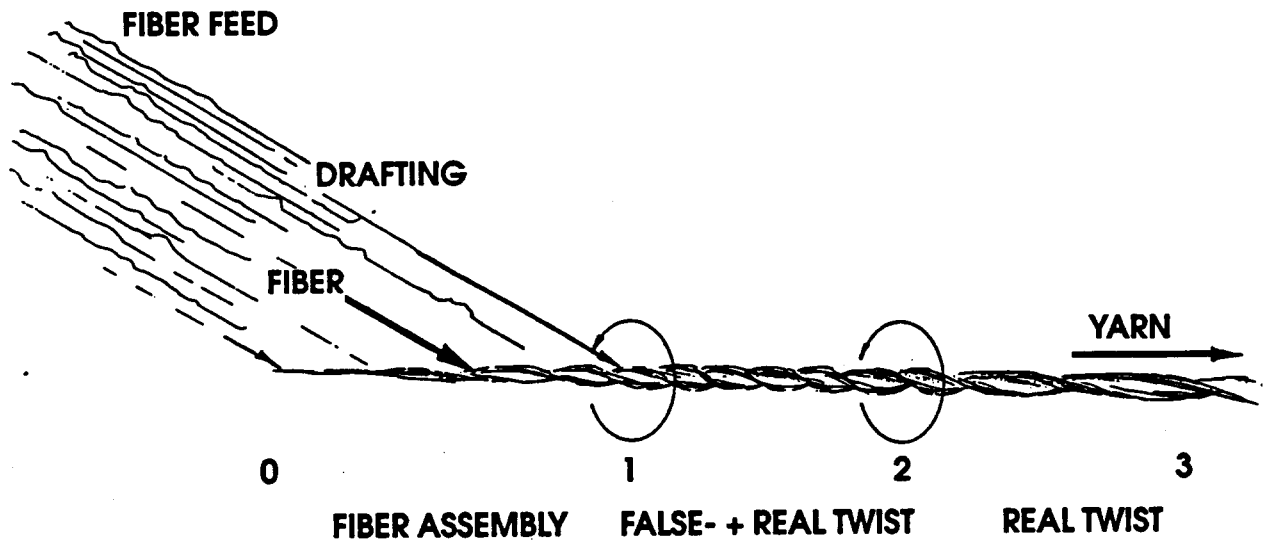


Figure 5-9 Schematic Diagram - Open End Spinning

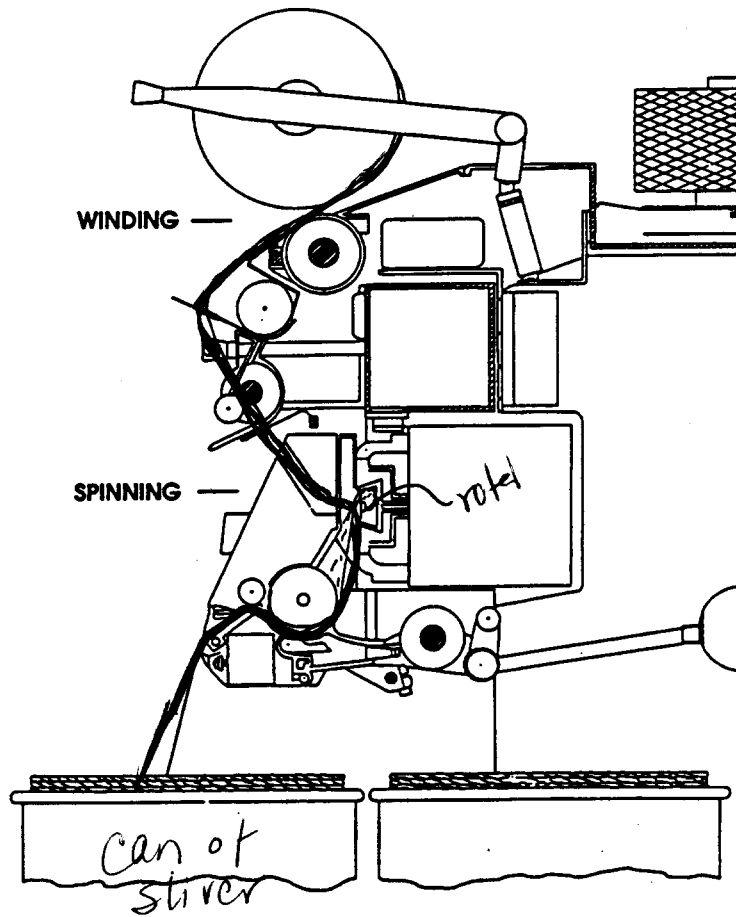


Figure 5-10 A Typical O.E. Machine

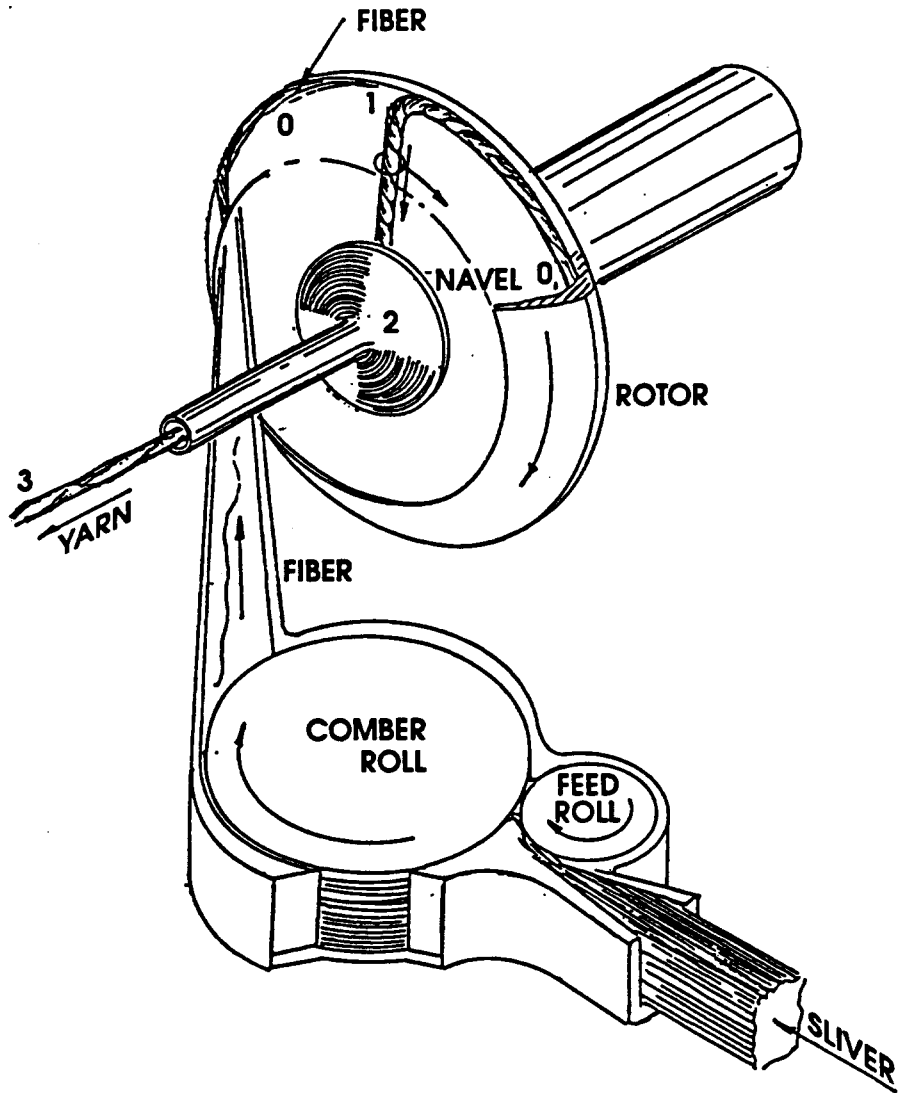


Figure 5-11 Yarn Formation: Ring vs Open End

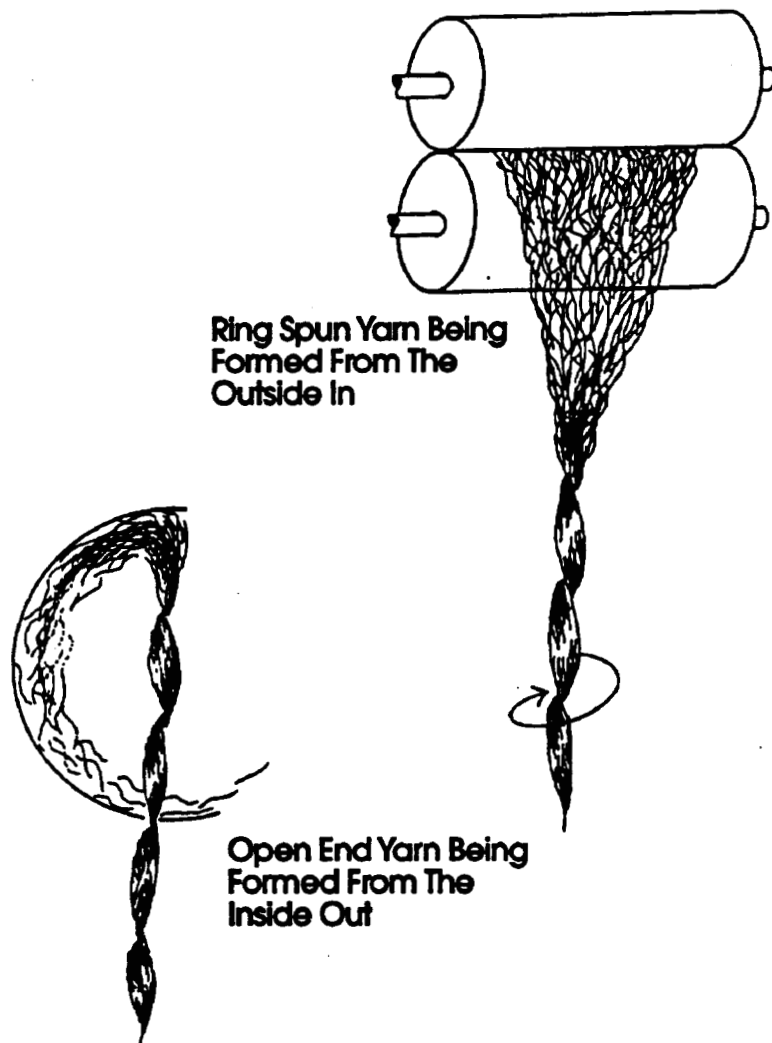
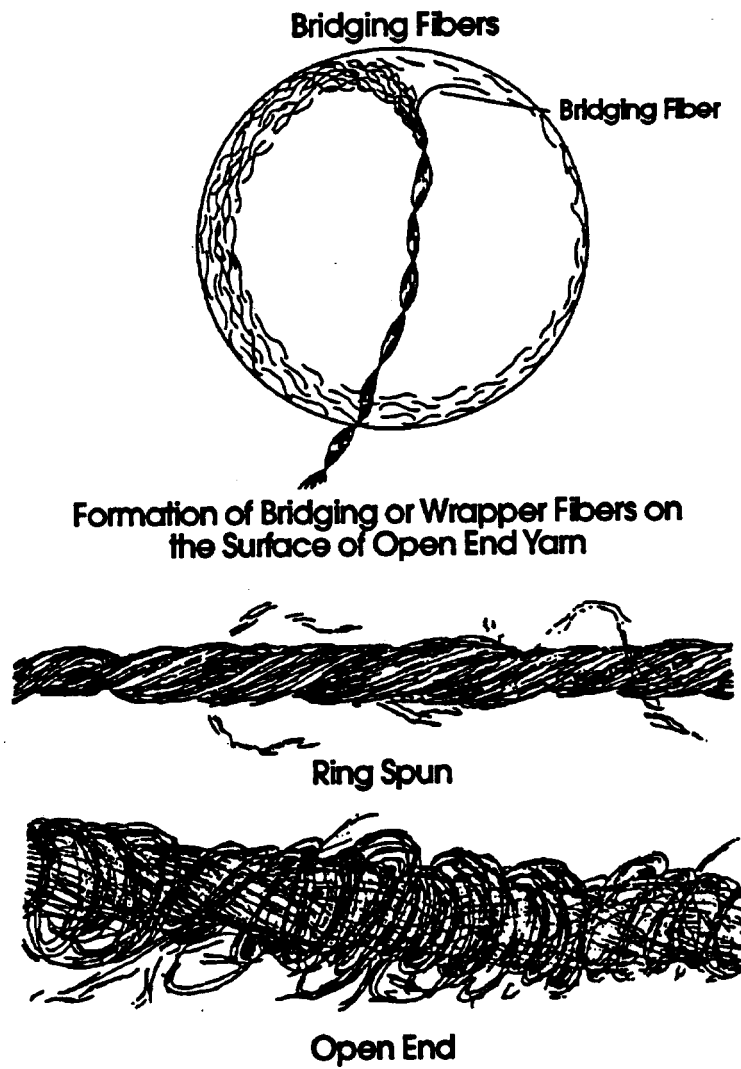


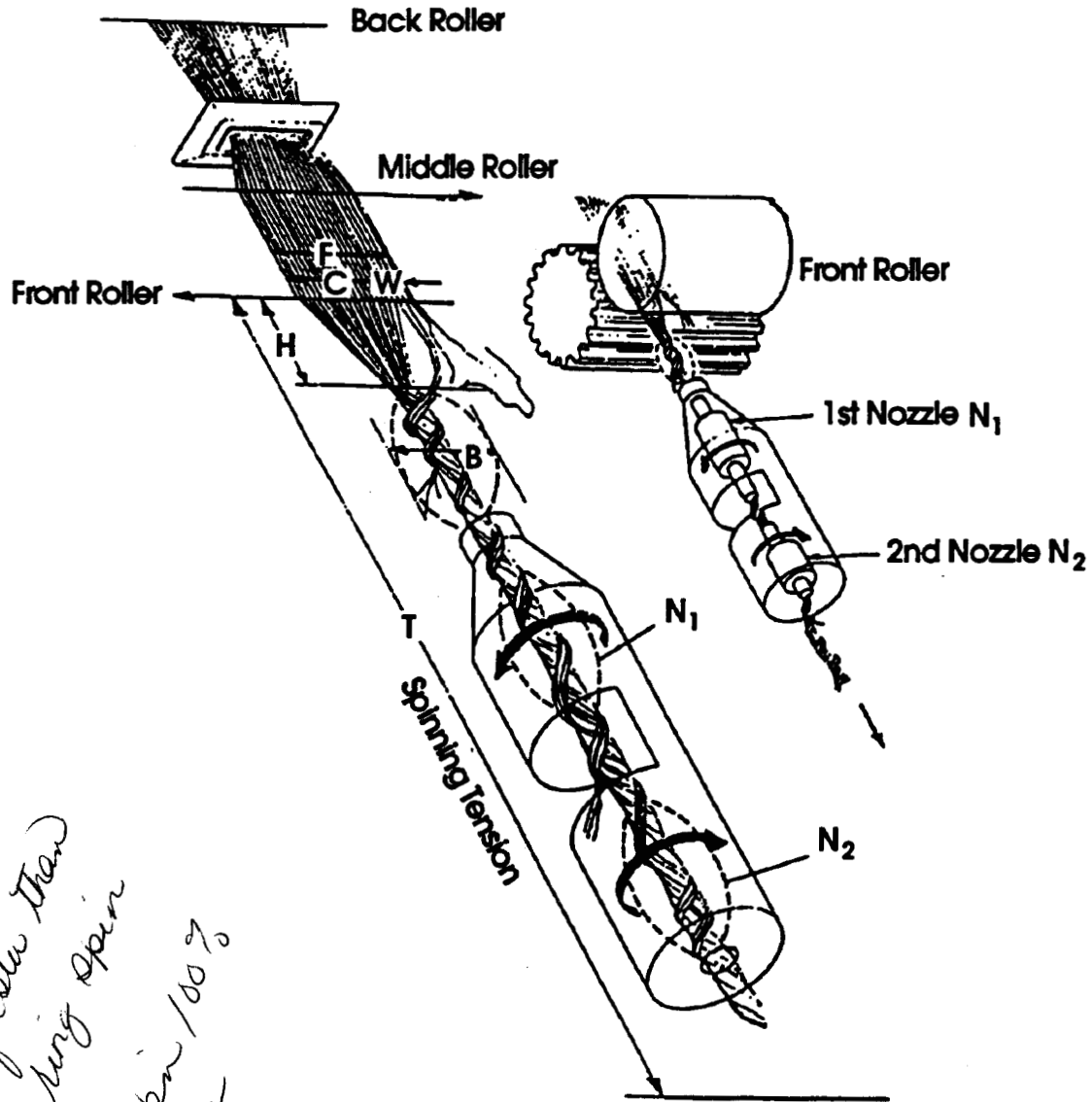
Figure 5-12 Surface Characteristic Differences of Ring and Open End Yarns



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

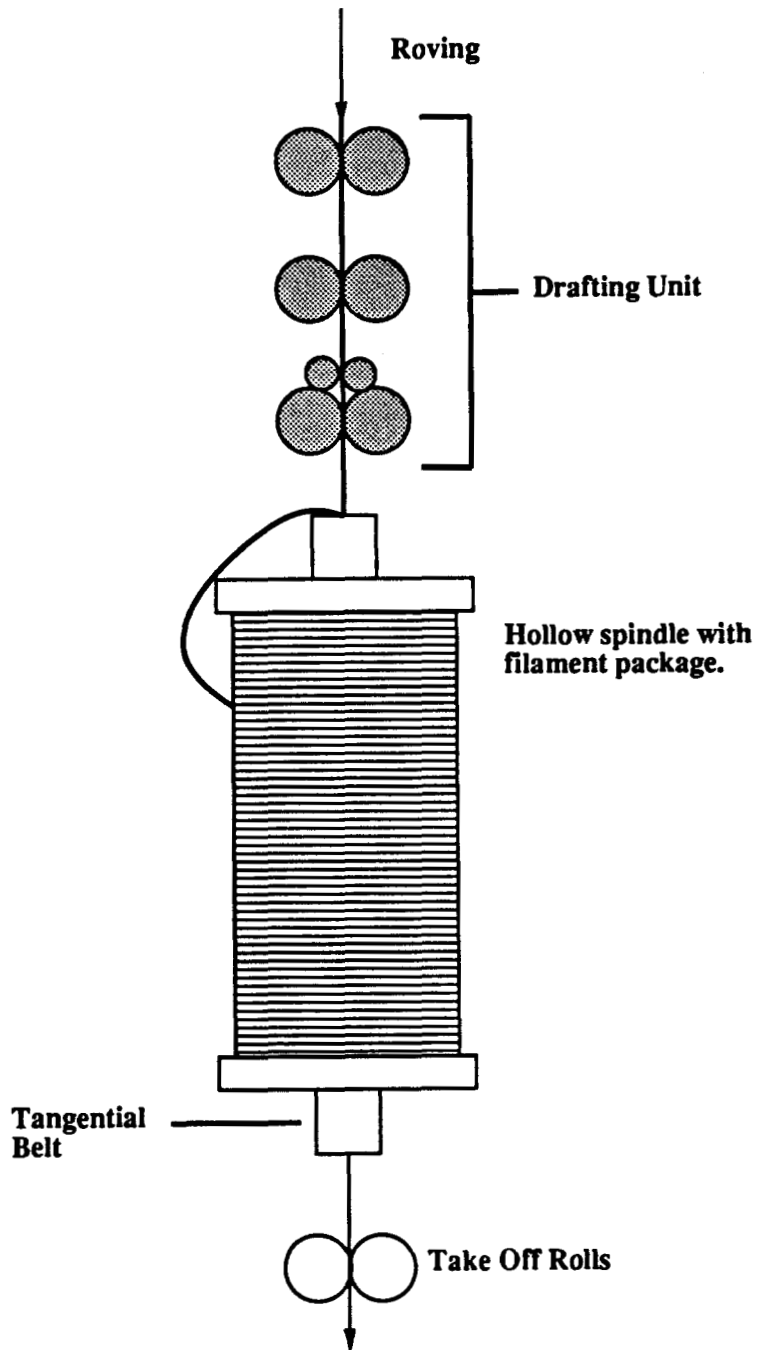
	Ring Spun	Open End
Evenness		+
Strength	+	
Strength Uniformity		+
Elongation		+
Slubs, Thick, & Thin		+ <i>fewer</i>
Twist		Higher
Liveliness		+
Fiber Orientation	+	
Hairiness	More	
Luster	More	
Handle	+	
Count Range	Finer	<i>40's</i>
Diameter		Thicker
Absorption		+
Cost/Productivity		+

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

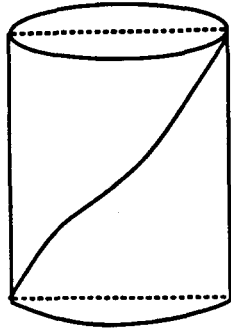


15-20x
faster than
ring spin
Can't spin 100%
cotton

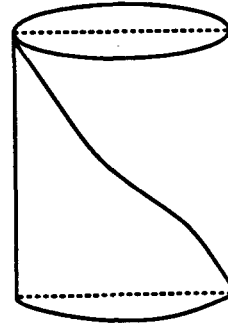
Figure 5-14 Wrap Spinning Process



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.

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

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



LOOP



SLUB



BOUCLÉ



CORE SPUN