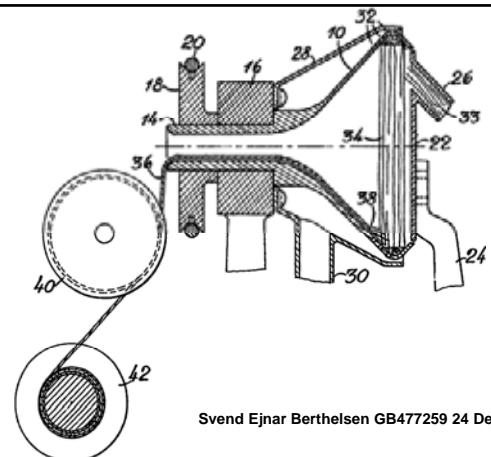


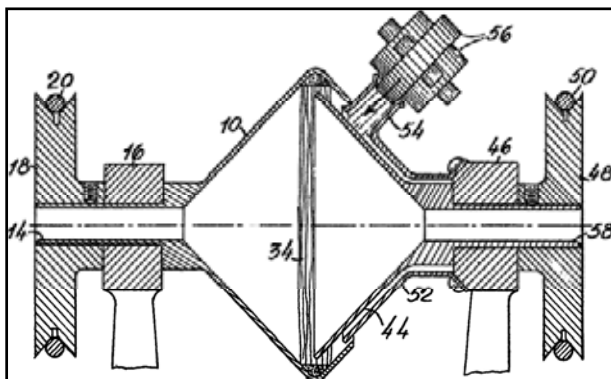
Brief History of Open-end Spinning Development

1876, J Hibry

1937, Svend Ejnar Berthelsen



Svend Ejnar Berthelsen GB477259 24 Dec. 1937



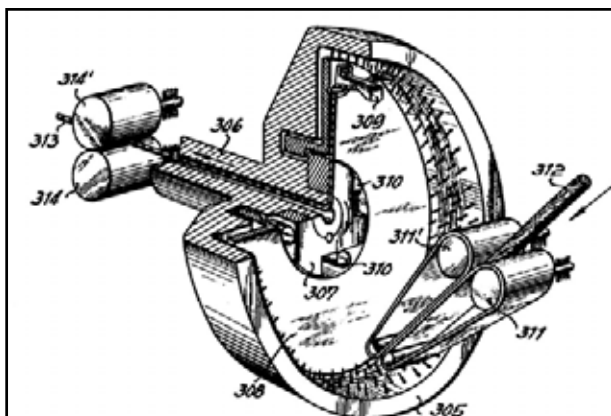
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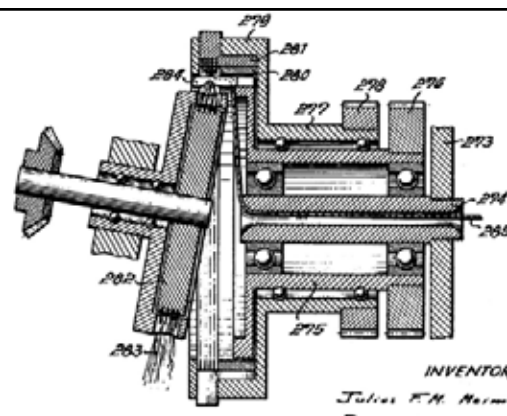
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USP3119223 Julius Meimberg 2 July 1956



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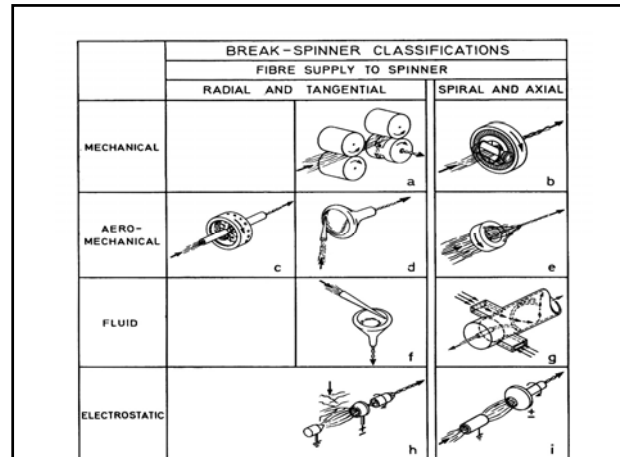
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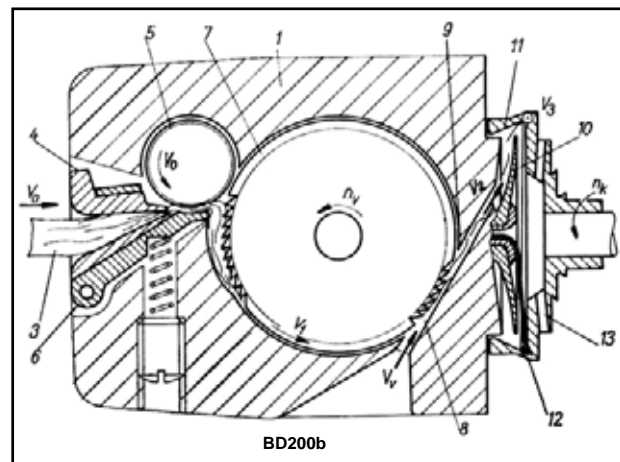
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1966, BD200 installed in factory

1967, ITMA Basel, Switzerland, Elitex's BD200, 30,000 rpm



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1971, ITMA Paris, wide spread commercial introduction

2003 8m rotors 174.5 m ring

Common requirements of open-end spinning

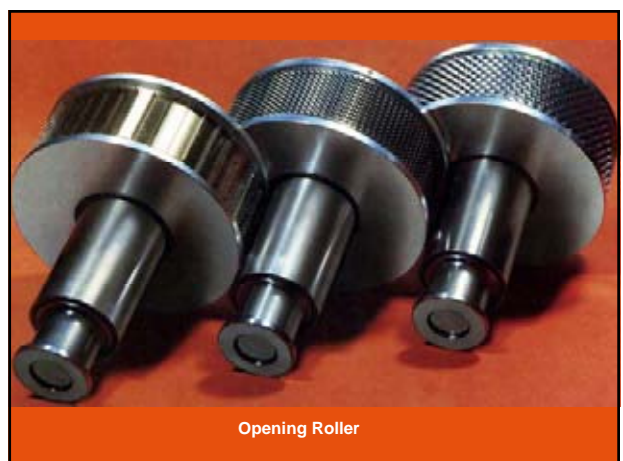
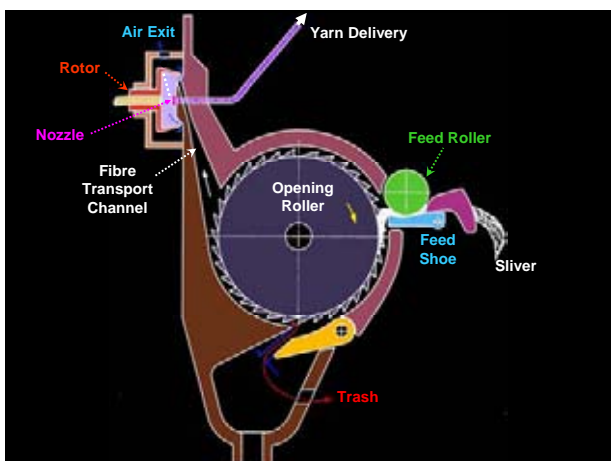
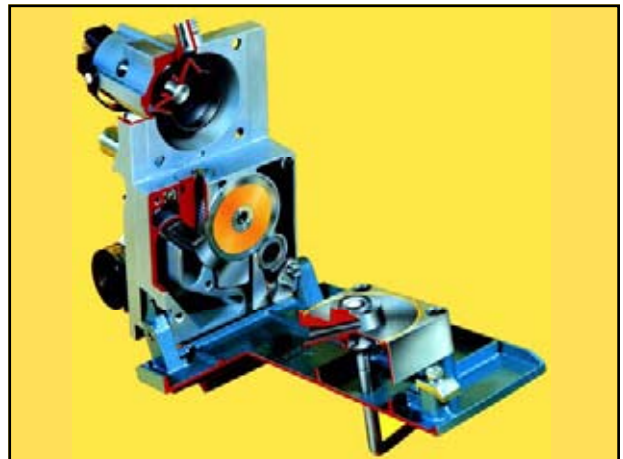
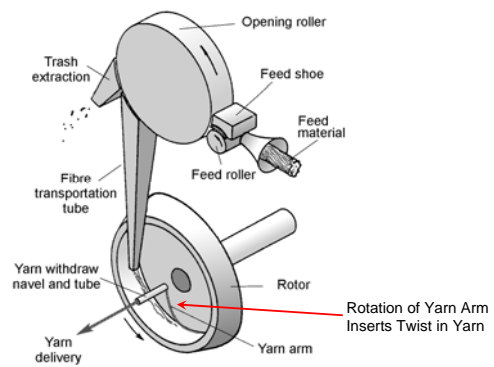
- Fibre separation device
- Means of fibre transportation
- Device for collecting separated fibres
- Device for rotating open-end of yarn (twisting device)
- Yarn take-off and package build mechanism

Key feature of open-end spinning:
Separation of twisting from winding, but
continuous operation

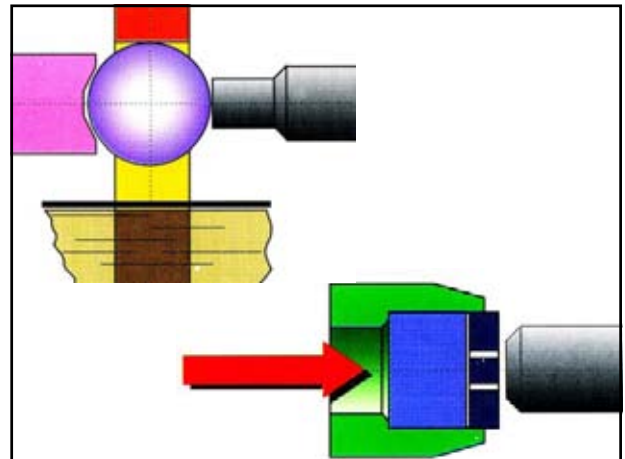
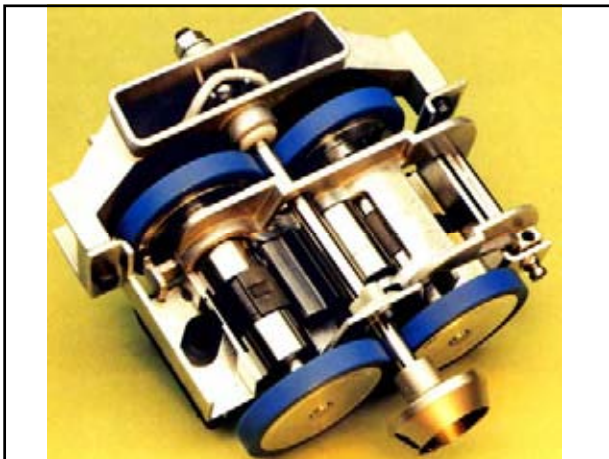
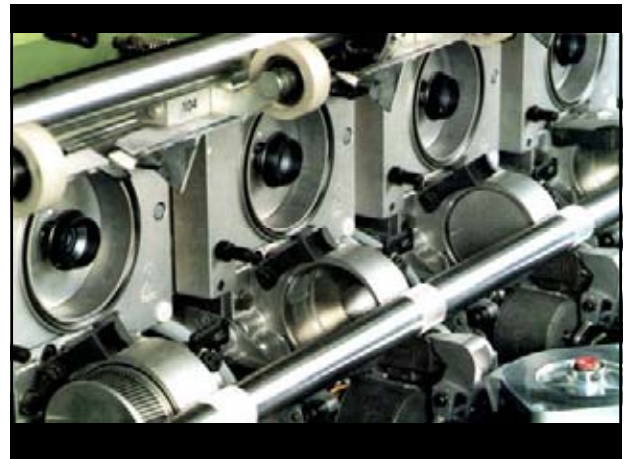
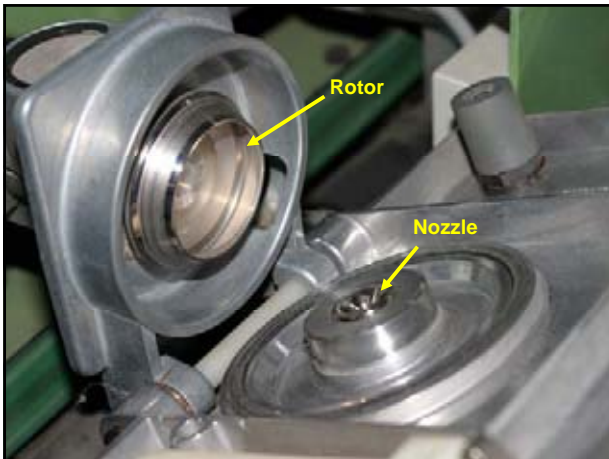
Critical point: yarn property
Most successful system: rotor



Rotor Spinning Principle

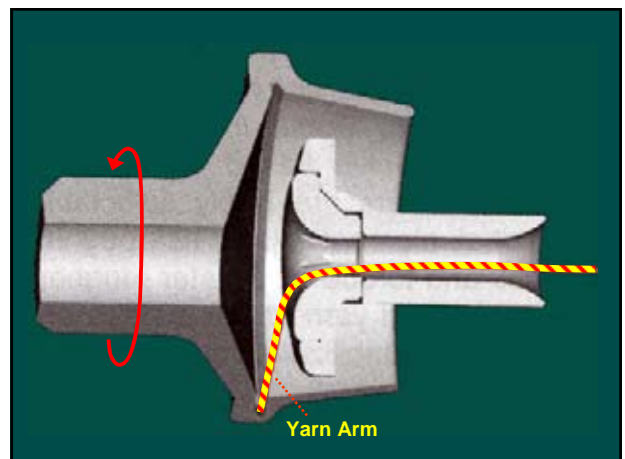


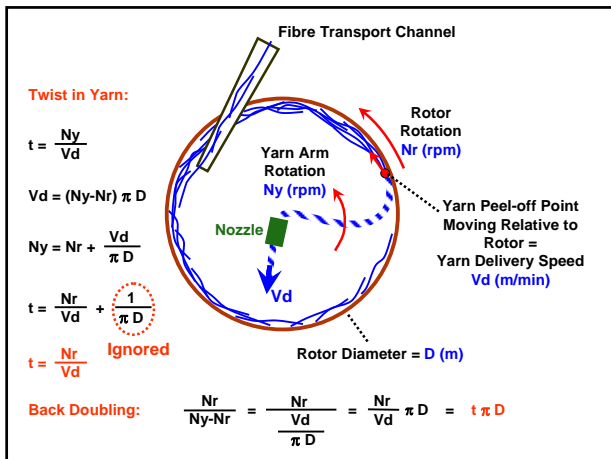
Opening Roller



Example of Fibre Mass Attenuation

	Feed Roller	Opening Roller	Exit of Fibre Transport Tube	Rotor Groove	Yarn Withdraw Point
Fibre Speed (m/s)	0.015	30	100	200	2.5
Draft	2000	3	2	1/80	
No. of Fibres In Cross Section	20,000	10	3	1.5	120



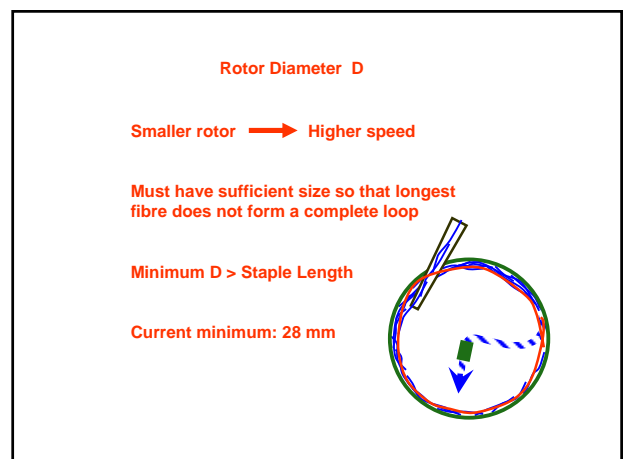
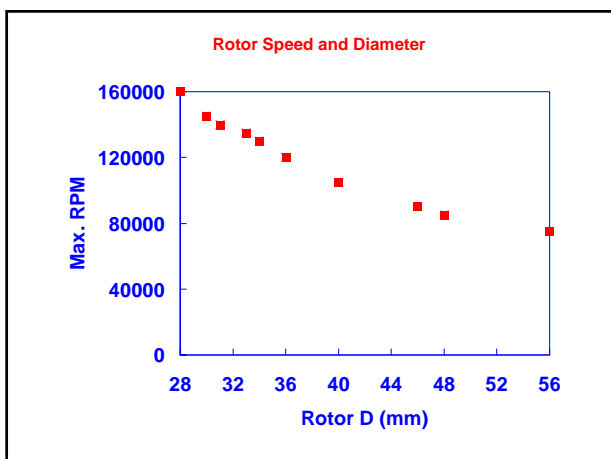
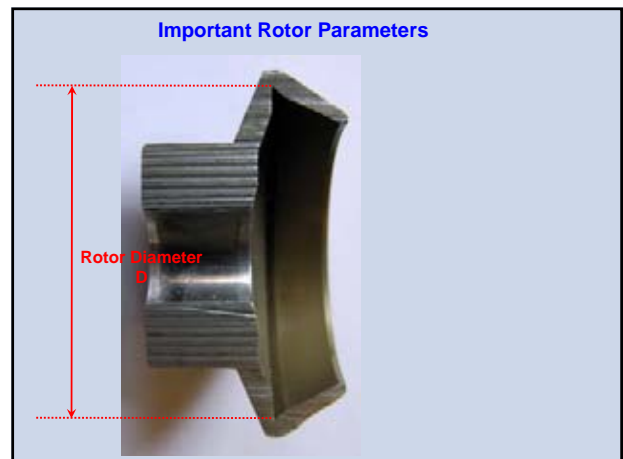
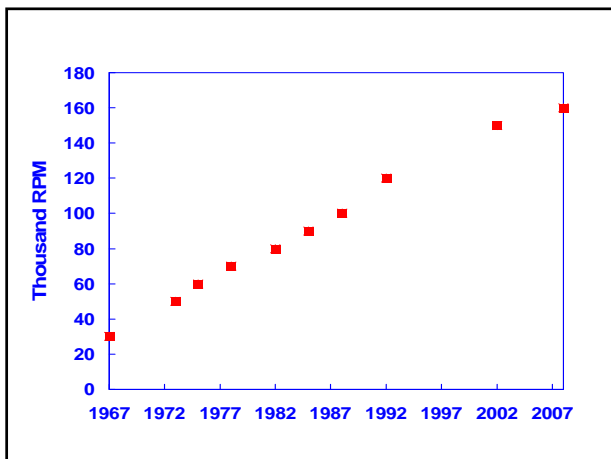


Yarn Twist $t = \frac{N_r}{V_d}$

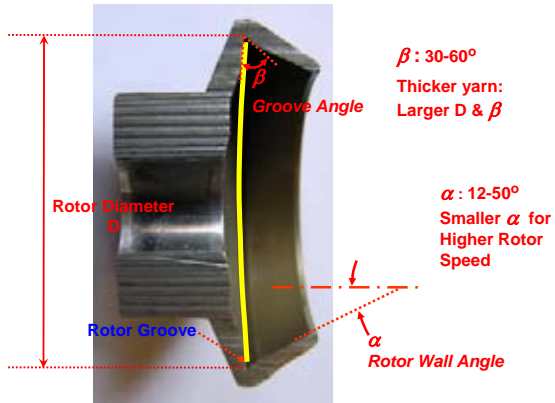
Back Doubling: $t \pi D$

Production rate (kg/h):

$$V_d \times \frac{\text{tex}}{1000} \times \frac{1}{1000} \times 60 \times E \times N$$

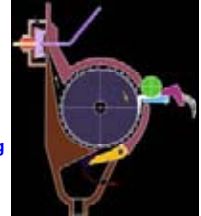


Important Rotor Parameters



Opening Roller Speed

- Higher speed gives better fibre opening
- If opening roller speed is too high, fibre striping by air may not be complete, leading to more yarn faults
- Optimum depends on fibre, yarn and rotor speed



Opening Roller Type

- Type of wire (pin or saw-tooth)
- Point density
- Working angle



Working angle

CLOTHING WIRE

Form / Type	Form										
	OB 20 B		OB 20/4		OB 20		OS 21		OS 43		
Coating / Flame material	DN	*	DN		DN	*	DN	*	XR	DN	XR
	Cotton										
	Regenerate										
	Viscose										
	Polyester/ acryl										
	Blends like PES/ED										

Rieter Opening Roller Wire

Draw-off Nozzle



- Steel draw-off nozzle:
- For man-made fibres and blends
 - No static charging
 - Lower surface nozzle temperature

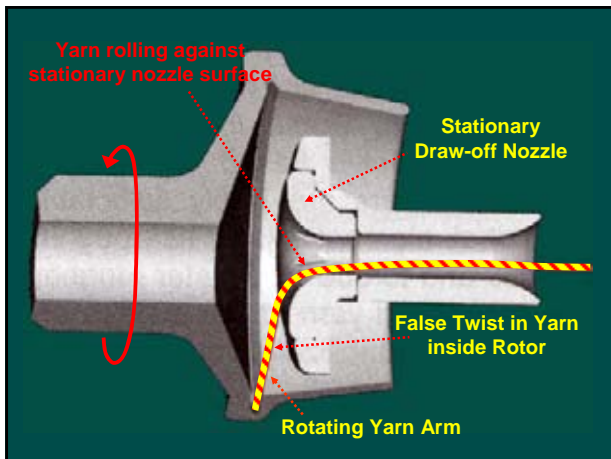


- Ceramic draw-off nozzle:
- More hard wearing, longer life

Effects of Draw-off Nozzle surface



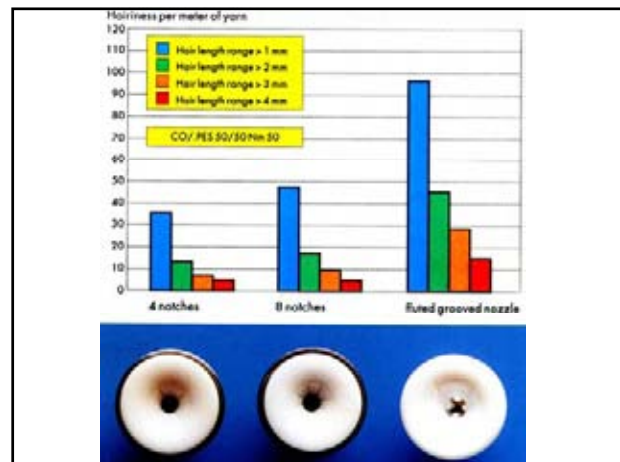
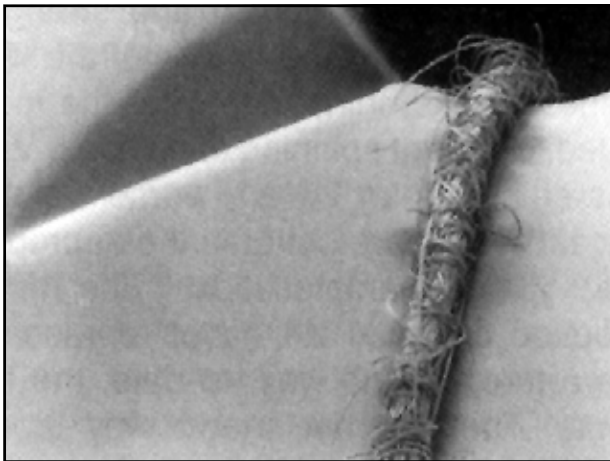
- Grooved nozzle increases false twist, helps to spin yarns with lower machine twist (e.g. knitting yarns)



Effects of Draw-off Nozzle surface



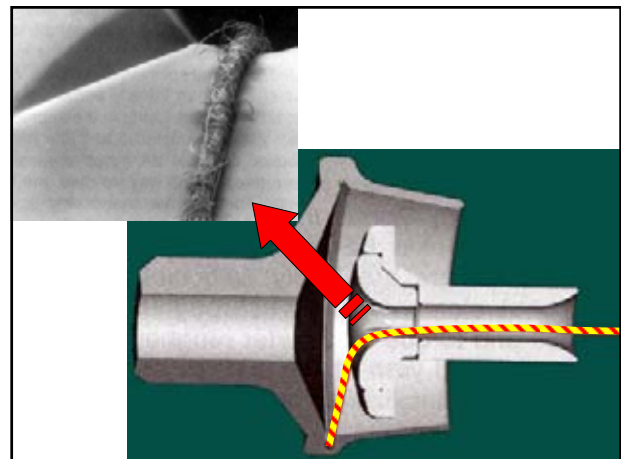
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- Grooves disrupt fibres in yarn, increasing hairiness and yarn faults



Effects of Draw-off Nozzle surface



- Grooved nozzle increases false twist, helps to spin yarns with lower machine twist (e.g. knitting yarns)
- Grooves disrupt fibres in yarn, increasing hairiness and yarn faults
- Higher false twist increase wrapper fibres during untwisting by nozzle



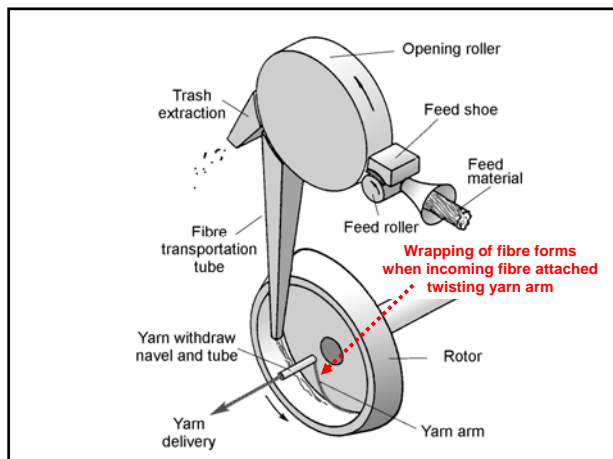
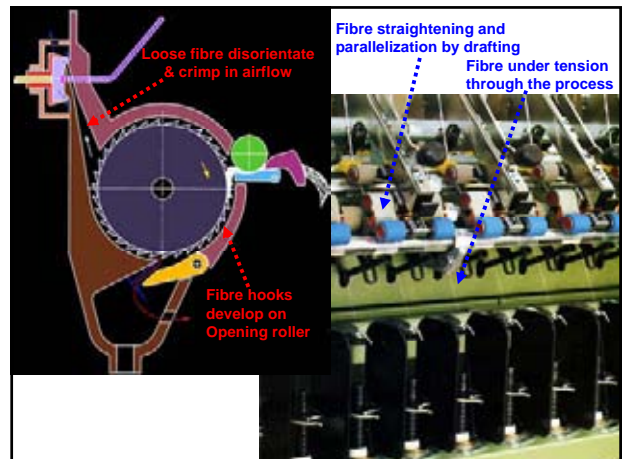
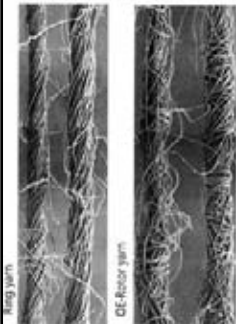
Ring Spinning and Rotor Spinning Comparison

Yarn Formation

■ Fibre Disposition

Fibre straightness/alignment

Wrapper fibres



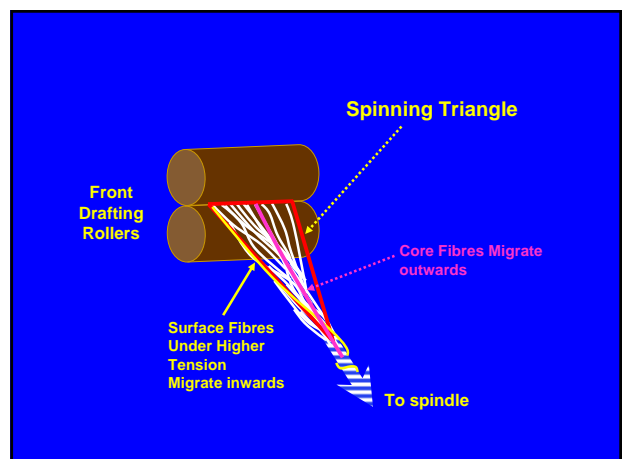
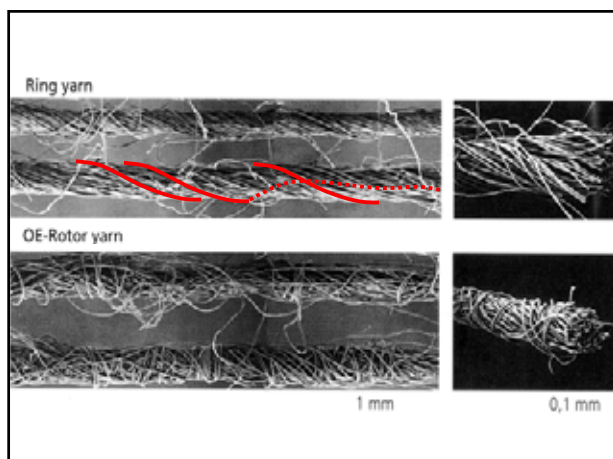
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■ Fibre migration



Ring Spinning and Rotor Spinning Comparison

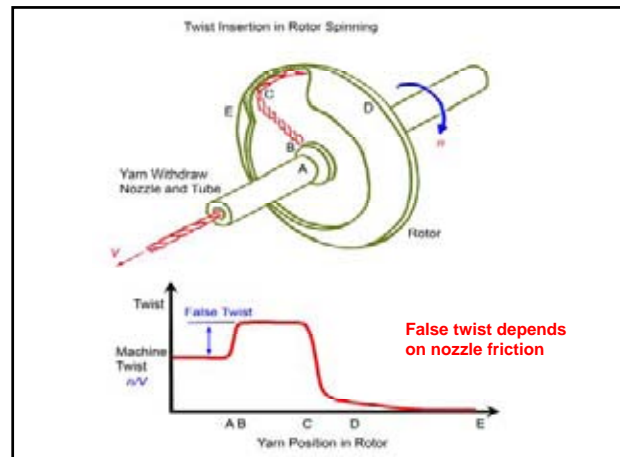
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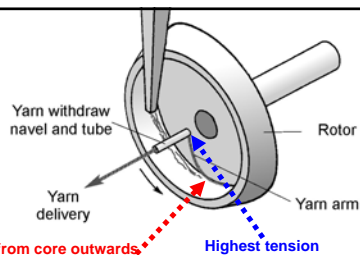
Fibre straightness/alignment
Wrapper fibres

■ Fibre migration

■ Twist structure

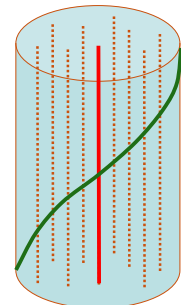


Rotor Yarn Twist



- Yarn formed gradually from core outwards
- Fibres deposited first (towards the core) has higher twist
- Fibres are twisted under low tension: low fibre straightness
- Twist differential & wrapping fibres make twisting testing difficult

Ring Yarn Twist



- All fibres twisted at same time with same t
- Fibres near core has lower twist angle & under lower tension

Ring Spinning and Rotor Spinning Comparison

Yarn Formation

■ Fibre Disposition

Fibre straightness/alignment
Wrapper fibres

■ Fibre migration

■ Twist structure

■ Yarn properties

Ring Spinning and Rotor Spinning Comparison

Yarn Properties

■ Tensile properties

■ Evenness

■ Aesthetic properties

■ Hairiness

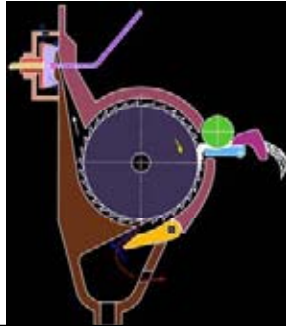
■ Abrasion resistance

■ Others

Ring Spinning and Rotor Spinning Comparison

Raw material requirements

- Fibre length
- Fibre fineness
- Fibre strength
- Effects of drawing
- Impurity content



Ring Spinning and Rotor Spinning Comparison

Techno-economics

- Investment
- Fixed costs
- Operating costs
- Raw materials/waste
- Maintenance
- Labour
- Energy
- Product value
- Application
 - Fibre type
 - Yarn type and end-use

Ring Spinning and Rotor Spinning Comparison

Ring Spinning

- Wider yarn count range
- Suitable for most fibre types
- Good yarn tensile, hand and aesthetic properties
- More preparatory processes
- Low speed
- High power requirement
- Small bobbin
- High doffing frequency (lower efficiency/higher labour cost)

Machine Example

Rieter R 40

- Material cotton, man-made fibres and blends up to 60 mm
- Feed weight 7.00 to 2.5 ktex
- Draft 40 to 400
- Yarn count 200 to 10 tex
- Twist 196 to 1500 T/m
- Package weight max. 6 kg (max. 350 mm Ø)
- Rotor Ø 28, 30, 31, 33, 36, 37, 40, 41 46, 47, 48, 56, 57 mm
- Opening rollers Ø 64 mm
- Draw-off nozzles ceramic in various designs

Rotor Spun Fancy Yarns

Limited to fibre effects (mainly slubs)

- Variable motor driven sliver feed
- Difficult to produce abrupt changes
- Minimum length πD due to back drafting



Rotor Spun Fancy Yarns

Other developments

- Special opening roller (using negative working angle for cotton so that fibres accumulate on roller and produce random bundles in yarn) (0.5-4 inch length slubs)



- Multi-twist effects (altering yarn twist randomly)
- Cover yarns

