

Air Purifier Assembly Line

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This production line is a custom-designed double-speed chain automated final assembly pipeline tailored to the structural characteristics of air purifiers (including tower-type, vertical floor-standing and desktop models) and similar small-to-medium-sized white goods. Centered on the dual mechanisms of differential speed extension and flexible accumulation, the system adopts a physical material flow logic of fast forward, slow exit: during empty pallet return strokes or non-assembly sections, the 2.5–3× speed ratio of the double-speed chain enables rapid displacement of tooling plates to cut cycle waiting time. At key workstations for manual assembly and functional testing, however, stoppers instantly cut off power transmission to bring tooling plates from motion to a standstill, decoupling chain operation from workstation dwell time. This design not only resolves

conveying energy consumption issues under heavy loads (e.g., composite filter screens, metal cabinets) but also permits independent start-stop control for each workstation. It eliminates full-line shutdown risks triggered by faults at a single workstation on traditional synchronous belt lines, substantially boosting the Overall Equipment Effectiveness (OEE) of the entire line and fault tolerance for human-machine collaboration.

I. Working Principle of Core Technology (Differential Speed Conveyance Mechanism)

The pipeline operates based on the differential drive principle of double-speed chains:

Speed Multiplication: The drive system propels the double-speed chain to run at a constant base speed v_0 . Load-bearing rollers (diameter D) fitted on the chain support the tooling plates. Since the roller diameter exceeds that of chain rollers (d), the travelling speed v of the tooling plates reaches 2.5 or 3 times the chain speed, realizing rapid workpiece transfer between workstations.

Precision Accumulation: As tooling plates enter each assembly workstation, photoelectric sensors activate the workstation stoppers. Cylinders of the stoppers act instantaneously to gently lift the tooling plates and separate them from frictional contact with the chain, bringing the plates to a complete halt. The chain continues running uninterrupted meanwhile, delivering the flexible accumulation function (chain keeps running while workpieces stay stationary) and reserving ample time for assembly, testing and other procedures.

II. Core Structural Composition & Technical Parameters

1. Double-Speed Chain & Guide Rail System

- **Chain Specifications:** High-strength nylon or carbon steel double-speed chains are adopted, with standard pitches of 25.4 mm and 38.1 mm to accommodate varying load requirements.
- **Guide Rail Material:** 6063-T5 industrial aluminum extrusions with anodized surface treatment, featuring low friction coefficient, stable operation and controlled noise emission.

2. Tooling Plates & Load-Bearing Units

- **Custom green tooling plates** are equipped with scratch-proof positioning grooves specially contoured for air purifier housings, preventing shaking and abrasion of casings during circulation.
- **Load Capacity:** Static load per workstation ranges from 50 kg to 200 kg; uniformly distributed dynamic loads fully satisfy conventional home appliance assembly demands.

3. Drive & Positioning Control System

- **Power Unit:** Standard-equipped with SEW or equivalent geared motors paired with inverters for stepless speed regulation ranging from 0.5 m/min to 20 m/min.
- **Positioning Accuracy:** Closed-loop control via stoppers and photoelectric sensors delivers a repeat positioning accuracy of ± 0.1 mm for parked tooling plates.

III. Technical Features & Advantages of the Production Line

1. Optimized Ergonomics

- **Adjustable Line Height:** Default line height is set at 750 mm in compliance with ergonomic principles, suitable for both seated and standing operations.
- **Independent Power Supply:** Each workstation is pre-fitted with dual power sockets and quick pneumatic connectors, enabling plug-and-play use of electric screwdrivers, pneumatic hand tools and local task lighting.

2. Modular Design & Expandability

- Assembled with standard connecting fittings, the line supports layout extensions including linear runs, curved sections and double-layer

upper/lower circulation.

- It is compatible with MES system interconnection; RFID tags or barcode scanning read tooling plate data to enable real-time monitoring of production metrics.

3. Wide Process Compatibility

- Conductive wheels and conductive rails are integrated to support live-power testing and online burn-in testing, meeting the requirements for full-machine energized runtime inspection of air purifiers.