

Continuous-Flow Industrial Fiber Processing System

Patent-Pending Automation of Flax to Linen Production

Industrial Problem

Linen production from flax involves labor-intensive manual processing steps between retting (fiber separation) and spinning (yarn production). Breaking, scutching, and hackling stages require skilled manual labor, creating throughput bottlenecks and limiting industrial scalability. Existing batch processing systems require human intervention between stages, preventing continuous flow.

Solution Architecture

A continuous-flow system that automates fiber processing from post-retting input through spinning-ready output. Eliminates batch processing and manual handoff between stages through novel mechanical mechanisms. Target throughput: 10–50 kg/hour per processing line.

Core Innovations

Roller Cascade (Breaking Stage): Progressive gap reduction across 8-12 roller pairs with tooth offset geometry creating alternating S-bends. Controlled fracture at woody nodes while preserving fiber length. Shive liberation through differential velocity between rollers.

Retractable Comb Mechanism (Stage Handoff): Cam-actuated teeth extend for grip (~300° arc) and retract for release (~60° arc). Solves the fundamental problem of continuous fiber transfer between processing stages without dropping bundles or requiring manual intervention.

Internal Press (Between Combing Stages): Transverse compression while fibers are longitudinally constrained by comb teeth. Geometric relationship (compression perpendicular to constraint) is the claimed innovation — debris displacement without fiber damage.

Spinning Pipe (Pre-Spinning Alignment): Rotating tube with helical groove texture encloses fiber bundle. Twisted by rotation, with pressurized sleeve responding to upstream moisture sensors. Produces pre-twisted bundle ready for final spinning.

Festoon Drying Tunnel: Folded path with fixed/floating rollers. Wet → mid → dry zones with controlled airflow. Roller contact pumps moisture from yarn during transit. Three-dimensional helical variant for multi-thread processing.

Technical Advantages

- Continuous flow eliminates batch accumulation and manual handoff labor
- Retractable comb mechanism enables automated stage transitions previously requiring human judgment
- Internal press innovation: perpendicular compression while longitudinally constrained — patentable geometric relationship
- Moisture-responsive spinning pipe adapts to upstream variation without manual intervention
- Modular design allows independent optimization of each processing stage

Market Application

Industrial linen production currently relies on either fully manual processes (artisanal, low throughput) or large-scale equipment designed for other fibers adapted poorly to flax. This system targets mid-scale producers seeking to automate without capital investment in gigantic industrial lines designed for cotton or synthetic fibers.

Development Status

Patent disclosure documentation complete (system description + seven technical diagrams). Conceptual architecture and reasoning chain documented for patent attorney review. No physical prototype yet — implementation would require extensive trial iteration on hardware placement, actuator topology, attachment points, and control system logic.

The architecture defines what problems must be solved (continuous fiber handoff, debris removal during constraint, moisture-adaptive pre-twist) and proposes mechanical solutions. Actual hardware implementation would validate and refine these concepts through empirical testing.

Patent Strategy

Filing provisional patent on core mechanisms (retractable comb handoff, internal press geometry, moisture-responsive spinning pipe). These represent novel solutions to fiber processing problems not addressed by existing automation systems. Full utility patent application pending attorney review and prior art search.